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OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE
WASHINGTON, DC

3 December 2024

Reference: ODNI Case No. DF-2022-00321

This letter provides an interim response to your Freedom of Information Act (FOIA) request to the Defense Intelligence Agency (DIA), dated 18 September 2017, requesting 18 specific theses written by students at the National Intelligence University. As previously noted by DIA, DIA transferred these cases to the Office of the Director of National Intelligence (ODNI) in 2022.

ODNI processed this request under the FOIA, 5 U.S.C. § 552, as amended and located 17 of the theses requested. Note, despite a thorough search, "Rationing the IC: The Impact of Private American Citizens on the Intelligence Community" was not located.

This interim response provides a response on ten of the theses. During the review process, we considered the foreseeable harm standard and determined that certain information must be withheld pursuant to the following FOIA exemptions:

- (b)(3), which applies to information exempt from disclosure by statute. Specifically, the National Security Act of 1947, as amended:
  - Section 102A(i)(l), 50 U.S.C. § 3024(i)(1), which protects information pertaining to intelligence sources and methods; and
  - Section 102A(m), as amended, 50 U.S.C. § 3024(m), which protects the names and identifying information of ODNI personnel.
- (b)(6), which applies to information that, if released, would constitute a clearly unwarranted invasion of personal privacy.

Be advised, we continue to process your request. If you are not satisfied with this response, a number of options are available. You may contact me, the FOIA Public Liaison, at ODNI_FOIA_Liaison@odni.gov, or the ODNI Requester Service Center, at ODNI_FOIA@odni.gov or (703)-275-1313. You may also submit an administrative appeal to the Chief FOIA Officer, c/o Chief, Information Management Office, Office of the Director of National Intelligence, Washington, DC 20511 or emailed to ODNI_FOIA@odni.gov. The appeal correspondence should be clearly marked "Freedom of Information Act Appeal of Adverse Determination" and must be postmarked or electronically transmitted within 90 days of the date of this letter.

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Sincerely,

Erin Morrison
Chief, Information Review and Release Group
Information Management Office

CLIMATE CHANGE AND UNITED STATES NATIONAL SECURITY: NORTHERN CHINA'S WATER CRISIS – A CASE STUDY

by

(b) (6)
Lieutenant, U.S. Coast Guard
NDIC Class 2009-M

Submitted to the faculty of the
National Defense Intelligence College
in partial fulfillment of the requirements for the degree of
Master of Science of Strategic Intelligence

8 July 2009

The views expressed in this paper are those of the author and
do not reflect the official policy or position of the
Department of Defense, Department of Homeland Security, or the U.S. Government

ABSTRACT

TITLE OF THESIS: Climate Change and United States National Security: Northern China's Water Crisis – A Case Study

STUDENT: (b) (6), MSSI, 2009

CLASS NUMBER: NDIC 2009-M **DATE:** July 2009

THESIS COMMITTEE CHAIR: (b) (6)

COMMITTEE MEMBER: (b) (6)

The United States considers climate change a national security issue. Based on current estimates provided by the United Nations Intergovernmental Panel on Climate Change, rising global temperatures may decrease the availability of key resources and contribute to instability in nations unprepared to adapt. Although climate change alone may not cause instability, it could exacerbate existing problems.

Stability relies on the ability of governments to provide basic resources to their populations. Water is a basic resource that is highly dependent on climate. In Northern China, Chinese leaders are struggling to provide healthy water to the region's inhabitants.

The water crisis is worsening existing problems: poor leadership, weak political institutions, public health, poverty, economic migration, social tensions, and environmental degradation. The Chinese Communist Party recognizes that the problems undermine stability and threaten the party.

The current economic crisis has caused the government to readjust priorities. Economic growth, perceived as the major source of Chinese stability, is again the nation's top priority. Leaders continue to seek ways to strengthen the party, at each level of government. However, corruption, competing priorities, and poor institutional structures prevent the party from exercising control over many environmental issues. During the crisis, Chinese officials are more likely to invest in water infrastructure projects that create jobs than to engage in regulatory activities that make Chinese businesses less competitive. In the short-term, China is unlikely to implement an environmental protection program sufficient to address the water crisis in Northern China.

Chinese leaders understand the problems brought about by climate change. They also realize they cannot address the problem alone. During the global economic crisis, the United States and China have an opportunity to collaborate on climate change initiatives that promote economic growth. By cooperating on projects like environmentally-friendly business incentives, technological research and development, and educational exchanges, the United States and China will be in a better position to strengthen their climate change partnership after the crisis ends.

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ACKNOWLEDGEMENTS

I thank the members of my thesis committee, (b) (6) and (b) (6), for their thoughtful insights and patient editing; (b) (6), for guiding me with my initial research; and (b) (6), for encouraging me to explore the relationship between climate change and U.S. national security.

INTRODUCTION

The November 2008 report, *Global Trends 2025: A Transformed World*, developed by the Office of the Director of National Intelligence, identifies climate change as one factor that may shape future events. This thesis examines one aspect of climate change, water scarcity, and how it relates to stability within the People's Republic of China, an important US trade partner and global competitor (Office of the Director of National Intelligence 2008, 51-59).

Global Trends includes an imagined diary entry from a future President of the United States, dated 11 years from now, describing the President's reaction to dam breaks in China that decimate over 100,000 people. The diary describes several of the issues examined by this thesis, which include rapid economic growth, urbanization, consumption, public health, governance, political legitimacy, and corruption.

> In China, it's the opposite—too much crony capitalism. It's not clear, for example, that China's Communist Party (CCP) will survive the scandal over burst dams and the devastation that followed. A couple of decades ago, I would have thought it possible. At that time, the public there was so grateful for the material benefits accruing from China's hell-bent efforts to modernize that the Chinese people forgave the leaders almost everything. Now it is different. The middle class wants clean air and water. They don't like the environmental devastation that was the price of rapid modernization or corruption that winks at the turning off of US provided carbon capture equipment in their coal fired electrical plants. The Party is split too. Half worry about a slowdown from more sustainable, environmentally prudent growth that could be politically devastating if jobs are not generated to the same degree. The other half understands the hardships and is more attuned to changing middle class priorities. I would not be surprised if the 100,000 who perished in the recent dam disaster turn out to be the straw that breaks the CCP's legitimacy, coming as it does on the heels of those corruption allegations against high party officials (Office of the Director of National Intelligence 2008, 59).

CHAPTER 1

China's Water Crisis and U.S. National Security

Industrialization, urbanization, and consumption have made the People's Republic of China (PRC) a global economic power and key U.S. trade partner. Between 1988 and 2007, China's average gross domestic product (GDP) grew by eight and one half percent annually (Blair and Hills 2007, 1). As industrial centers boomed, people living in the countryside, seeking job opportunities and a higher standard of living, migrated to the cities at an unprecedented scale. The World Bank estimates that by 2020, 60 percent of China's population will live in urban areas (Yusuf and Saich 2008, 1). The same forces that forged China's economic growth are producing a myriad of new challenges for the country's leaders: increased demands for public services, health concerns, income disparities, higher expectations for government accountability, endemic corruption, and environmental degradation (Blair and Hills 2007, 13).

Environmental degradation has caused a severe water scarcity problem, especially in highly industrialized and populated areas. This thesis examines how China's water scarcity problem impacts existing social problems, hampers economic development, and undermines internal stability. Ma Jun, a Chinese journalist and author of *China's Water Crisis,* describes China's water scarcity problem as a major threat to the country's social and economic development (Jun 2004, vii).

Several United States, PRC, and international governmental, business, and social reports have examined China's water scarcity problem. In addition, several notable experts on Asia have written on the subject. Elizabeth Economy, the author of *The River*

Runs Black: the Environmental Challenges in China's Future, describes China's environmental crisis as the "Great Leap Backward." She writes that China's pollution problems risk the country's economic growth, public health, and social stability (Economy 2007, 1). Director of National Intelligence Dennis Blair and Carla Hills from the Council on Foreign Relations note that China's economic growth is widening the gap between rich and poor. They explain that the gap sparks urban migration and resentment, especially in places with scarce water resources (Blair and Hills 2007, 16). PRC water scarcity influences a wide range of existing social problems. PRC water scarcity is a National Intelligence Council strategic issue.

Over 50 percent of Chinese surface water resources are seriously polluted and unfit for human consumption. Pollution also contaminates Chinese groundwater resources. As surface water supplies decrease, China extracts groundwater at alarming rates. In some areas of the country, groundwater tables decrease between 10 and 16 feet annually. In many areas of the PRC, water scarcity has led to rationing, causing some people to use polluted water for irrigation. In the countryside, millions of people consume unsafe, polluted water, causing disease. Contaminated water contributes to a myriad of health problems: cancers, hypertension, peripheral vascular diseases, skeletal deformities, Hepatitis A, dysentery, cholera, and typhoid/paratyphoid. In addition, high water pollution levels cause malnutrition, adversely impacting women, the young, elderly, people who are ill, and the poor. According to the World Bank, Chinese consume over 264 billion gallons of unsafe drinking water each year (World Bank 2007a, 6-9, 44-45).

The PRC State Council has introduced several conservation and efficiency measures, with limited success. As rates of economic development and population growth rise, Chinese water resources will continue to decrease. In response, groups within the PRC may compete for limited water resources: upstream users against upstream users, cities against each other and rural townships, rich against poor, and agriculture against industry. As competition for water resources increases, people will probably look to the central government for solutions and may hold Communist officials accountable for failures. Widespread dissatisfaction with the pace of water reform may threaten internal stability.

The water crisis is most acute in northern China, a highly populated area rich in minerals and fertile soil. Northern China contributes the strongest share of China's GDP; however, the area is poor in water resources and heavily relies on southern China for assistance. Northern provinces only have access to 7.5 percent of China's water resources. In contrast, southern China has access to over 70 percent. High production levels in the North drives its water demands for energy, industry, and agriculture. The North produces between 40 and 45 percent of GDP. In contrast, the South produces 30 percent (McAlister 2005, 4).

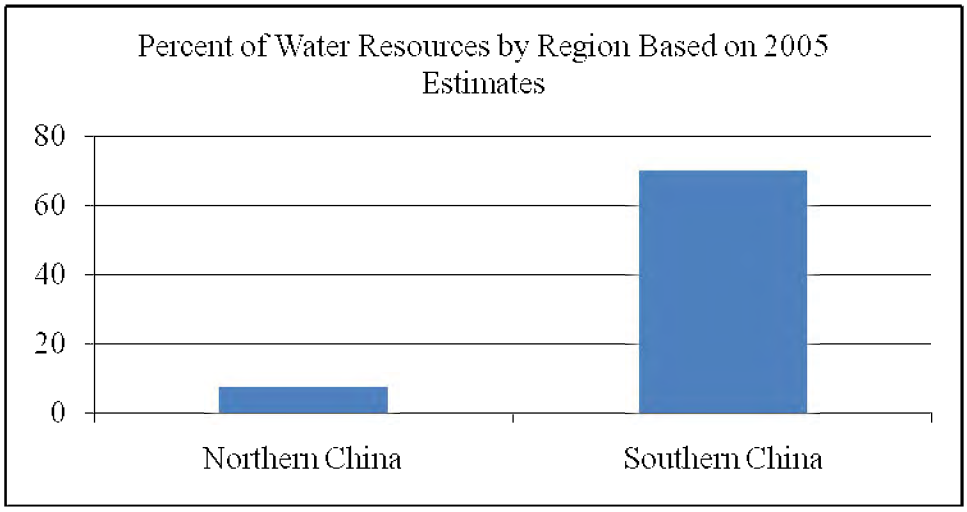

Figure 1-1: Percent of Water Resources by Region Based on 2005 Estimates (McAlister 2005, 4)

Water scarcity endangers public health in many of China's most heavily populated areas. Most people in northern China, for example, only have access to 198 thousand gallons of water per year. In the heavily industrialized Northern China Plain, the amount is only 132 thousand gallons per year. Both levels are significantly below the World Bank's estimated threshold of danger, which is 264 thousand gallons per year (McAlister 2005, 5).

The World Bank uses the threshold of danger to project the likelihood of economic or social disruption. For comparison purposes, the threshold of concern, the point at which the World Bank recommends that a government introduce water management reforms, is 462 thousand gallons per year, a difference almost three times as great as the amount available per capita in the Northern China Plain (McAlister 2005, 5). The nation's poor, young people, and the elderly living in rural areas are most affected by polluted water (World Bank 2007a, xv). Generally, China does not monitor agricultural

or small industry discharges. Industries that produce the greatest share of waste discharges include: pulp and paper, textiles, mining, and tanning (Zhong 2007).

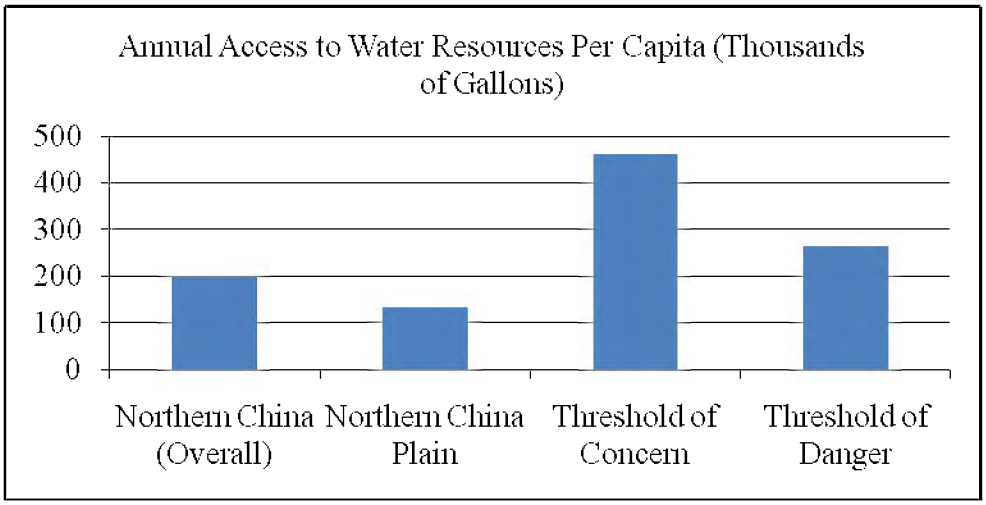

Figure 1-2: Access to Water Resources per Capita Each Year (Thousands of Gallons) (McAlister 2005, 5)

Despite increasing demand and the increasing danger to public health, China uses approximately seven to 15 times more water to produce an equivalent unit of GDP than other developed economies (McAlister 2005, 1). According to a 2004 report from the PRC's Ministry of Water Resources (MWR), Chinese industry consumed over 51,000 gallons of water to generate 10,000 yuan of GDP, eight times the rate of other advanced countries and four times the global average (Zhong 2007).

Chinese leaders recognize that feeding over 1.34 billion people is a national security issue. Thus, they seek to maintain self-sufficiency in grain production, making agriculture one of China's greatest water users. Grain production, however, consumes vast quantities of water. In the fertile Northern China Plain, an area that produces nearly half of China's grain requirements, farmers depend on deep wells to tap groundwater

sources. In their search for water, people in northern China pump groundwater for 60 percent of their water needs. In 2000, China extracted over 6.6 trillion gallons of water from non-rechargeable aquifers. Yet, ground water quality is poor. As in many other parts of China, 75 percent of its aquifers are contaminated (Yardley, Beneath Booming Cities, China's Future is Drying Up 2007). The same pollutants damaging China's water supply also contaminates its food supply. Water scarcity may cause China to rely more on other countries to feed its people.

In the Northern China Plain, surface waters have nearly dried up. Lakes, wetlands, streams, and rivers are disappearing. The most notable example is Lake Baiyangdian, known as the "Pearl of Northern China." Dangerously contaminated with industrial waste, the lake's water level is decreasing (China Radio International 2007). Overall, 75 percent of Chinese lakes show some level of eutrophication due to wastewater discharges, pesticides, or fertilizer run-offs (World Bank 2007a, 6).[1] Based on a 2004 estimate, environmental pollution costs China over $62 billion annually, approximately 3.05 percent of GDP. Water pollution's effect on crops, fisheries, public health, and pollution prevention amounted to 56% of the cost (World Bank 2007b, 2).

In May 2006, the MWR issued a five-year plan to increase efficiency and drop water consumption per unit of GDP by 30 percent by 2010 (China Daily OnLine 2006). The plan called on cities to increase water prices, increase fines, monitor discharges, enforce standards, improve treatment methods, and build desalinization plants. The

[1] The U.S. National Geological Survey defines eutrophication as a process whereby water bodies, such as lakes, estuaries, or slow-moving streams receive excess nutrients that stimulate excessive plant growth (algae, periphyton attached algae, and nuisance plants weeds). The enhanced plant growth is often called an algal bloom. The growth reduces dissolved oxygen in the water when dead plant material decomposes and can cause other organisms to die. Nutrients can come from many sources, such as fertilizers applied to agricultural fields, erosion of soil containing nutrients, and sewage treatment plant discharges (U.S. Geological Survey 2008).

Ministry also encouraged direct investment by multinational wastewater treatment companies (Yardley 2007). However, the implementation of the plan has fallen short of projected goals. In July 2007, the technical head of the project told reporters that an environmental report on the cost of economic development would be postponed indefinitely (Bristow 2007). If the government is not able to implement domestic policies to improve water management, China may have to divert waters supplying its neighbors.

The State Council may seek to divert surface waters supplying other countries in East Asia. Rivers originating in the northwestern provinces of Qinghai and Tibet provide water to India, Bangladesh, Burma, Bhutan, Nepal, Cambodia, Pakistan, Laos, Thailand, and Vietnam. These countries are experiencing water problems similar to China, but to a lesser degree. An attempt to redirect the water from these rivers could significantly jeopardize the stability of East Asia (Sud 2008).

Figure 1-3: Map of Chinese Rivers, Provinces, and Autonomous Regions (Economy 2004, i)

The PRC has attempted to address water contamination and pollution, with limited success. The areas of China with the highest levels of industrialization, urbanization, and consumption have felt the greatest impact. Poor people living in rural areas are the worst affected. In northern China, where most surface and ground water is polluted to dangerously unhealthy levels, the polluted water supply has affected agricultural output, industrial production, and public health.

The National Intelligence Assessment on Climate Change

In 2008, the National Intelligence Council (NIC) identified water scarcity as a strategic issue and published its findings in the National Intelligence Assessment on the National Security Implications of Climate Change to 2030 (NIA) (Butts 2008, 1). Members of the NIC Long Range Analysis Unit developed the NIA. They worked in cooperation with the Armed Forces Medical Intelligence Center from the Defense Intelligence Agency, the Office of Naval Intelligence, the Department of State Bureau of Intelligence and Research, the Office of Transnational Issues from the Central Intelligence Agency, the National Geospatial-Intelligence Agency, and national intelligence officers for science and technology and for economics (Fingar 2008, 4).

The assessment includes the views of experts outside the intelligence community. The NIC consulted with several US government organizations, including the US Climate Change Science Program, Department of Energy, and the National Oceanic and Atmospheric Agency. In addition, the NIC worked with experts from the Joint Global Change Research Institute, the Columbia University Center for International Earth Science Information Network, the Naval Postgraduate School, and the United Nations Intergovernmental Panel on Climate Change (IPCC) (Fingar 2008, 2).

The NIA relies on open source information, especially IPCC reports. The US government and a team of respected international scientists contributed to the reports. The assessment assumes that the global climate will change as forecast by the IPCC. In addition, the assessment relies on the findings of the IPCC Fourth Assessment Report (Fingar 2008, 3-4).

The NIA projects how climate change could impact U.S. national security by 2030. The NIC employs a broad definition of national security. First, the assessment examines how climate change could impact the homeland, economic partners, and allies. It describes the causes of climate change in China, its effects, China's capability to address the problem, and the potential for a humanitarian disaster. Second, the assessment estimates how climate change could strengthen or weaken an element of U.S. national power. Overall, the assessment finds that the United States will be capable of adapting to the effects of climate change. However, other countries, including China, will be less capable. The NIC assesses that climate change will impact the United States indirectly by weakening economic relationships, frustrating diplomatic efforts in developing countries, and destabilizing military partnerships (Fingar 2008, 4).

Notably, the NIC recognizes that climate change alone will not cause instability or state failure in developing counties. Rather, climate change could worsen existing problems like poverty, social tensions, environmental damage, economic migration, poor leadership, and weak political institutions (Fingar 2008, 5). The assessment emphasizes the relationship between stability and the ability of governments to provide for the basic needs of their populations. Identifying water as a basic need, the assessment projects how climate change could exacerbate water scarcity in different parts of the world. It

examines the effect of climate change on China's water resources. The assessment identifies water scarcity as a threat to stability and a contributing factor to intrastate conflict (Butts 2008, 1-2).

According to IPCC estimates, as global temperatures rise, water will become increasingly scarce across many parts of the world, including Asia, Africa, and the southwestern United States. IPCC data indicates that water scarcity is caused by a variety of factors, including ecological changes like decreased precipitation, increased evaporation, and reduced river flows. It is also caused by anthropological changes like urbanization, agricultural methods, and industrialization. Water scarcity debilitates people by causing food and water shortages, increasing health problems and disease, and increasing the potential for civil disorder as people compete for limited resources and others migrate from more severely impacted countries (Fingar 2008, 6-7).

The October 2006 *Stern Review on the Economics of Climate Change*, developed by the British government, estimates that world-wide, water scarcity may displace over 200 million people by 2050. The Review notes that such an increase would mark a 1000 percent increase from the number of refugees and displaced people documented today. The Review refers to the new type of displaced persons as "climate migrants" (Peters 2006, vii).

Scholarly Works

Various scholars have addressed how resource competition contributes to social conflict. Notable studies include: *Resource Wars: The New Landscape of Global Conflict* by Michael Klare; *The Political Economy of Armed Conflict: Beyond Greed and Grievance* by Karen Ballentine and Jake Sherman; and *Natural Resources and Violent*

Conflict: Options and Actions by Ian Brannon and Paul Collier. These works address several factors that influence conflict. Many of the factors raised by the authors apply to the relationship between water scarcity and instability.

In *Resource Wars: The New Landscape of Global Conflict*, Klare examines water conflict in the Nile Basin and water conflict in the Jordan, Tigres-Euphrates, and Indus River Basins. Klare explains how water scarcity contributes to instability. First, he examines multiple factors: demand overtaking supply, shared water sources, lack of cooperative agreements on distributing existing supplies, and disputes over access. Second, he examines how the danger of conflict increases where supplies are most scarce. The more one state uses a resource, the more likely conflict will occur. Third, Klare explores how urbanization and population growth increase demand and decrease supplies. According to Klare, agricultural production, industrial output, and human use, necessary for urbanization and population growth, stress existing supplies. Dishwashers, other appliances, meat consumption (which requires higher grain production), and indoor plumbing increase demand. He contends that conflict is more likely where population densities are highest (Klare 2001, 139-141).

Fourth, he demonstrates that in regions where water is scarce, governments are more likely to consider the use of force because critical resources vital to the survival of the state are at stake. Klare also provides various quotations from world leaders explaining how water is vital to national security. For example, Klare uses a quotation from Israeli Prime Minister Yitzhak Rabin: "If we solve every other problem in the Middle East but do not satisfactorily resolve the water problem, our region will explode." He also contends that the price for losing such a conflict would be severe. Fifth, Klare

examines how water is an essential resource. People rely on it for drinking, bathing, sanitation, and food production. He examines the principle sources of water, which are rivers and aquifers (Klare 2001, 142).

In *The Political Economy of Armed Conflict: Beyond Greed and Grievance*, Ballentine and Sherman examine the role of natural resources in intrastate conflict. The authors include several case studies to support their theories. Unfortunately, they do not consider water in any of their case studies. However, some of the case studies and factors could apply to water scarcity and intrastate conflict by analogy. Their work presents several unique factors affecting intrastate conflict.

Their study focuses on three resource characteristics: lootability, obstructability, and legality. First, they contend that unlootable resources are more likely to produce intrastate conflict. They argue that the more unlootable a resource is, the more likely it will lead to separatist conflict. Water is an unlootable resource. Second, they theorize that competition over natural resources contributes to the onset, duration, and intensity of conflict. They also consider whether different types of resources are more likely to generate or lengthen conflict (Ballentine and Sherman 2003, 47-48, 56). Third, they contend that conflict occurs at different rates according to people's dependence on the resource. According to Ballentine and Sherman, resource-dependent states are at higher risk of conflict. Finally, they contend that the more a resource is obstructable, the more likely the duration and intensity of conflict will increase (Ballentine and Sherman 2003, 49-62). People may obstruct water through physical means, including embankments, dams, and reservoirs. They may also obstruct water through use, including pollution, irrigation, and consumption.

International Government Organization Studies

The World Bank Analytical, Advisory, and Assistance Program provides Chinese Water Scarcity studies on pollution incidents, attempted water management reforms, and health impacts. The World Bank cooperates with the Chinese government to develop the reports. However, the PRC has demonstrated a reluctance to provide adverse information that could embarrass the government and impact internal stability.

Several World Bank reports provide information on Northern China's water crisis. First, *China Urbanizes: Consequences, Strategies, and Policies*, written by Shahid Yusuf and Tony Saich in 2008, provides useful information on how urbanization affects water use, demand, distribution, sanitation, and treatment. It also addresses PRC attempts to alleviate water scarcity. The report provides unique information. First, it includes public opinion surveys on sanitation services and water quality. Second, the report includes data on water treatment capacity. Third, it includes information on government corruption (Yusuf and Saich 2008, 171-194). Each of these topics is addressed in the NIA.

Water Pollution Emergencies in China: Prevention and Response by the World Bank provides information on recent water pollution emergencies in the PRC. It also provides information on the numbers of people affected and the amount of time the government took to address the situation (World Bank 2007b). Finally, *Cost of Pollution in China* by the World Bank explores the health impacts of water pollution in the PRC. It identifies the most toxic agents and the correlating health costs. It also identifies areas most heavily impacted (World Bank 2007a).

Think Tank Studies and Academic Journal Articles

Global Water Futures developed by the Center for Strategic and International Studies examines the impact of water scarcity in many regions around the world, including Asia. First, the analysis addresses several drivers affecting water supply, including food, industrial, and energy demands. Second, *Global Water Futures* addresses the relationship between economic growth and water supplies. Third, the analysis examines the effect of poor governance. Fourth, it examines how water affects domestic unrest and stability. Fifth, it addresses water as a US strategic interest (Center for Strategic and International Studies 2005).

The Woodrow Wilson International Center for Scholars, the Brookings Institute, the RAND Corporation, and the Council on Foreign Relations provide numerous scholarly articles on Northern China's water crisis (Woodrow Wilson International Center for Scholars 2005). *Foreign Affairs*, *Foreign Policy, Chinese Journal of International Law,* and the *China Journal* include several articles on Chinese governance and corruption. The articles provide useful background information.

Methodology

This thesis employs the analytical framework and methodology set out by the NIA, IPCC, and several scholarly works on resource competition. Using a combination of unclassified sources, it examines the relationship between water scarcity and instability within the PRC. First, it examines existing water resources in the PRC, the roles of political institutions governing water use, the role of the Chinese Communist Party (CCP), competing policies, and the impact of political corruption. Second, the thesis explores anthropological threats to China's water supply caused by urbanization,

agriculture, and industrialization. Third, this thesis considers how water scarcity influences economic growth and public health. Fourth, it examines how water scarcity could worsen existing social problems including competition among provinces, between urban and rural areas, between industrial and agricultural sectors, and between wealthy and poor. It also presents the potential impact of economic migration caused by water scarcity in other parts of Asia. In conclusion, this thesis describes how the CCP has responded to water scarcity in China and its capacity to adapt to future water problems brought about by climate change.

Value to the Intelligence Community

This thesis seeks to add value to the intelligence community's effort to evaluate stability in the PRC and how water scarcity influences Chinese social, political, military, and economic activities. The study takes place within the analytical framework provided by the *National Intelligence Assessment on the National Security Implication of Climate Change to 2030*. It examines one aspect of climate change and assesses how it may impact existing problems within the PRC. Kent Butts of the Strategic Studies Institute of the U.S. Army War College describes climate change as "a worthy topic for intelligence community research, military planning, and interagency cooperation" (Butts 2008, 1).

When evaluating threats against the United States, analysts often consider state stability. Water scarcity is related to many factors that analysts consider, including economic development, agricultural output, public health, energy, immigration, and social unrest. Water scarcity in different parts of the world, especially in China, will influence U.S. instruments of national power, including its economy, diplomatic relationships, and military partnerships.

The NIA calls on the intelligence community to improve how it collects information on physical, agricultural, social, and political impacts from climate change. It recognizes that much of the information on climate change exists outside the intelligence community, especially from international institutions like the World Bank, United Nations, non-governmental organizations, universities, and scientific communities (Butts 2008, 3). Unlike most studies on water scarcity, which focus on how existing management and distribution inefficiencies, pollution levels, and future climate change could influence regional populations, this thesis addresses how water scarcity could worsen existing social conditions and lead to instability and intrastate conflict.

During his June 2008 testimony before the House Permanent Select Committee on Intelligence, Thomas Fingar, Chairman of NIC, recognized a need to "explore in depth the potential effects of climate change on a set of countries and regions of the world and the resulting impact to U.S. security interests" (Fingar 2008, 20). This thesis seeks to respond to that need by examining how one effect of climate change, water scarcity, could impact a major U.S. economic partner, the PRC.

U.S. National Interest

President Obama considers climate change a critical American interest. The 2009 national security strategy will probably identify it as a key driver in United States international relations. Obama seeks to "build a common security for a common humanity" (Obama and Biden 2008a, 1). Many of the advisors President Obama will rely on to build a common security have worked at the Center for American Progress.

In the Center for American Progress monograph *In Search of Sustainable Security: Linking National Security, Human Security, and Collective Security to Protect*

America and Our World, Gayle Smith, explains that the United States can achieve "sustainable security" by striving toward three goals. First, prevent and defend against real-time threats to America. Second, reduce human insecurity around the world. Third, manage long-term threats to global security (Smith 2008, 2). Climate change influences each goal.

The February 2009 *Annual Threat Assessment of the Intelligence Community for the Senate Select Committee on Intelligence*, developed under Director of National Intelligence Dennis Blair, describes how climate change impacts national security. The report emphasizes the results of the NIA and estimates how climate change may contribute to instability. It identifies water scarcity as a threat to domestic stability. (Blair 2009, 42).

In his 2007 *Foreign Affairs* article, "Renewing American Leadership," President Obama states that the mission of the United States is to provide global leadership to combat common global threats (Obama 2007a). In his *Blueprint for Change*, the President identifies the common global threats as: 1) nuclear weapons and terrorism, 2) climate change and poverty, and 3) genocide and disease. (Obama and Biden 2008c, 6). Water scarcity is related to many global threats including climate change, poverty, and disease.

Some observers at the Woodrow Wilson International Center for Scholars contend that international cooperation can address many of these threats, including water scarcity. They emphasize that international water management efforts could build international trust, dialogue, and cooperation (Butts, Dabelko, et al. 2008). The new administration will probably consider international cooperation on environmental security issues an

effective way to encourage regional stability. In his *Blueprint for Change*, the President explains that he intends to build environmental security by using trade agreements to enforce environmental standards (Obama and Biden 2008c, 14).

U.N. Secretary General Ban Ki-moon has called on world leaders to transform and reinvigorate the global economy by investing in environmentally friendly technologies. He envisions a world-wide Green Revolution to fire economic growth (Ki-moon, A New Green Economics 2007). Similarly, President Obama and European leaders, including Prime Minster Gordon Brown and French President Nicolas Sarkozy, speak about a global New Deal that would refocus the financial system toward green technologies to reinvigorate the world economy (Whitlock 2009). In a March 2009 column in *The Sunday Times*, Prime Minster Brown describes how the financial system could encourage investments in green technology. He writes: "I believe that central to this new investment is that every country backs a green recovery for the future, that every country that wishes to participate in the international financial system agrees common principles for financial regulation, coordinated internationally, and changes to their own banking system that will bring us shared prosperity once again" (Brown 2009).

CHAPTER 2

The Chinese Communist Party and Governmental Reform

The CCP is the largest ruling political party in the world, with over 73.4 million members (Shambaugh and Li 2008, 10). It controls the Chinese government and suppresses all real or perceived challenges to its authority. President Hu Jintao is General Secretary of the CCP, President of the PRC, and chairman of the Central Military Commission (The Economist 2009). The primary decision-making body in the CCP is the Politburo Standing Committee. The CCP Central Committee appoints members to the Politburo. China's legislature, the National People's Congress (NPC), regularly accedes to Central Committee decisions and is popularly viewed as a rubber stamp (Bergsten, et al. 2006, 45).

President Hu Jintao and other party leaders seek to neutralize sources of instability because they threaten the party. In 2004, during the Fourth Plenum of the Sixteenth Party Congress, party leaders decided to strengthen Chinese society and rebuild the CCP (Shambaugh and Li 2008, 11). Party leaders realized that as China introduced economic reforms during the early 1990s, economic growth soared. However, growth also unleashed new forces, worsened problems that jeopardized stability, and presented new threats to the party. The party leadership recognized that it had gradually lost some control over the country's intellectual, social, economic, and political life (Shambaugh and Li 2008, 17).

Increasingly concerned over the new forces threatening stability, the Central Committee met in October 2006. Party leaders adopted new policy priorities advocated

by President Hu Jintao. Rather than focusing all national efforts on rapid economic development, the Central Committee decided to introduce a series of reforms to address existing social and environmental problems. The 2006 session of the Central Committee was the first in 25 years to focus on health, social, and environmental reforms rather than economic development (Fan 2006).

Building a Harmonious Society

Hu referred to the social reforms as the "Harmonious Society" program (The Economist 2009). Following the meeting, the Central Committee issued a press release, recognizing the rising threat of social conflict: "China is a harmonious society in general, but there are many conflicts and problems affecting social harmony. We must always remain clear-headed and be vigilant even in tranquil times." Through the Harmonious Society program, the Central Committee and President Hu Jintao intended to address problems fostered by rapid economic growth: competition between rural and urban populations, the disparity of wealth between rich and poor, and public health. The Committee recognized that environmental degradation and political corruption exacerbated the problems and contributed to social unrest (Fan 2006).

President Hu Jintao sought to transform the Chinese economy from a model dependent on environmentally harmful manufacturing industries like paper, chemicals, and textiles to a model grounded in computers and biotech, enterprises that are less harmful to the environment (Eunjung Cha 2008). During the same year, the State Environmental Protection Administration (SEPA), the equivalent of the U.S. Environmental Protection Agency, received 161 reports of environmental emergencies; 95 of the reports described water incidents. The number of incidents had more than

doubled from 2005. On average, China faced an environmental emergency every other day (Qiu and Li 2009, 10154).

Improving Government Efficiency

By November 2006, the Task Force on Environmental Governance issued a report recognizing the threats posed by environmental degradation. The task force included policy experts, scholars, and attorneys from China, Germany, the Netherlands, Japan and the United States. They examined China's identified systemic weaknesses and called on the government, business sector, and public groups to transform how China managed its environmental resources:

> As development proceeds and more citizens are lifted from poverty, their attention naturally focuses on enjoying their new lives, enjoyment that requires a healthy environment. The government has set a goal of achieving the [Harmonious] Society by the year 2020. The common representation of this goal is primarily in terms of material wealth. However, material wealth without the good health to enjoy it is an unsatisfying outcome. Therefore, the Task Force recommends that a set of measures and institutional innovations be adopted similar in scope to those for the economic reform which will insure that the environmental and natural resource wealth of the nation will be preserved and enhanced to support the welfare of the people (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 4-5).

The task force recommended four ways to improve environmental governance. First, refocus priorities across the legislative, executive, and judicial branches of government. Second, allow market incentives to encourage private business to adopt more environmentally friendly practices. Third, promote public participation, especially through NGOs. Fourth, encourage international cooperation and promote regional environmental agreements.

Refocus Priorities

The task force recommended that the CCP refocus legislative, executive, and judicial priorities. For the legislative branch, the task force recommended that the NPC strengthen environmental laws and hire a professional environmental staff. For the executive branch, the task force called for government officials to enact more effective environmental regulations and to improve enforcement capabilities. The task force noted several problems obstructing enforcement. SEPA was too weak to implement national policies or plans. As a sub-cabinet ministry, it was incapable of coordinating with other powerful agencies. SEPA was more of a reactive agency, incapable of interagency coordination or planning. It often reacted to pollution emergencies as they occurred rather than trying to prevent them. The task force recommended that the government strengthen SEPA by making it a cabinet ministry (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 5-7). For the judiciary branch, the task force recommended that judges learn more about complex environmental liability and compensation cases. It also called on the judiciary to develop more innovative remedies. (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 5-7).

Economic Incentives

The task force recommended that China engage with the business sector to promote best practices, provide incentives to protect the environment, and penalize polluters. The task force advised government leaders to harness the "immense power of the market" to "harmonize economic and environmental goals." The task force called for

the provision of economic incentives rather than overly restrictive governmental regulations, the task force explained. It also called on SEPA and local environmental agencies to establish clear standards, reporting requirements, and methods for calculating environmental damages. Additionally, the task force called for the creation and enforcement of penalties to discourage businesses from breaking the law. Specific suggestions of the task force included: 1) making penalties high enough to prevent environmentally harmful business activities from generating a profit, 2) requiring businesses to create emergency response plans, and 3) creating a Hazardous Substances Response Fund to enable government agencies to respond to an emergency and recover the costs from liable businesses (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 6). Many of the task force's recommendations are based on U.S. best practices.

Public Participation

The task force advised policy-makers to provide the public with greater access to government decision-making and reports describing environmental conditions. The members recognized that environmental problems had overwhelmed China and that the government required the assistance of NGOs. The task force recommended that the government remove obstacles impeding NGOs from fully participating in policy development and enforcement. It also encouraged the leadership to provide NGOs with legal standing to represent injured parties in court. The members recommended cooperation with NGOs and the general public, what Chinese officials describe as greater "civil society participation" (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 7-8).

International Cooperation

The task force called on leaders to establish a comprehensive plan for international cooperation. The panel recognized that China was incapable of addressing its environmental problems alone. The members recommended that China use free trade agreements to promote regional environmental protection. They also called on the government to cooperate with international efforts to develop multi-lateral environmental agreements and conventions, especially on issues like pollutants, water, and climate change, among others. (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 7-8).

Government Planning and Reorganization

In May 2006, the government issued a five-year plan to increase efficiency and drop water consumption per unit of GDP by 30 percent by 2010 (China Daily 2006). The plan called on cities to increase water prices, increase fines, monitor discharges, enforce standards, improve treatment methods, and build desalinization plants. SEPA also encouraged direct investment by multinational waste treatment companies (Yardley 2007). However, the implementation of the plan fell short of projected goals. By July 2007, the technical head of the project told reporters that an environmental report on the cost of economic development, called green GDP, would be postponed indefinitely (Bristow 2007).

In March 2008, the NPC created five super ministries to improve governmental coordination and to reduce duplication of effort. As part of the initiative, the NPC

elevated SEPA to the Ministry of Environmental Protection (MEP), a cabinet-level position.[2] Under the reform, the MEP was the only agency to preserve its organizational structure and responsibilities. In contrast, many other agencies merged or reorganized. According to some observers, the move demonstrated President Hu Jintao's commitment to environmental reform. The initiative strengthened the environmental protection agency's ability to administer laws and regulations, increase funding, coordinate with other agencies, and attract national visibility (Qiu and Li 2009, 10152).

Impact of the Global Economic Crisis

At first, most businesses and local governments welcomed the reforms. Even Guangdong province, the center of China's export manufacturing sector, enthusiastically supported the new measures. However, the transformation caused many factories that were not equipped to meet pollution standards to close, increasing unemployment. For example, a multi-million dollar textile factory in the city of Fuan in Guangdong province, which employed over 4,000 people, had to close after dyes used to make T-shirts turned the Maozhou River red in February 2008 (Eunjung Cha 2008).

The Maozhou River incident demonstrates the conflict between national environmental protection policies and local government policies promoting economic growth. As the Chinese economy grew, production demands increased, yet pollution controls remained unchanged. As the Fuan textile factory produced more T-shirts, it also generated more waste. By 2008, the factory produced 47,000 tons of waste each day;

[2] The MEP is also referred to as the environmental Super Ministry Reform (Qiu and Li 2009, 10152).

However, it only had the capacity to process 20,000 tons. The factory dumped the remaining 27,000 tons into the river (Eunjung Cha 2008).

As Chinese environmental reforms began to transform industry and take hold, the global economy began to lose momentum. In late 2008, government budget and enforcement priorities changed. Environmental initiatives to build wastewater treatment plants and upgrade factories fell off the public agenda. Today, the Fuan textile factory is operational again. Its waste treatment capacity remains unchanged (Eunjung Cha 2008).

The global economic crisis is causing Chinese officials to reevaluate Harmonious Society environmental policies. Amid the crisis, the most critical priority for the Chinese leadership is to promote economic growth. Growth creates jobs and meets popular expectations to improve the standard of living. Growth also promotes social stability. All other initiatives and policy goals complement this critical priority.

Between 2003 and 2007, the PRC experienced an average real GDP growth rate of 11 percent (The Economist 2009). At a minimum, party leaders estimate that China needs to achieve eight percent real GDP growth annually to maintain stability (Lieberthal and Sandalow 2009, 30-31). However, the World Bank estimates that the global economic crisis will limit Chinese GDP growth in the near term (World Bank 2009). Years of rapid growth will decrease to six and one half percent in 2009 (J. Wu 2009). As of March 2009, *The Economist* forecasts gradual increases to seven percent in 2010, and eight and one half percent in 2011 (The Economist 2009). On the other hand, some economists project a gradual transition period leading to a long term economic slowdown (Bergsten, et al. 2006, 7).

The challenging economic environment will hinder government efforts to protect the environment. Since the global economic crisis began, numerous Chinese enterprises have laid off workers, decreased workers' pay, or gone out of business (The Economist 2009). Many observers anticipate that Chinese businesses and party officials will disregard environmental standards to promote economic growth. During an interview with an American newspaper reporter, Peng Peng, a research director at the Guangzhou Academy of Social Sciences said: "With the poor economic situation, officials are thinking twice about whether to close polluting factories, whether the benefits to the environment really outweigh the dangers to social stability" (Eunjung Cha 2008). The reporter also interviewed Zhou Xiaorong, an engineer at a Guangdong province waste water facility. He said: "I am worried the economic situation is having a negative impact. Meanwhile, the city's ability to monitor the environment is not at full capacity" (Eunjung Cha 2008). Although some local officials may disregard environmental standards, many encourage investors to build water treatment facilities. Water infrastructure projects like treatment plants promote employment and offset the damage caused by pollution discharges.

Party Strengths and Weaknesses

In 2006, as Chinese leaders began to implement the Harmonious Society program, they also set out to reinvigorate the party. In *China's Communist Party: Atrophy and Adaptation*, David Shambaugh describes how the CCP studied the collapse of the Soviet Union and the color revolutions of central Asia. The Central Committee examined other government models, striving to develop ways to improve efficiency and strengthen party control. They studied authoritarian states in the Middle East, corporate states in Latin

America, and social democratic states in Europe and North America. The studies identified several tasks. The party had to rebuild the local party organization, diversify its membership to include businesspeople, and build stronger relationships with groups outside the party. Shambaugh refers to the new approach as the "strategy of cooptation" (Shambaugh and Li 2008, 12-18).

Chinese leaders recognized that the PRC had achieved economic growth at a high cost, damaging the environment and social welfare. Economic growth policies competed with environmental protection and social welfare policies introduced by the Harmonious Society program. Seeking to reconcile economic, environmental, and social welfare initiatives, they adopted an approach taken by Eastern European governments during the 1990s. After the disintegration of the Soviet Union and Warsaw Pact, Eastern European countries enacted environmental protection laws, developed environmental agencies, encouraged public participation, and promoted nongovernmental environmentalist groups (Economy 2004, 129).

In 1994, the government recognized China's first environmental NGO, The Friends of Nature (The Friends of Nature 2003). Today, over 2,000 registered environmental groups operate within China (Blair and Hills 2007, 17).[3] Simultaneously, the government encourages media investigations of pollution incidents and allows for public participation in environmental planning efforts (Economy 2004, 129). Wary of any threat to party control, however, the government seeks to prevent NGOs from developing expansive networks. For example, the government discourages Chinese

[3] According to a 2007 Council on Foreign Relations independent task force report, U.S. – China Relations: An Affirmative Agenda, A Responsible Course, there are over 285,000 registered NGOs in the PRC (Blair and Hills 2007).

environmental groups from collaborating with foreign groups and groups from other provinces.

Chinese officials realize that government agencies are not capable of protecting the environment on their own and that NGOs have a critical role in the CCP's vision of a "civil society." Through a series of rules called the "Regulations on the Registration and Management of Social Organizations," the Ministry of Civil Affairs attempts to exercise control over NGOs. The regulations favor groups with governmental or party ties. The party also exercises control over NGOs by establishing cells in groups with three or more members[4] or by outlawing a group. The Friends of Nature provides a case study on how environmental NGOs operate within China. First, each group must obtain a sponsor. The government identifies a sponsor for each field of work; each sponsor is affiliated with the CCP. The sponsor's role is to ensure that the NGO complies with the law. Sponsors are held responsible for NGO violations (Saich 1999, 7-12). The Academy for Chinese Culture, part to the Ministry of Civil Affairs, sponsors Friends of Nature (The Friends of Nature 2003).

Second, each group must register with the government. The Friends of Nature is registered as a social organization (Urban Studies and Planning - Civil Society and the Environment 2008). The PRC allows two types of NGOs: social organizations, like the Friends of Nature, and private non-enterprise units. Both types of organizations are non-profit. Social organizations may recruit members, private non-enterprise units may not. Chinese observers divide Chinese NGOs into two categories: popular NGOs and

[4] Article 29 of the CCP Constitution requires members to form cells in all organization with three or more members (Saich 1999, 12).

officially organized NGOs.[5] Popular NGOs are organized by individual citizens and are not subsidized. Officially organized NGOs, on the other hand, are led and funded by government officials. They help implement government policies (Lu 2005, 2-4). The MEP, for example, sponsors three officially organized NGOs: The China Environment Science Association, the China Environment Protection Association, and the China Environment Fund (Economy 2004, 134). The government uses officially organized NGOs to build relationships with foreign counterparts, the general population, and popular NGOs (Economy 2004, 135). The Friends of Nature is a popular NGO, with 14 fulltime staff. The group relies on membership fees, self-generated income, and donations from international foundations. Between 2004 and 2005, The Friends of Nature received 178,500 yuan in membership fees, 1,046,000 yuan in self-generated profit from book sales, and 1,581,800 yuan in funds provided by international organizations (The Friends of Nature 2003).

Third, NGOs may not establish branch offices. Under the regulations, an NGO may not have a branch in Beijing, a provincial capitol, or a county seat at the same time (Lu 2005, 2). The Friends of Nature, for example, has one office, which is located in Beijing (The Friends of Nature 2003).

Fourth, a person may not represent more than one NGO at the same time (Lu 2005, 2). A successful leader in one NGO is unable to create a new NGO unless he resigns his leadership position in the first. Despite these regulations, environmental groups have successfully built an informal network across China. As The Friends of Nature's website explains, "Friends of Nature has … helped establish numerous other

[5] Officially organized NGOs are also known as government-organized nongovernmental organizations (GONGOs) (Economy 2004, 134).

grassroots environmental NGOs and university student groups around the country" (The Friends of Nature 2003). The Friends of Nature recruits new members during seminars, workshops, lectures, exhibitions, and through the internet (The Friends of Nature 2003).

Some members join the small staff at The Friends of Nature office in Beijing and learn how to operate an NGO (The Friends of Nature 2003). After a brief stay in Beijing, many staff members travel to other provinces and set up separate NGOs, remaining in contact with The Friends of Nature and the informal Beijing environmental network. They also collaborate with other non-environmental NGOs (The Friends of Nature 2003). The group's website explains:

> These grassroots NGOs have often emerged when concerned citizens and students, having participated in FON workshops or seminars, realize that it is every individual's and organization's responsibility to promote an environmentally sustainable society. Another pattern has been for individuals to work at FON for a few years in order to gain skills and knowledge before leaving to start their own NGO. Rather than seeing this as a loss, however, we see this as FON spreading the seeds of environmental consciousness. Over the last decade, these seeds have taken root in every province of China, as environmental NGOs and other civil society groups work towards the creation of an environmentally Harmonious Society (The Friends of Nature 2003).

Fifth, a new NGO may not form in the same administrative level where another NGO engaged in the same work already operates. The government contends that the measure promotes efficiency by avoiding duplicative efforts (Lu 2005, 3). However, the measure also enables the government to co-opt troublesome popular NGOs by establishing an officially organized NGO, requiring the popular NGO to disband or relocate. When Liang Congjie, the founder of The Friends of Nature, applied to register his group in 1993, the National Environmental Protection Agency (NEPA) advised him that his group could only register if it represented the interests of all the people with

environmental concerns. Congjie declined and registered with the Academy of Chinese Culture, where he was a professor and vice-president (Saich 1999, 10).

Despite the central government's efforts to control NGO activities, many local agencies do not enforce the regulations. People circumvent them by forming informal associations and clubs. NGO sponsors, as well as provincial, county, and local governments often lack the resources to implement the regulations (Saich 1999, 13-15). For example, the MEP operates with approximately 300 full-time employees. In contrast, over 9,000 employees work at the EPA in Washington, D.C. alone (Economy 2007, 6). Similarly, the Ministry of Civil Affairs employs 25 people at the Popular Organizational Management Bureau, which monitors NGO activities, develops NGO-related policies, and registers international NGOs that operate in China. The small staff is incapable of overseeing thousands of NGOs. Instead, it focuses on politically troublesome NGOs that publicly challenge state policies (Lu 2005, 3-4). Most environmental NGOs seek to cooperate with government leaders rather than challenge them.

A 1997 Public Security Bureau circular advised government leaders on how to confront problematic NGOs (Economy 2004, 134). First, pressure the NGO sponsor to end its support. Second, charge the NGO with financial irregularities. Third, if the first two options fail, transfer the NGO leaders to more arduous jobs, requiring them to work more hours and decreasing their ability to participate in NGO activities (Economy 2004, 134).

Corruption is a major problem. According to a Chatham House report, *The Growth of Civil Society in China: Key Challenges for NGOs*, some government officials extort money from NGOs. When multiple NGOs with similar work seek to organize in

the same area, local officials often look the other way, allowing the groups to form, sometimes accepting kick-backs (Saich 1999, 13). With increasing NGO overhead costs, corruption enables NGOs to avoid the regulatory constraints envisioned by the central government. The report explains: "…Many government units simply use the cover of NGOs to create agency slush funds and to make money through charging illegal fees or extorting donations from enterprises. Apparently, these agencies have every incentive to circumvent central government policies in order to protect their NGOs" (Lu 2005, 3).

Either through corruption or through lobbying, some environmental NGO leaders are skilled at influencing public policy, especially when they have political connections. For example, Congjie is a member of the Chinese People's Political Consultative Conference (CPPCC) and a leading lobbyist for environmental reform. The Friends of Nature website includes a document called *Participating in Policy-making.* It boldly describes his membership in the Conference and his group's effectiveness at influencing policy-making at all levels of government (The Friends of Nature 2007):

> We are happy to report that the CPPCC is listening to [The Friends of Nature] and others concerned about the environmental costs of rapid industrialization and urbanization. The concept of sustainable development is now well-known among all government officials, with the Central Government experimenting with different formulations of a "Green GDP" in order to correctly estimate the environmental costs of economic development. We hope and foresee increasing levels of participation in the policy-making process at the national, provincial, and local levels (The Friends of Nature 2007).

The Friends of Nature's effort to influence the Yuanmingyuan project demonstrates the roles of the media, the environmental NGO network, and government environmental protection agencies. In 2005, media outlets reported that the government intended to line the lakebed with a plastic membrane to prevent pollutants from

contaminating the surrounding area. The Friends of Nature worked with scholars, scientists, reporters, other environmental NGOs, and members of the community to further publicize the project and to engender public opposition. The environmental NGOs lobbied SEPA to hold public hearings on the project. SEPA agreed and invited the NGOs to participate. The Yuanmingyuan project involved water contamination. During the project, China held its first national public hearing on an environmental problem (The Friends of Nature 2007).

In *Cooptation and Corporatism in China: the Logic of Party Adaptation*, Bruce Dickson examines whether the CCP can successfully adapt to the rapidly changing economic and social environment created by the party's economic reforms. Dickson notes four obstacles limiting the party's ability to implement the strategy of cooptation. First, various sectors of the Chinese economy are expanding at such a rapid rate that many business activities do not have party organizations within them. Second, many of the new businesspeople are not responding to party recruitment initiatives. Third, party members at the local level are pursuing business opportunities at the expense of their party responsibilities. Fourth, in rural areas, party organizations are stagnant and face competition from tribal groups. Dickson concludes that the obstacles are warning signs of party disintegration. The party is unable to lead its members, address the needs of new businesses, or control society (Dickson 2000-2001, 517).

According to Kenneth Lieberthal and David Sandalow, fellows at the Brookings Institution, the CCP is incapable of implementing a national water conservation policy. For a national policy to succeed, top party leaders have to agree that the policy issue is important enough to address, identify it as a high priority, and strive to oversee its

implementation. This seldom happens. Although the government has promoted the MEP to a cabinet ministry position, the global economic crisis will limit its ability to promote environmental protection. Party leaders have demoted the environment to a non-critical issue. On most non-critical issues, the party reveals itself as a decentralized and poorly disciplined institution (Lieberthal and Sandalow 2009, 33).

National initiatives to address water pollution have been obstructed by conflicting interests among local party members and businesspeople. The CCP interacts with the Chinese economy at each of the five levels of government: national, provincial, municipal, county, and township. The party enables officials at each level to act independently. Independently governed localities often compete against each other for investment and resources. When officials successfully promote GDP growth, the party rewards them (Lieberthal and Sandalow 2009, 33-34).

The Chinese system of government provides flexibility, competition, and rewards. It promotes dynamism and entrepreneurism, which are essential for economic growth. However, these qualities also inhibit environmental stewardship. Although national party leaders have attempted to create incentives for local officials to protect the environment, GDP growth remains their overriding concern (Lieberthal and Sandalow 2009, 33-34).

The global economic crisis has derailed many of the initiatives President Hu Jintao introduced during the Fourth Plenum of the Sixteenth Party Congress in 2004: building a harmonious society, building a more efficient government, and strengthening the party. The government has readjusted priorities. Economic growth, perceived as the major source of Chinese stability, is again the nation's top priority. Efforts to transform

China into a Harmonious Society are on hold. Leaders continue to seek ways to strengthen the party at each level of government. However, corruption, competing priorities, and poor institutional structures prevent the party from exercising control over many environmental issues, especially in the area of NGO governance.

The party recognizes the critical role NGOs have in promoting a civil society and protecting China's environment. Party leaders seek to control the NGOs, although their efforts are ineffective. Economic growth proceeds at a slower rate. Unregulated business activities continue to degrade China's environment, worsening existing social problems.

CHAPTER 3

Climate, Environmental Degradation, and Urbanization

China has one of the world's most abundant sources of fresh water, ranking sixth after Brazil, Russia, Canada, Indonesia, and the United States (Xie, et al. 2009, 9). However, due to its high population, China provides its people with one of the lowest levels of fresh water, less than one-third of the world average. The Food and Agriculture Organization of the United Nations estimates that China provides each of its 1.34 billion citizens with less than 558,460 gallons of water each year. The global average is 1.79 million gallons (World Bank 2008, 2). In comparison, India supplies each of its 1.17 billion citizens with 303,797 gallons and the United States supplies each of its 307 million citizens with 2.5 million gallons (Food and Agricultural Organization of the United Nations 2009).

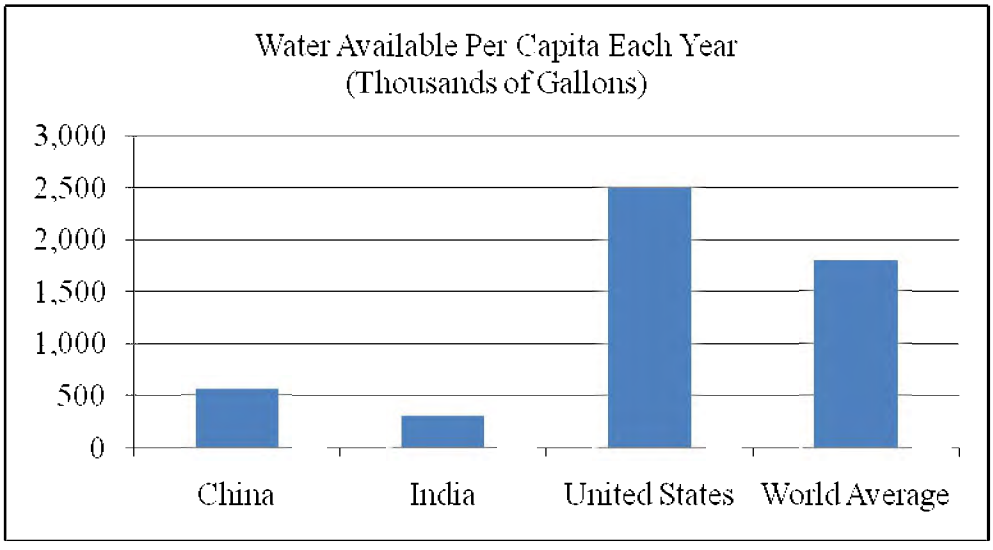

Figure 3-1: Water Available Per Capita Each Year (Thousands of Gallons)

According to the Central Intelligence Agency, China's population grows .655 percent annually. As China's population grows, its per capita water supply decreases

(Central Intelligence Agency 2009). Between 1980 and 2005, as China's population increased from 1 billion to 1.19 billion, the country's per capita water supply decreased 183 thousand gallons (Yusuf and Saich 2008, 158).

Comparing China's water supplies with the world average and with two other developed nations, India and the United States, sets China's situation in a global context. In Northern China, 680 million people survive on approximately 107 trillion gallons of water.[6] At 157.5 thousand gallons per person, the northern supply is one-tenth of the world average (Browder, et al. 2007, 32). Northern China provides one half of what India supplies and a fraction of what the United States supplies. In Southern China, meanwhile, 650 million people live on 636 trillion gallons (Yusuf and Saich 2008, 157-159). At 977.8 thousand gallons per person, the southern supply is approximately one half the world average, three times India's per capita average, and four tenths of the United States per capita average.

Methods of Measuring Water Shortages

International observers use two methods to measure water shortages. The World Bank, the World Resources Institute, and the U.N. Environmental and Development Programs measure water stress and water scarcity on a per capita basis (Shalizi 2006, 5). Under the per capita approach, water stress occurs when a person's annual water availability is less than 528 thousand gallons. Water scarcity occurs when annual water availability is less than 264 thousand gallons (Yusuf and Saich 2008, 158). With a per

[6] The World Bank defines Northern China as: Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Jiangsu, Anhui, Shandong, Henan, Shaanxi, Gansu, Qinghai, Ningxia, Liaoning, Jilin, and Heilongjiang provinces. Northern China includes more people than Europe and South America combined. (Yusuf and Saich 2008, 159).

capita supply of 157.4 thousand gallons, people living in Northern China live under water-stressed conditions.

The International Water Management Institute, on the other hand, measures water availability and access, using four categories: low exploitation (under 20 percent use); comfortable exploitation (20-59 percent use); overexploited (60-100 percent use); and mining (greater than 100 percent use) (International Water Management Institute 2009). The Institute determines use based on a ratio with the average amount of water used for human activities and ecosystem needs in the numerator and available water flows in the denominator. The Institute's calculation excludes water reserves held by dams, aquifers, and surface lakes. When water use requires the exploitation of water reserves, the ratio may exceed 100 percent. Under this approach, China uses 44 percent of its water resources and falls within the comfortable exploitation zone (Shalizi 2006, 5). In the north, however, some areas fall within the overexploited and mining categories.

Regional Disparities

In *China Urbanizes: Consequences, Strategies, and Policies*, Shahid Yusuf and Tony Saich demonstrate a significant disparity between northern and southern water resources. Based on studies developed by the International Institute for Applied Systems Analysis, they found that people living in Northern China have 600 percent less water than people living in Southern China (Yusuf and Saich 2008, 157-159).

Northern China has access to less than 15 percent of China's overall water resources while Southern China has access to more than 85 percent. In the north, surface waters provide 10 percent of water resources while ground waters provide the remaining five percent. In the south, surface waters provide 67 percent and ground waters 18

percent. The wide disparity between north and south is due to differences in climate and average annual rainfall. In the north, China has a temperate-to-cool, moderately humid climate. In the south and southeast, China benefits from a warm and humid climate (Yusuf and Saich 2008, 160).

Southern China receives abundant rainfall. During the summer, these areas experience heavy precipitation due to monsoons (Encyclopedia Britannica 2009). On average, between 60-80 percent of precipitation occurs during the summer (Yusuf and Saich 2008, 157-159). In contrast, Northern China receives sparse rainfall throughout the year. While provinces in the south fight to prevent flooding during the summer, in the north, they struggle through recurring droughts (Hai-Lun and Kang 2001, 42). For example, during the summer of 2006, rainstorms drenched southern China with 15.7 inches of rain daily. The storms caused widespread flooding, killing an estimated 70 people and destroying $1.6 billion in crops, residences, and businesses. During the same period, northern China endured a severe drought, receiving only 0.7 inches of rain during a four-month period. The drought threatened 95 million people and 450 million acres of crops and grazing land (Stanford Program on International and Cross-Cultural Education Digest 2007).

Southern rivers, such as the Pearl and Yangtze Rivers, originate in Southeast China and travel east to the sea. Many northern rivers, like the Yellow River, also originate in the Southeast. Following the terrain, they meander through the mountains and hills along northerly and southerly routes. Northern rivers rely on tributaries from the Northwest, which resupply them on their journey. Each year, on average, the southeast receives 72 inches of rain. In contrast, the northwest receives eight inches. Nine times

more rainfall supplies Southeast China, the source of southern rivers, than Northwest China, where northern tributaries originate. Rivers provide approximately 82 percent of the north's supply and aquifers provide the remainder (Yusuf and Saich 2008, 157-159).

Southern cities consume more water than northern cities. For example, in 2005, an average Guangzhou resident used 90 gallons of water each day. Guangzhou is located along the fertile Pearl River in Southern China. In Tianjin, in contrast, an average resident uses 36 gallons each day. Tianjin is located along the mouth of the Hai River in Northern China (Yusuf and Saich 2008, 166).

Throughout China, an extensive reservoir system enables local governments to capture river flows and build their supplies to withstand periodic droughts. However, in Northern China, due to infrequent rainfall, silting, and heavy domestic, agricultural, and industrial water use, the rivers are running dry. Water no longer flows to the sea (Browder, et al. 2007, 32). To meet demand, some northern cities have to transfer water from distant regions, drain aquifers, or divert water from downstream users, worsening the situation. Northern China's water problems are most severe along the Huai, Hai, and Yellow Rivers (Shalizi 2006, 9).

The Yellow River: a Case Study on Environmental Degradation

Chinese civilization began along the hillsides of the Yellow River. Its history provides a case study for the myriad of problems impacting most Chinese rivers, especially in Northern China. From the time of the Xia Dynasty in 2000 B.C. to the 20th Century, people have looked to the river as a source of trade, transportation, commerce, irrigation, food, religion, and folklore. Simultaneously, they also recognized the river as a formidable threat. Water managers from "Old" and "New China" alike shared a

common priority: flood control. Today, due to modern water management methods, flooding along the Yellow River is no longer a major problem. Instead, people are concerned with different matters: water scarcity, environmental degradation, and pollution (Giordano, et al. 2004, 1-2).

In *China's Water Crisis*, Ma Jun traces the journey of the Yellow River from its origin among the glaciers atop the Himalayas, along its circuitous path through the northern interior, and eastward toward the Yellow Sea (Jun 2004, 3-44). The river flows 3,387 miles, winding through eight autonomous regions and provinces: Qinghai, Tibet, Gansu, Ningxia, Inner Mongolia, Shanxi, Henan, and Shandong. The Yellow River is China's second longest waterway (Giordano, et al. 2004, 2-3).

The Yellow River Basin collects water from its tributaries, draining an area larger than France. The basin supports nine percent of China's population and 17 percent of its agricultural land (Giordano, et al. 2004, 2-3). The river's tributaries provide water to major cities in the Northern China Plain, including Beijing, Tainjin, Zhengzhou, and Ji'nan. (Economy 2004, 1). More people live in the Yellow River basin than the populations of Europe and South America combined (Shalizi 2006, 7). For water management purposes, the Yellow River Conservancy Commission divides the river into three parts: the upper, middle, and lower reaches.

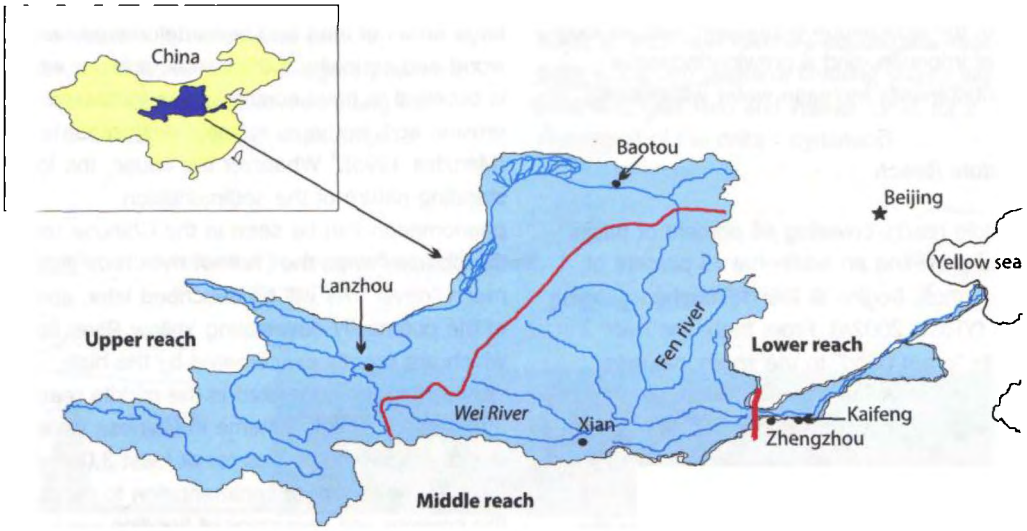

Figure 3-2: Diagram of the Yellow River Basin: Upper, Middle, and Lower Reaches (Giordano, et al. 2004, 2)

The Upper Reach: Farming in the Desert

The upper reach starts at the Qinghai-Tibetan Plateau, where the river flows down from mountainous rocky slopes, collecting water from melting snow and abundant rainfall. Overall, the western side of the upper reach contributes over 56 percent of the river's total runoff (Giordano, et al. 2004, 2-6). Most rainfall takes place between June and September. In contrast, practically no rainfall takes place between November and March. During the dry season, people struggle to conserve water. At this time of year, even hydroelectric plants remain idle. Ma Jun explains:

> A person would be amazed to see just how carefully the local people conserve water—half a basin with which to wash their face, then wash the dishes, then slop the pigs, and then (if anything is left over) water the few trees and shrubs struggling for existence (Jun 2004, 22-23).

Along the eastern side of the upper reach, the river winds north toward the Gobi Desert, south of Mongolia. Here, evaporation levels rise significantly higher than precipitation rates. Only 4.8 inches of rain fall in Ningxia and Inner Mongolia each year (Giordano, et al. 2004, 2-6). Yet, farmers divert vast quantities of water to irrigate their crops. Yearly, farmers from Inner Mongolia use 1.3 trillion gallons of water to irrigate 1.4 million acres of land, which amounts to approximately 929 thousand gallons per acre. The high usage rates are due to evaporation, poor crop selection, and faulty irrigation pipes that lose approximately 528 billion gallons each year.

Cost is not an issue for most farmers because water prices are very low. Thus, many farmers grow profitable but water intensive crops like cotton and rice. Along the Great Northern Bend, for example, farmers require 1,585 gallons of water to produce 2.2 pounds of rice. In other parts of China, most farmers take 264 gallons to produce the same quantity (Jun 2004, 25-28). Along each reach, the Yellow River loses vast quantities of water to agriculture. Nationally, agriculture accounts for 64 percent of Chinese water consumption (Yusuf and Saich 2008, 165-166).

The Middle Reach: Mines, Factories, and Barren Hills

The middle reach provides access to rich energy and mineral resources. Hydropower dams provide energy to approximately 15 percent of China's population. Hillsides along the river contain nearly 25 percent of China's oil resources and 50 percent of its coal deposits. Superior grade coal rests along the surface of the hillsides, where it is easy to mine. Marked with strip mines and open pits, the area is known as the "Black Triangle" (Jun 2004, 29-31). The surrounding mountains and hills provide bauxite, zinc,

lead, aluminum, nickel, copper, and gold. Four of China's eight aluminum mills are located along the Yellow River (Giordano, et al. 2004, 5-8).

The middle reach also provides a transportation route for raw materials and trade, as it has since the time of the Silk Road. As part of its Westward Development Program, China intends to build highways and railways to connect Eastern China with Central Asia. Under current plans, many of the routes will parallel the river (Lai 2002). Anticipating future population growth and commercial opportunities, investors and state enterprises in Qinghai, Gansu, Ningxia, Inner Mongolia, and Shaanxi provinces are developing more farmland and building more factories along the Yellow River's tributaries (Jun 2004, 44).

Several factors impact the river in the middle reach. First, the Yellow River receives water from its major tributaries, the Fen and Wei Rivers. The tributaries extend to nearly half of the basin and provide 43 percent of the river's total runoff. The tributaries are highly industrialized. Their factories and mines discharge pollution into the river. Second, the river passes through the historic Loess Plateau, where development and environmental degradation combine to impede the river's course (Giordano, et al. 2004, 2-4). Climate and topography, the third factor, aggravates these problems.

Water crossing the Loess Plateau carries vast quantities of silt to the river. Five thousand years of development have transformed the surrounding terrain from grassy plains and forested hillsides into farms and barren slopes. Gradually, the surrounding soil, unsupported by trees, grass, and bushes, began to erode into the river (Jun 2004, 4-6). Today, despite government reforesting efforts, agriculture, population growth, and low precipitation levels inhibit the growth of vegetation in the area. When precipitation

occurs, 35 percent takes the form of sudden cloud bursts, which overwhelm the soil's capacity to absorb the oncoming water, sending sediment into river (Giordano, et al. 2004, 7). Soil erosion is causing the Chinese desert, located along the Mongolian border, to expand 1,900 square miles each year. The desert already constitutes 25 percent of China (Economy 2007, 92).

In the middle reach, the topography changes, forcing the river to increase elevation. Here, the river loses speed and sediment accumulates (Giordano, et al. 2004, 2-4). According to contemporary estimates, the river carries over 1.6 billion tons of sediment annually. Ma Jun contends that the river includes three times the amount of sediment as the Amazon, Nile, and Mississippi Rivers combined (Jun 2004, 3-4). Mark Giordano, the lead author of *Water Management in the Yellow River Basin: Background, Current Critical Issues and Future Research Needs*, explains that if the annual amount of sediment could be made into a square belt with one yard sides, the belt would extend across the Earth's equator 27 times (Giordano, et al. 2004, 26). Due to the rising elevation, the river is not powerful enough to transport the sediment to the sea. According to a 2001 study, the river averages approximately 4 trillion less gallons than necessary to transport the sediment. Instead of travelling down river, 75 percent of the sediment settles along the river's floodplains or along its bottom, causing the riverbed to rise 2-4 inches annually.

The Lower Reach: Irrigation Projects and Embankments

In the lower reach, the topography changes again, as the river spills onto the Northern China Plain. Passing over the flat Plain, the river is highly unstable. According to the International Water Management Institute, during the last 3,500 years, the river has

shifted more than 250 miles, changing direction more than six times (Giordano, et al. 2004, 2-4). In an effort to counteract the river's changing course, a 3,000 year-old network of dikes and embankments guide the river through the Plain.

The original purpose of the structures was to prevent flooding and divert collected water resources for agricultural purposes (Jun 2004, 3-4). The Yellow River Basin is a fertile agricultural area; seventy-five percent of the basin's inhabitants work in agriculture. Farmers in the lower reach produce 16 percent of China's grain output (Giordano, et al. 2004, 5-8). They rely on the river for irrigation. Over 150 irrigation projects along the lower reach divert over one million gallons of water per second. By diverting the water, farmers reduce the average water flow in the lower reach to 485.8 thousand gallons per second (Jun 2004, 27-28).

In some places, the embankments make the river appear suspended over the ground (Giordano, et al. 2004, 2-4). In the ancient city of Xinxiang in Henan province, for example, the river rises more than 7 feet above the surrounding countryside (Jun 2004, 4-6). The embankments prevent inflows from replenishing the river. Although Shandong province in the lower reach receives over 32 inches of rain annually, the most of any of the provinces bordering the Yellow River, most of the rainfall cannot reach the river, walled behind tall embankments. Thus, the lower reach contributes only three percent to the river's total runoff. The remaining rainfall in the lower reach recharges nearby aquifers (Giordano, et al. 2004, 3-6).

Water Management

For most of China's history, water management efforts along the Yellow River focused on flood control. Chinese records from the Tang (A.D. 618-907), Song (A.D.

960-1279), and Ming (1368 -1644) dynasties indicate that Chinese leaders recognized that soil erosion and earthen dikes had made the lower reach susceptible to flooding (Jun 2004, 5-6). Pan Jixun, a Ming engineer, developed a new solution. He envisioned a great wall of closer embankments that would narrow the river, increase the water's velocity, and decrease the accumulation of sediment. Jixun's vision guided Chinese water management efforts until the 20th Century (Jun 2004, 5-7).

When the CCP came to power in 1949, party leaders fundamentally changed China's water management policies. In 1954, Chinese and Soviet engineers developed a proposal to improve agricultural and energy production along the Yellow River. The State Council integrated the proposal into the PRC's first Yellow River Basin Five-Year Plan, which called for new hydroelectric plants along the river's upper reach, strengthened flood control measures along the middle reach, and improved irrigation systems along the lower reach. Party leaders sought to "harness the river" by building massive dams, embankments, and reservoirs (China Development Gateway 2004). Starting in 1955, engineers set out to build 46 new dams along the main stem of the Yellow River. Soon after they began, two large-scale projects failed, causing party leaders to modify their plans (Giordano, et al. 2004, 12-16).

The Victory Canal project took place in Henan province, located along the lower reach; it was China's first massive irrigation project. Engineers intended to divert water from the Yellow River to irrigate over 247 thousand acres of farmland in the Northern China Plain.[7] Due to poor design and construction techniques, the project saturated the

[7] At the time, the nation's total irrigated land amounted to less than 44.5 million acres (Giordano, et al. 2004, 13-14).

surrounding farmland and jeopardized agricultural production. By 1961, farmers had torn down the irrigation canals (Giordano, et al. 2004, 13-14).

The Sanmenxia Reservoir project took place in the middle reach (Wang, Wu and Wang 2005).[8] Within three years after construction, the reservoir had filled with sediment, choking the river. Water built up along the Wei River and threatened to flood Xian in nearby Shaanxi province (Giordano, et al. 2004, 13-14). Engineers had to redesign the dam and reservoir. Sediment buildup remains a problem today (Wang, Wu and Wang 2005).

The PRC continued to construct large-scale water management projects along the Yellow River during the Great Leap Forward, which began in 1958, and the Cultural Revolution, which lasted from 1966 to 1975. Engineers successfully controlled flooding by retaining water in the upper and middle reaches, draining water in the lower reaches, and diverting water from the river's tributaries (Giordano, et al. 2004, 24). Notably, they built enormous reservoirs in the upper reach, new terraced fields along the Loess Plateau in the middle reach, and wider embankments and modern irrigation projects along the lower reach (Giordano, et al. 2004, 14-15). Ma Jun estimates that laborers worked over 500 million workdays on the projects. They moved enough earth and rock to build thirteen 3,100 mile Great Walls (Jun 2004, 39).

After Mao Zedong died in 1975, government control over water management became less centralized. The party enabled provincial and local governments to manage projects in cooperation with the Yellow River Conservancy Commission and multiple national agencies. It also encouraged individual farmers to participate in irrigation

[8] When the project began, China had only 23 reservoirs (Giordano, et al. 2004, 13-14).

projects. In 1984, the State Council approved a second Yellow River Basin Five-Year Plan to address soil erosion along the middle reach and irrigation along the lower reach. In contrast with the 1954 plan, energy production and flood control were no longer top priorities (Giordano, et al. 2004, 14-15).

Mao's successor, Deng Xiaoping, introduced new laws to strengthen water management efforts, including the 1988 Water Law, which set out basic principles governing water use and conservation. Numerous other laws followed, including the Water Pollution Prevention and Control Law, the Soil and Water Conservation Law, the Flood Control Law, the Environmental Protection Law, the Fishery Law, and the Forestry Law (Giordano, et al. 2004, 15-16). The same legal framework continues today. Within the framework, local officials are responsible for enforcing the laws and promulgating regulations. Most laws remained unenforced, however (Giordano, et al. 2004, 14-17). Local officials have other priorities. They often compete against upstream cities for water (Jun 2004, 28).

Simultaneously, Deng Xiaoping introduced economic reforms that enabled China to begin an unprecedented period of economic growth. Prospering agricultural and industrial sectors relied on the river for irrigation, production, and transportation; expanding cities relied on the river for sanitation and drinking water. Today, agricultural, industrial, and domestic sectors extract over 90 percent of the water traveling down the Yellow River (Shalizi 2006, 9). Eighty percent of the extracted water is for agricultural use and 20 percent is for industrial and domestic use. People extract 74 percent of their water from the Yellow River's surface waters and 26 percent from its ground waters (Giordano, et al. 2004, 7-8).

Measuring Pollution Levels

When the water returns to the river, it carries pollutants. Since the 1990s, Yellow River pollution levels have increased sharply. According to standards issued by the MEP, less than 40 percent of the water in the Yellow River is potentially suitable for human consumption. MEP assesses water quality under six classes. Classes I and II are suitable for human consumption. Class III may be suitable for consumption with added treatment. Classes IV and V are suitable for agricultural and industrial purposes only. In some places, where pollution levels exceed Class V parameters, the MEP recognizes a "Class V worse" category (Giordano, et al. 2004, 28-30).

Pollution aggravates China's water scarcity problem. Between 1985 and 2001, "Class V worse" waters increased from 3.7 percent to 25.4 percent of the Yellow River's flow. Class II waters decreased from 50 percent to 1.5 percent during the same period. Based on the current rate of contamination, the International Water Management Institute estimates that without major discharge reforms, the entire river and its tributaries may reach "Class V worse" conditions (Giordano, et al. 2004, 28-30). The other principle northern rivers, the Hai and the Huai, are 80 percent Class IV or worse (Shalizi 2006, 11). Pollution levels are even higher in the river's tributaries, which are not accounted for in the 2001 government estimates. The most contaminated tributary is the Fen River, which travels through Shanxi province (Jun 2004, 36-37). Over 66 percent of the tributaries are categorized as Class V or "Class V worse." Pollution seeps into the river's ground water as well. According to the Ministry of Water Resources, over half of the domestic wells in Taiyuan, the capitol of Shanxi province, located along the middle reach, are contaminated at Class IV or worse (Giordano, et al. 2004, 28-29).

Agriculture and industry contributes approximately 80 percent of the river's pollution discharges. Domestic sources contribute 20 percent, which includes untreated sewage from rural and urban areas. Most of the pollution enters the river in the upper reaches. The primary reported sources of pollution are Ningxia province, which discharges 151 billion gallons of wastewater, Shanxi province, which discharges 152 billion gallons, and Gangsu province, which discharges 204 billion gallons. Much of this water is reused downriver, causing significant health risks. In the middle reach, the primary sources are Shaanxi province, with 349 billion gallons, and Henan province, with 172 billion gallons. One of Northern China's most polluted rivers, the Wei River, joins the Yellow River in Shaanxi province. The Wei River contributes over one quarter of the total discharges entering the Yellow River (Giordano, et al. 2004, 28-29).

Discharges from unreported sources of pollution are difficult to estimate. The two primary unreported sources are small industry and agriculture. As China transitioned from a centralized economy to a free market economy during the 1990s, the number of state-controlled industries decreased while the number of small private industries increased. Many of these small industries, called Township and Village Industrial Enterprises (TVIEs), discharge waste water with extremely high heavy metal, cyanide, and phenol densities. They also contribute to acid rain. According to a 1999 article published by the National Institute of Environmental Health and Sciences, the primary TVIE polluters are paper and pulp mills, chemical industries, and textile dyeing and staining plants (Wu, et al. 1999, 252). Due to a lack of technology and financial resources, most local governments do not require TVIEs to monitor their discharges (Giordano, et al. 2004, 30-31).

Generally, agricultural activities produce three types of discharges: fertilizers, pesticides, and animal waste. As China's economy prospered in the 1990s, farmers began to rely more on fertilizers and pesticides. Today, China produces and uses the highest amount of fertilizer in the world. In addition, many farmers and rural families raise pigs, which are in high demand among prospering urban populations. Large-scale farming operations use animal waste generated from intensive livestock operations to fertilize crops. Irrigation runoff carries chemical residues and animal waste to the river (Shalizi 2006, 11). Environmental professionals refer to agricultural discharges as non-point source pollutants. Along the Yellow River, most agricultural discharges take place in the upper and middle reaches. Agricultural discharges from the Northern China Plain, located in the lower reach, contaminate ground waters or flow into the sea (Giordano, et al. 2004, 30-31).

In the delta, the river meets the sea. During some parts of the year, however, the river dries up, causing seawater to intrude into the delta and surrounding ground waters under the Huai, Hai, and Yellow River basins. Northern coastal provinces, including Hebei, Shanxi, and Shandong, rely on the damaged aquifers (Shalizi 2006, 9-10). Burdened with sediment, the river does not carry enough water to counteract the seawater. The problem began during the early 1990s, when the river experienced 40 days of low flows each year (Shalizi 2006, 9). In recent years, the problem has grown worse. In 1997, for example, the river experienced 200 days of low flows. When the Yellow River reaches its delta, polluted water contaminates the wetlands, impacting wildlife,

plant life, fisheries, and the ocean environment. For the Bohai Estuary, nutrients are hard to find (Giordano, et al. 2004, 30-31).[9]

Urbanization in Northern China

Supported by industry and agriculture, northern China's urban populations continue to grow. The region includes seven cities with populations over 2 million and 81 cities with populations between 200 and 500 thousand people. The World Bank estimates that by 2050, unless China reduces demand and increases supply, Northern China may face a water shortfall of almost 15 trillion gallons. Although water problems impact Northern China most severely, some observers estimate that 400 of China's 600 cities are short of water; 100 face major water shortages (Yusuf and Saich 2008, 160-161).

Northern China's cities are growing in wealth. As incomes rise, people purchase washing machines, showers, and flushable toilets, multiplying domestic water consumption rates (Shalizi 2006, 14). They also improve their diets, eating higher quantities of meat and vegetables, increasing agricultural demands. Simultaneously, northern cities build water-intensive parks and other green spaces, seeking to attract investors and skilled workers,. City planners build the green spaces to counteract dust storms, which spiral through Northern China. Ironically, dry conditions caused by water shortages generate the storms (Yusuf and Saich 2008, 161).

In 1980, urban populations used 1.9 billion gallons of water annually. By 2005, they used 8.5 trillion gallons (Yusuf and Saich 2008, 166). As water resources decrease, urban water managers and farmers compensate by mining ground waters. However, they

[9] China also operates its second largest oil field in the delta (Giordano, et al. 2004, 30-31).

deplete the resources at a faster rate than the resources naturally recharge. Mining weakens the ability of city leaders to respond to future water problems caused by drought or contamination and aggravates surrounding environmental problems, including salt water intrusion (Yusuf and Saich 2008, 161). In addition, mining causes the ground to subside, damaging structures and croplands (Shalizi 2006, 9-10).

Some northern cities compensate for water shortages by building desalination plants or experimenting with artificial rain. Last year, for example, the French company *Veolia Environnement* recently agreed to operate a desalinization plant to supply water to Tianjin, China's third largest city. Tianjin is located at the mouth of the highly polluted Hai River (Cohn 2008). Some cities have established "weather modification bureaus." The bureaus use rockets, antiaircraft guns, and specially designed aircraft to disperse silver iodide or liquid nitrogen into passing clouds to force them to produce rain. The chemicals make the clouds produce ice and decrease altitude. As clouds descend to warmer air below, the ice melts and forms rain. Government regulations encourage cities to cooperate. At times, however, neighboring cities contend for the same clouds. According to Edward Cody from the *Washington Post*: "The hunt for rain has become so intense that rival regions sometimes compete for clouds sailing in the sky" (Cody 2004).

Climate Change

Scientists disagree over what has caused Northern China's rainfall and runoff to decline since the 1990s. Some contend that periodic water shortages are caused by natural conditions. Climate cycles account for the declines, they explain. After all, surviving records indicate that the region experienced a more severe drought from 1922-1932, less than a century ago, when China's population was less than half of what it is

today (Laris 1998). Many older records were lost during the Cultural Revolution (Giordano, et al. 2004, 17-18).

Other scientists contend that runoff declines are due to irrigation projects as well as obstacles like dams and high embankments. Data indicates that runoff rates have decreased 100% in the lower reach. Yet, the data also demonstrates that the lower reach experiences the river's highest precipitation rates. The disparity between runoff and precipitation must be due to the high embankments that prevent runoff from joining the river, they contend (Giordano, et al. 2004, 17-18).

Finally, some scientists estimate that the shortages are due to global climate change (Giordano, et al. 2004, 17-18). This group attracts significant world-wide attention, especially among current United States and European governments. A 2007 IPCC report provides several key findings on how global climate change may impact Chinese water resources during the 21st Century.

The Panel defines climate change as any variation in climate over time due to natural conditions or human activity. The definition differs from other approaches. For example, the Framework Convention on Climate Change takes a more narrow approach. The Convention defines climate change as variations caused by human activity alone (Parry, et al. 2007, 21). Under the broader approach, the Panel estimates that climate change in China will increase water stress for hundreds of millions of people, especially in Northern China. (Parry, et al. 2007, 16).

The Panel estimates that climate change will cause warmer days and nights over land, more frequent heat waves, more frequent and heavier precipitation, increases in the severity of droughts, higher monsoon activity, and higher sea levels. Each of these

phenomena will impact China's water resources. Higher temperatures will increase glacier and snow melts, increase water demands, and intensify water quality problems like algal blooms (Parry, et al. 2007, 18).[10] The Panel estimates that heavier precipitation and flooding will further contaminate surface and groundwater resources, increasing the prevalence of infectious diseases and associated mortality rates. More severe droughts will increase the risk of malnutrition and the risk of water and food-borne diseases. A higher frequency of monsoons and higher sea levels could further increase the risk of injuries, deaths, and disease (Parry, et al. 2007, 18).

First, the Panel projects that annual average river runoff and water availability will decrease by 10 to 30 percent in some dry regions at mid-latitudes. Most of China is located in the mid-latitudes. According to the Panel, climate change, population growth, industrialization, and increasing demands due to higher standards of living will decrease the availability of water by the 2050s. The panel contends that these factors will limit sustainable development (Parry, et al. 2007, 13).

Second, the Panel projects heavier and more frequent rainfalls, which will increase the risk of flooding. Due to increased precipitation, crop yields will probably increase 20 percent in China and throughout East and South-East Asia. However, floods and droughts are likely to cause higher incidents of gastro-intestinal infections caused by microbial contamination. Diarrhea diseases, including cholera, an acute infection caused by the ingestion of contaminated water or food, will increase mortality rates, especially in

[10] An algal bloom is a dense combination of microorganisms, including plankton, algae, and bacteria. The organisms produce toxins that damage aquatic life. In coastal areas, an algal bloom is frequently referred to as a red tide (Woods Holes Oceanographic Institution 2006).

highly populated Chinese coastal regions. Increases in coastal water temperatures caused by climate change could worsen the problem (Parry, et al. 2007, 11-13).

Third, the Panel estimates that water supplies dependent on glaciers and mountain snow will decline (Parry, et al. 2007, 11). China depends on water from over 15,000 glaciers in the Himalayas. The glaciers feed major Chinese river systems, including the Yellow, Yangtze, and Mekong Rivers. The glaciers also feed the Ganges and Indus Rivers, which bring water to the subcontinent (Marquand 1999). The Panel anticipates that climate change will cause the glaciers to recede during the next thirty years, causing flooding and rock avalanches in the region.[11] As the glaciers recede, river flows will decrease, limiting downriver water supplies (Parry, et al. 2007, 13).

Overall, China provides its people with one of the lowest levels of fresh water in the world. However, the problem is far more significant in water-stressed Northern China, where people survive on 600 percent less water than people in Southern China. A variety of factors, including inefficient agricultural methods, soil erosion, poor discharge controls, and a toxic combination of agricultural, industrial, and domestic waste are contaminating China's rivers and aquifers. Meanwhile, as China's urban population grows in wealth, it is consuming more water than ever, compelling China to deplete water resources faster than they naturally recharge. If IPCC climate change forecasts prove accurate, by 2050, Northern China will have less water, suffer from more frequent floods, and will be more susceptible to infectious diseases and malnutrition.

[11] The International Commission for Snow and Ice estimates that the glaciers in the Himalayas may disappear by 2035 (Marquand 1999).

CHAPTER 4

Water Sources, Sanitation, and Public Health

In 2007, a military advisory board assembled by the CNA Corporation issued a report called *National Security and the Threat of Climate Change*. Board members included 11 retired admirals and generals, including Gordon Sullivan, former U.S. Army Chief of Staff; Joseph Prueher, former Commander of U.S. Pacific Command; and Anthony Zinni, former Commander of U.S. Central Command. Their report describes how climate change could impact various regions of the world, including East Asia. Based on current projections, the Board anticipates that climate change could destabilize East Asia and threaten United States national security interests. The Board refers to climate change as a "force multiplier for instability" (Catarious, et al. 2007, 3-6).

National Security and the Threat of Climate Change relies on climate projections developed by international groups, including the United Nations (UN) and the International Water Management Institute. For example, the report cites a UN Environmental Program study that predicts that 40 percent of the world's population may experience water shortages by 2025 (Doering, et al. 2000). Although the report recognizes disagreement among members of the scientific community over the extent and likely impacts of climate change, it does not include contrary views or studies.

The report provides several findings on the relationship between water resources and instability. First, climate change could decrease water resources, thereby degrading sanitation facilities and increasing the spread of infectious diseases. Second, climate change could cause flooding, droughts, and natural disasters, jeopardizing crops and

disrupting global food supplies. Third, environmental changes could cause large groups of people to relocate in search of more resources and better living conditions, resulting in regional population shifts (Catarious, et al. 2007, 13).

Health emergencies and population shifts occurring simultaneously could destabilize weak governments and cause internal unrest among undeveloped and volatile states in Asia (Catarious, et al. 2007, 6). The Board emphasizes that a humanitarian crisis involving disease could quickly cause regional instability, requiring US assistance ranging from medical care, evacuation operations, and stability operations (Catarious, et al. 2007, 16). In response, the United States may have to provide aid to restore stability and prevent violent extremists from taking advantage of deteriorating situations (Catarious, et al. 2007, 6). Population shifts could pressure more developed and stable European, North American, and Asian states to accept sizeable amounts of migrants.

In Asia, the Board notes that increasing temperatures are causing Himalayan glaciers to melt at unprecedented rates. According to some projections, in 20 years, the glaciers could shrink or disappear, decreasing water supplies in China, India, and Southeast Asia. East Asia's major rivers, including the Yellow, Yangtze, Indus, and Ganges, originate in the Himalayas (Catarious, et al. 2007, 15). Poor access to water and disease could lead people in Southeast Asia to migrate to China, where water sources are already strained.[12]

[12] *National Security and the Threat of Climate Change* includes two examples of regional population shifts caused by water shortages. In 1975, India built a dam along the Ganges River to divert water to the Hugli River, which supplied Calcutta. The diversion caused environmental damage downriver in Bangladesh, leading many Bangladeshi farmers to move to inland cities or across the border into India (Catarious, et al. 2007). In 2003, a 20-year period of draught in Sudan compelled Arab tribes of herdsmen in the northern Darfur to migrate south, where different tribes of farmers lived. The search for water, complicated by population growth, tribal disagreements, and religious differences led to violence (Ki-

Water Sources

Water sources and sanitation influence public health, economic development, life expectancy, standards of living, and education (World Health Organization and United Nations Children's Fund 2005, 10-11). Many factors impact water sources and sanitation: wastewater treatment systems, discharge controls, distribution and collection networks, public health education, and monitoring (World Bank 2007a, 35-41).

In 2002, the World Summit on Sustainable Development reaffirmed the international community's commitment to reduce by 50 percent the proportion of people without access to safe water sources and basic sanitation facilities. The Summit emphasized that improving water access promoted international Millennium Development Goals (MDGs): 1) eradicating extreme hunger and poverty, 2) achieving universal primary education, 3) promoting gender equality, 4) reducing child mortality, 5) improving maternal health, 6) combating diseases like HIV/AIDS, 7) ensuring environmental sustainability, and 8) forging development partnerships. The international community seeks to achieve the MDGs by 2015 (United Nations Department of Economic and Social Affairs 2002).

The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Program for Water Supply and Sanitation (JMP) monitors the progress of states striving to achieve MDGs associated with water sources and sanitation facilities. In June 2006, the JMP issued one of its first reports on improved

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moon, A Climate Culprit in Darfur 2007). In Darfur, water scarcity threatened communities and people's livelihoods, forced people to relocate, and jeopardized the stability of the region.

drinking water in China. The JMP worked with Chinese officials to update the report in 2008 (United Nations Statistics Division 2009).

The report consolidates data from 17 studies developed by Chinese and international organizations, including the WHO, UNICEF, University of Michigan China Data Center (CDC), and various Chinese government ministries, including the Sanitation Authority of the Ministry of Health. By extrapolating data collected between 1988 and 2003, the report estimates the proportion of people living in urban and rural areas who have access to improved water sources as well as the proportion of urban and rural households with water connections (World Health Organization and United Nations Children's Fund 2006). Much of the report's data on water sources is based on 1996 Chinese census data, a 1999 population sampling survey, and three Chinese Ministry of Health National Health Service Surveys from 1993, 1998, and 2003. Data on household water connections is based on five CDC China Economic, Population, and Health Household Surveys conducted between 1989 and 2000 as well as a WHO World Health Survey completed in 2003.

The report notes numerous difficulties involved in measuring access to improved water sources and sanitation facilities in China (World Health Organization and United Nations Children's Fund 2008). As a preliminary matter, representative data may not be available. Two examples from the report demonstrate the difficulties involved in collecting representative data. First, the report recognizes that CDC and WHO surveys may not represent Chinese conditions nationally. Despite the limitations, the JMP incorporates substantial amounts of data from both surveys because other data is not available (World Health Organization and United Nations Children's Fund 2006, 2-5).

Second, in 2008, China worked with the JMP to update the 2006 report to include three Chinese National Health Service Surveys from 1993, 1998, and 2003. The JMP incorporated the government health surveys to ensure its report included more representative data (United Nations Statistics Division 2009).

Further complicating efforts, definitions may differ among countries, international governmental organizations, or within a country over time (World Health Organization and United Nations Children's Fund 2008). For example, in 2008, China collaborated with the JMP to modify the definition of "improved water sources." When the UN completed its 2006 study, "improved water sources" included: piped water into dwellings or plots, public taps, standpipes, tube wells, boreholes, protected dug wells, protected springs, and rainwater collection systems. In 2008, the UN added "piped water into neighbor's plot" to the definition of improved water source to more closely match the Chinese definition (United Nations Statistics Division 2009). The definition of "unimproved water sources" remained the same: tanker truck water, and unprotected dug wells, unprotected springs, and surface waters, which include rivers, streams, lakes, dam waters, canals, and irrigation channels (World Health Organization and United Nations Children's Fund 2005, 6-7).[13]

Finally, analytical methodologies may differ. China's Ministry of Health calculates water access differently than the JMP and some leading international governmental organizations. World Bank researchers, on the other hand, frequently adopt Chinese methodologies, definitions, and data (World Bank 2007a). Generally, Chinese officials do not account for the various kinds of improved and non-improved

[13] With limited exceptions, the UN treats bottled water as an unimproved water source (World Health Organization and United Nations Children's Fund 2005, 6-7).

water sources. Instead, they collect data on households with access to "piped" water sources and "non-piped" water sources (World Bank 2007a, 40). Non-piped water sources include deep wells, hand pumps, spring water, and "other safe water." Unimproved water sources are not specified (World Health Organization and United Nations Children's Fund 2008, 6).

With the new data from government health surveys, modified definitions, and a different analytical methodology, the results of the updated report differ markedly from the original. Rural and urban water access measurements greatly improved under the new parameters. In 2009, The UN projected that China would outperform its Millennium Development Goals related to water access (United Nations Statistics Division 2009).

China continues to increase access to improved water sources in rural and urban areas. Among people living in rural areas, access to improved water sources increased from 55 percent in 1990 to 81 percent by 2006. During the same time period, the percentage of households with water connections rose from 36 percent to 57 percent. Based on available data, approximately 38 percent of rural residents have to share water sources (World Health Organization and United Nations Children's Fund 2008, 11).

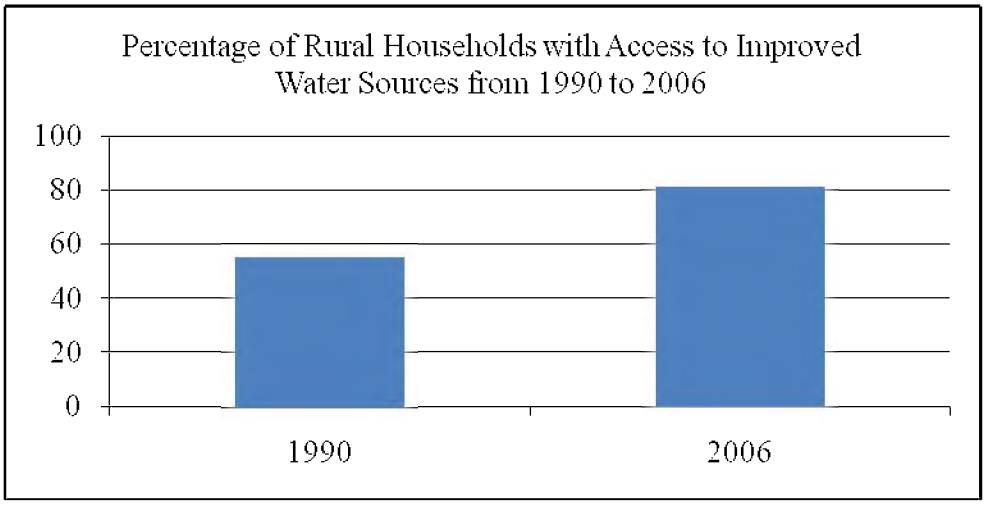

Figure 4-1: Percentage of Rural Households with Access to Improved Water Sources from 1990 to 2006 (World Health Organization and United Nations Children's Fund 2008, 11).

Urban residents benefit from greater access to improved water sources and more household connections. Among urban residents, access to improved water sources increased from 97 percent in 1990 to 98 percent in 2006. Today, most urban residents do not have to share water sources. From 1990 to 2006, the number of urban household connections rose from 81 to 87 percent (World Health Organization and United Nations Children's Fund 2008, 10).[14] In 2006, only 13 percent of urban residents had to share

[14] The original 2006 report indicated that China had not kept up with the urban population's increasing demands for water. In 1990, 99 percent of people living in urban areas had access to improved water sources. By 2004, the percentage had decreased to 93 percent. At the same time, however, the percentage of households with water connections rose from 81 percent in 1990 to 87 percent in 2004 (World Health Organization and United Nations Children's Fund 2006, 2-5). Relying on the same data, other international organizations, including the Organization of Economic Cooperation and Development, reached similar conclusions (Organization for Economic Cooperation and Development Working Party on Environmental Performance 2006, 5-6).

water sources (World Health Organization and United Nations Children's Fund 2008, 11).[15]

China's improved water sources vary. In both rural and urban areas, piped water taps and tube wells compose the majority. Among people who depend on unimproved water sources, the majority uses unprotected dug wells. Approximately 23 percent of rural residents and almost four percent of urban residents use unprotected wells (World Health Organization and United Nations Children's Fund 2006, 3).

Sanitation

Nationally, estimates vary on how many urban and rural residents use improved sanitation facilities. The UN defines improved sanitation facilities as: ventilated pit latrines, pit latrines with slabs, composting toilets, and flush or pour-flush toilets that deposit waste into piped sewer systems, septic tanks, or pits.[16] Unimproved sanitation facilities include: public latrines, pit latrines without slabs, open pits, handing toilets or latrines, bucket latrines, and flush or pour-flush toilets that deposit waste into the street, yard, open sewer, or other location (World Health Organization and United Nations Children's Fund 2005, 6-7).

Due to differences between how China's Ministry of Health and international organizations measure improved and unimproved sanitation facilities, the WHO and

[15] Under the original 2006 report, China had achieved 57 percent access to improved water sources in 2004. However, it measured progress based on different methodologies, definitions, and data (World Health Organization and United Nations Children's Fund 2006, 2-5).

[16] Simultaneously, the JMP updated its 2006 estimate with government data and different analytical methodologies. Under this updated approach, the UN projects that China will meet its Millennium Challenge goals by providing 74 percent of its population with access to improved sanitation facilities by 2015 (United Nations Statistics Division 2009).

UNICEF modified their definition of "improved sanitation facilities" to include 50 percent of people who use dry latrines, dry toilets, or shallow pits. According to a 2008 report using the updated definition, 74 percent of China's urban population has access to improved sanitation facilities, 15 percent share facilities, seven percent rely on unimproved facilities, and four percent do not to use facilities. In 1990, only 61 percent of the urban population had access to improved facilities (United Nations Statistics Division 2009).

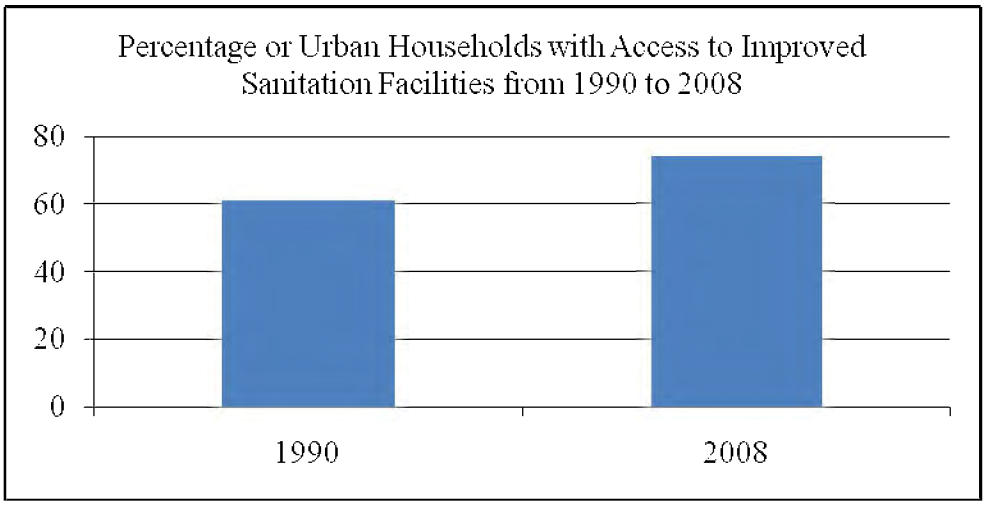

Figure 4-2: Percentage or Urban Households with Access to Improved Sanitation Facilities from 1990 to 2008 (United Nations Statistics Division 2009).

Among China's rural population, 59 percent have access to improved sanitation facilities, 1 percent share facilities, 38 percent use unimproved facilities, and 2 percent choose not to use facilities. People choosing not to use sanitation facilities prefer to use open fields or bushes (United Nations Statistics Division 2009). In 1990, only 43 percent of the rural population had access to improved facilities; the proportion of people choosing not to use facilities remained steady (World Health Organization and United Nations Children's Fund 2008, 12-13).

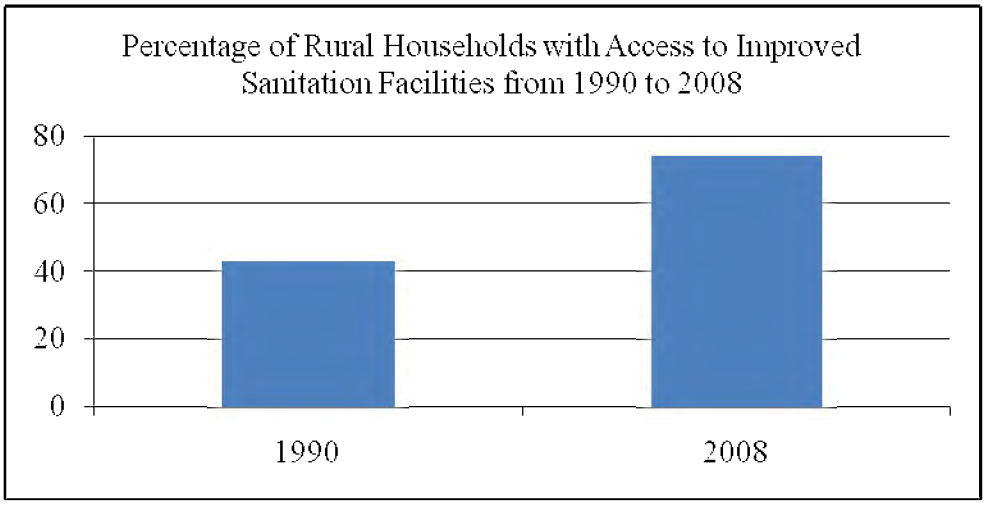

Figure 4-3: Percentage or Rural Households with Access to Improved Sanitation Facilities from 1990 to 2008 (United Nations Statistics Division 2009).

Chinese officials and non-government organizations continue to disagree over China's sanitation capacity. A 2003 National Health Service Survey developed by the Ministry of Health indicates that over 84 percent of Chinese households have water flushable toilets (World Health Organization and United Nations Children's Fund 2008, 9). In contrast, *China County Population Census*, a 2004 report developed by the All China Marketing Research Company, indicates that only 18 percent of Chinese households possess water flushable toilets, 49 percent possess another type of system (pit-latrines, open trenches, or squatting holes), and 28 percent are not equipped with a lavatory (World Bank 2007a, 40).

Wastewater Collection and Treatment

Despite improvements in water access and sanitation, wastewater treatment and sewage collection problems adversely impact water quality throughout China. Each day, people obtain water from a variety of improved and unimproved water sources.

Determining whether a water source is clean and suitable for drinking does not depend on whether it is improved or unimproved. Improved water sources may be contaminated if they are not treated properly. Similarly, unimproved water sources may be clean as long as they are protected from contamination.

Most of China's piped water sources are only partially treated (World Bank 2007a, 40-41). Common treatment methods include a combination of sedimentation, disinfection, and chlorination. MEP regulations require cities to treat their drinking water to meet China's Class I drinking water quality standards. However, according to a 2006 Organization for Economic Cooperation and Development report, nearly half of China's major cities do not treat water to the extent necessary to meet Class I drinking water quality standards. (Organization for Economic Cooperation and Development Working Party on Environmental Performance 2006, 5-6). For example, Beijing only treats 50 percent of its water. By 2010, city officials intend to increase the treatment rate to 70 percent (Yusuf and Saich 2008, 171).

Meanwhile, many rural townships are not capable of treating their water or only use one treatment method. Townships treat water differently than cities because they lack funding, use unreliable sampling and monitoring systems, and follow different regulatory standards (World Health Organization and United Nations Children's Fund 2005, 7-9). The MEP only requires townships to meet Class III drinking water quality standards (World Bank 2007a, 40-41, 47). Most people in rural areas rely on household treatment methods like boiling water (Boyle 2007, 2).

Between 2001 and 2006, China constructed more than 1,000 new wastewater treatment facilities (Yusuf and Saich 2008, 172-173). The need was great. In 1999,

China only had 266 wastewater treatment facilities. The facilities had a combined annual capacity of approximately three billion tons. At the time, China produced over 20.4 billion tons of waste annually. Each year, sewage systems discharged approximately 17 billion tons of untreated waste into nearby rivers (Boyle 2007, 2).

Despite the new construction projects, much of China's water remains untreated. First, many cities lack modern facilities with new treatment technologies. According to 2008 World Bank estimates, 278 of China's 660 major cities have not built new wastewater treatment facilities. In addition, many treatment plants are not designed to receive industrial wastewater. Instead, factories treat and discharge wastewater independently from municipal systems. Rather than recycling treated industrial wastewater for other industrial uses, agricultural purposes, or city parks, much of the water is returned to the river, to the detriment of downstream users (Yusuf and Saich 2008, 171, 174).

Second, approximately 50 percent of the new wastewater treatment facilities do not operate at full capacity, partially treat the wastewater they collect, or remain idle. Researchers at the World Bank estimate that 50 facilities in 30 major cities operate below 30 percent capacity (Yusuf and Saich 2008, 172). According to China's Ministry of Construction, underutilization is due to poor coordination among city governments and inadequate collection systems. In many areas, city governments do not cooperate with each other to invest in modern treatment facilities. Although they build facilities required under national laws and regulations, they often construct inefficient plants with high maintenance costs (Yusuf and Saich 2008, 171-172). In addition, many construction companies refrain from investing in wastewater collection systems because they are

unprofitable. Companies that invest in collection systems have to lay wastewater pipes under roads and highways, which involve high costs with limited returns (DMG Investment Research 2007, 2).

Third, many wastewater discharges remain untreated and unmonitored. According to the World Bank, many cities and towns do not regulate discharges from sanitation facilities that are not connected to sewage systems (Yusuf and Saich 2008, 171). Nor do they regulate agricultural discharges. Farmers continue to contaminate unimproved water sources with animal waste and untreated chemicals, including pesticides and fertilizers (World Bank Operations Evaluation Department 2005, 27). Finally, industrial Township and Village Enterprises (TVEs) discharge a variety of chemicals directly into local streams and rivers (Stanford Program on International and Cross-Cultural Education Digest 2007, 2). The worst TVE polluters are paper and pulp mills, chemical factories, and textile dyeing and staining plants (Wu, et al. 1999, 252).

Fourth, many plants and collection systems receive inadequate funding. Often, many cities take revenues generated by water treatment services and use them for other municipal projects. In general, most cities do not use treatment fees to operate, maintain, and repair wastewater treatment systems. On the other hand, some wealthier cities are experimenting with sewage wastewater reuse programs. Beijing, for example, requires new residential construction projects that are 324,000 square feet and over to include on-site wastewater reuse equipment (Yusuf and Saich 2008, 171, 175).

Chinese officials understand existing problems and are working to improve wastewater collection and treatment systems. In cooperation with the World Bank and other international organizations, cities and townships frequently rely on private firms to

develop water infrastructure projects. Before the global economic crisis began, DMG & Partners Securities, a major East Asian financial firm, projected that China planned to spend $202 billion on water projects through 2010. DMG estimated that 33 percent would go toward wastewater treatment facilities, 30 percent to improve water sources, and 32 percent to construct water transfer projects. However, China only intended to invest five percent to upgrade sewage collection systems (DMG Investment Research 2007, 2).

The World Bank recognizes that it exercises limited influence over Chinese water treatment policies. A July 2005 report entitled *China: an Evaluation of World Bank Assistance* states: "For water supply, there has been no significant difference between Bank and non-Bank supported utilities, leading to a questioning of whether there is really any Bank value-added. Bank supported projects may have been better implemented than others, but overall water quality targets are not being met" (World Bank Operations Evaluation Department 2005, 29). The Bank does not coordinate projects within a national planning framework. Instead, it relies on Chinese officials to determine priorities (Varley 2005, 17). Rather than working with provincial, regional, or national officials, the Bank usually works with township and municipal officials, often requiring them to privatize water systems as a condition for receiving loans (Barlow 2001, 17).

The economic crisis has probably not changed China's plans to construct water infrastructure projects. When the economic crisis began, the government allocated $586 billion in stimulus to accelerate infrastructure construction projects including water and environmental projects (The Economist 2009). In *Overcoming Obstacles to U.S. China Cooperation on Climate Change*, Kenneth Lieberthal and David Sandalow contend that

each month, China constructs enough infrastructure and creates enough jobs to build a city of 1.25 million people (Lieberthal and Sandalow 2009, 32). During the global economic downturn, the Chinese are unlikely to risk social instability by diverting resources from building and job-creation initiatives. Cement, steel, and aluminum industries contribute the most to infrastructure development. Ironically, they also produce the most pollution (Lieberthal and Sandalow 2009, 32). China seeks to address water pollution by concentrating efforts on immediate tasks, including water treatment and management (Lieberthal and Sandalow 2009, 32). On the other hand, the economic crisis will probably make it less likely that PRC officials will enforce discharge controls. Controlling discharges increases costs and decreases companies' global competiveness.

Public Health

Due to sporadic treatment methods, deteriorating water quality remains a major health concern. Each day, over 300 million people, a quarter of China's population, drink contaminated water (Stanford Program on International and Cross-Cultural Education Digest 2007, 2). Chemical and microbial contaminants are the greatest problems. Nitrates, phosphates, mercury, arsenic, chrome, fluorine, lead, and a variety of other substances cause chemical contamination (World Bank 2007a, 41-44). Untreated human and animal wastes cause microbial contamination (Boyle 2007, 1-2). Pathologists estimate that long-term exposure to contaminated water may cause acute poisoning or contribute to chronic health problems, such as hepatitis, cirrhosis, various cancers, cardiovascular disease, hypertension, respiratory diseases, skeletal deformities, neurological diseases, and digestive ailments. Contaminated water also contributes to birth defects, at-risk pregnancies, and spontaneous abortions (World Bank 2007a, 41-44).

The Chinese MEP Environmental Statistical Yearbook indicates that 1,406 environmental pollution incidents took place in 2005. Approximately 693 incidents involved water polluted with chemicals or microbial contaminants, although the yearbook does not distinguish between them (Ministry of Environmental Protection 2007).[17] The World Bank estimates that the actual numbers are probably much higher because some local officials are unlikely to report environmental incidents (World Bank 2007, 2). Beijing, for example, did not report any incidents in 2005. In addition, the yearbook only records incidents identified as "environmental pollution and destructive incidents" (Ministry of Environmental Protection 2007).

Generally, environmentalists recognize two types of pollution incidents. The first type is caused by a sudden discharge of short duration. Industrial and wastewater treatment facilities usually cause sudden discharges. Sudden discharges are most likely to pollute unimproved water sources. The second type is caused by the cumulative effects of discharges over a long period (World Bank 2007, 1). Cumulative discharges from farms and faulty sewage lines usually pollute improved water sources like reservoirs and lakes. The yearbook definition of "environmental pollution and destruction accidents" only captures the first type of incident:

> …sudden accidents, due to economic or social activities that are in contrast to environmental protections laws or due to unforeseen factors or natural disasters, that lead to environmental pollution, the destruction of protected wild animals, plants or nature reserves, the damage to human health, the economic and property losses, and the negative impact on the society (Ministry of Environmental Protection 2007).

[17] In 2005, 48 incidents involved solid waste pollution. The yearbook does not specify whether the solid waste pollution involved water (Ministry of Environmental Protection 2007).

Chemical contamination is due to both natural conditions and anthropological factors. In Northern China, the Great Bend of the Yellow River, Inner Mongolia, and Shanxi province all have high levels of arsenic naturally found in the environment. According to a 2005 Ministry of Water Resources (MWR) study, nationally, 2.3 million people drink water contaminated with arsenic. Arsenic exposure may cause various bladder, liver, lung, renal, and skin cancers, hypertension, and peripheral vascular diseases. Throughout China, but especially in the northeastern and central provinces, high levels of fluorine are also a problem. The MWR estimates that each year 63 million people drink water contaminated with fluorine. Fluorine exposure is associated with skeletal deformities (World Bank 2007, 44-45).

Anthropological chemical pollutants contribute to esophagus, stomach, liver, and bladder cancers. According to a 2004 Ministry of Health study, liver and stomach cancers are most common. Mortality rates are high in both rural and urban areas. In rural areas, mortality rates for both cancers are 30 and 23 percent. In urban areas, mortality rates are lower, approximately 27 and 15 percent, respectively. The world averages for liver and stomach cancer are 10 and 12 percent (World Bank 2007, 45-46).

The industrial sector is the primary source of anthropological chemical contaminants. In 2004, the State Environmental Protection Agency determined that 90.7 percent of industrial chemical pollutants met national standards. Yet, untreated chemical pollutants and periodic chemical spills continue to cause widespread health problems. According to a 2006 Worldwatch Institute estimate, an industrial pollution incident occurs every third day in China (Stanford Program on International and Cross-Cultural

Education Digest 2007, 2). Household treatment methods and proper hygiene are ineffective against chemical pollutants (Boyle 2007, 2).

Microbial contamination is most common in areas lacking access to protected water sources and basic sanitation facilities (Boyle 2007, 2-3). Poor hygiene, high population densities, and low health education levels increase the likelihood that people will spread disease. In China, common infectious diseases associated with water are Hepatitis A, dysentery, cholera, and typhoid/paratyphoid. According to the Chinese Ministry of Health, the incident rate for each of these diseases has decreased significantly since 1985. For example, in 1985, the annual incident rate for dysentery, the most common water-related disease, was approximately 320 per 100,000 people. By 2003, the annual incident rate had fallen to approximately 50 per 100,000 people (World Bank 2007, 45-46, 51).

Although China's mortality rates for microbial diseases have decreased, when compared with other developing nations in East Asia, China's mortality rates remain high. For example, China's dysentery mortality rate is approximately 10 times greater than Vietnam's and 20 times greater than Thailand's. According to one of the latest studies completed by the WHO, China suffered 108.4 dysentery mortalities per 100,000 people in 2002. That year, studies analyzing dysentery showed that Vietnam and Thailand averaged 10.7 and 4.6 mortalities per 100,000 people, respectively (Boyle 2007, 2). The decrease in microbial disease incident and mortality rates is probably due to improved treatment facilities, home treatments, and successful health education programs. In most cases, people can decrease their vulnerability to microbial diseases through proper hygiene and sanitation (World Bank 2007, 45-46, 51).

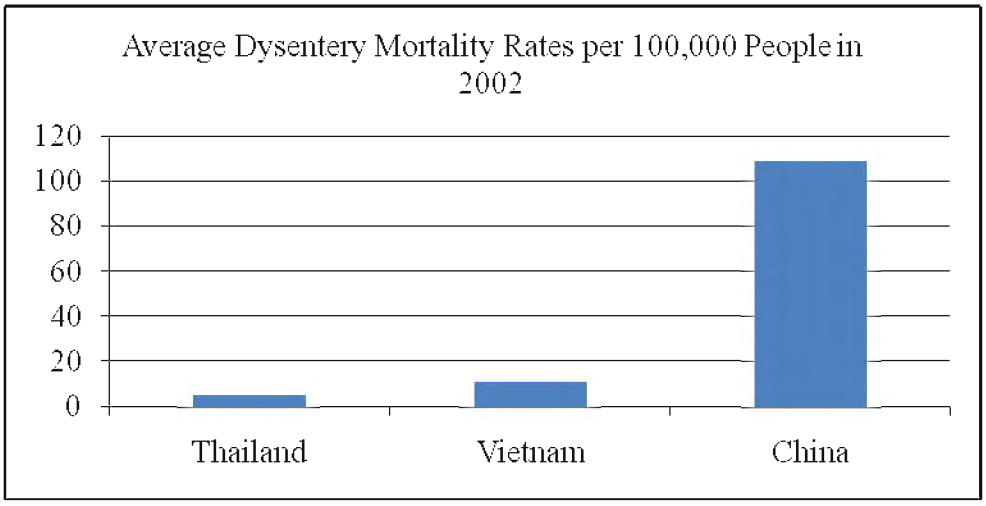

Figure 4-4: Average Dysentery Mortality Rates per 100,000 People in 2002 (Boyle 2007, 2)

Demographic Impacts

According to the WHO and UNICEF, when people digest untreated water, rely on unprotected water sources, or lack improved sanitation facilities, children under five years old and people 60 years old and over suffer most. Across all ages, poor access to water negatively impacts women more than men. People with diseases that make them susceptible to infection also suffer disproportionately (World Health Organization and United Nations Children's Fund 2005, 1-8).

Among children under five years old, contaminated water contributes to malnutrition, weakens resistance to infection, and spreads waterborne illnesses, especially diarrheal diseases (World Health Organization and United Nations Children's Fund 2005, 10-16). In China, the child mortality rate due to diarrheal diseases is twice as high in rural areas as in urban areas. Rural areas often lack access to improved water sources and sanitation facilities, resembling many developing countries in Africa and other parts of

Asia. According to a 2004 Ministry of Health Report, among 1,000 children under five years old, 1.35 children died due to diarrhea in rural areas and .75 died in urban areas each year (World Bank 2007a, 46-47).[18] Nationally, 30,000 children die from diarrheal diseases annually (Stanford Program on International and Cross-Cultural Education Digest 2007, 2). In urban areas that have access to clean water, people benefit from proper nutrition, healthy hygienic habits, and easily accessible sanitation facilities. (World Health Organization and United Nations Children's Fund 2005, 10-16).

Among young people between five and 14 years old, contaminated water causes many to miss school, impeding their education and social development. Many rural households lack access to clean water supplies and schools often lack sanitation facilities. According to the WHO and UNICEF, young girls often miss school because they have to haul water home from nearby streams and wells. By the time they finish their chores, many are too tired to go to school (World Health Organization and United Nations Children's Fund 2005, 14-15).

In rural areas, over 300,000 public schools lack basic hygiene and sanitation facilities. Local governments are striving to introduce new toilets, sinks with access to hot water, sewage treatment equipment, and hygiene education programs. For example, in Shanxi province, government officials joined with the international NGO, the World Toilet Organization, to sponsor the Happy Eco-School Project. The 2006 project improved sanitation and hygienic conditions for 358 students and 28 teachers at the Zhou

[18] According to UNICEF 2000-2003 estimates, in the United States and Europe, among 1,000 children under five years old, .012 died due to diarrhea (World Health Organization and United Nations Children's Fund 2005, 16).

Jia Gou Middle School by providing affordable, low-maintenance sanitation systems (World Toilet Organization 2006).

Contaminated water causes people between 15-59 years old to lose income because they become debilitated, malnourished, ill, or tired from hauling water home. According to the WHO, women often incur greater health and financial impacts because they care for ill children, tend household vegetable gardens, and raise small livestock. Expectant mothers and their babies are also more susceptible to diseases caused by unsanitary living conditions and inadequate drinking water. Contaminated water also exacerbates other health problems and diseases. For example, HIV/AIDS patients are more likely to die from the disease when they lack access to water, sanitation, and basic hygiene (World Health Organization and United Nations Children's Fund 2005, 16-20).

People 60 years old and over are more susceptible to diseases caused by poor hygiene and unsafe water. In rural parts of China that resemble developing nations, older people suffer from weaker immune systems, malnutrition, and unsanitary living conditions. Legionellosis is a leading waterborne disease among older people. The disease thrives in warm water and damp places. Unsafe water shortens the life expectancy of people 60 and over (World Health Organization and United Nations Children's Fund 2005, 17-20).

Chinese leaders intend to invest over $202 billion in water infrastructure projects through 2010. They are planning to improve water sources, build wastewater treatment facilities, construct water transfer systems, and sewage collection systems. Although China built more than 1,000 new wastewater treatment facilities between 2001 and 2006, wastewater treatment and sewage collection remains an area of concern. Most of China's

piped water sources are only partially treated. In fact, nearly half of China's major cities do not treat water to the extent necessary to reach clean drinking water quality standards and many rural areas have no treatment facilities at all. Among the new facilities, many operate at less than full capacity or remain idle due to a lack of sewage collection systems, poor market incentives, and inadequate funding.

Poor sanitation, wastewater treatment, and sewage collection capabilities make China's population more susceptible to disease. Each day, a quarter of China's population drinks water contaminated with chemical or microbial pollutants. Deteriorating water quality contributes to widespread health problems, especially among women, the young, the elderly, the infirm, and the poor. Long-term exposure to contaminated water may cause acute poisoning or contribute to chronic health problems, such as hepatitis, cirrhosis, various cancers, cardiovascular disease, hypertension, respiratory diseases, skeletal deformities, neurological diseases, and digestive ailments. Contaminated water also contributes to birth defects, at-risk pregnancies, and spontaneous abortions (World Bank 2007a, 41-44).

CHAPTER 5

International Cooperation on Climate Change

President Obama and Congressional leaders consider climate change one of the most critical issues facing the United States and the international community (Lieberthal and Sandalow 2009, x). During the next four years, national leaders will take steps to address global climate change (Obama and Biden 2008a). Most initiatives will probably seek to reduce greenhouse gases through initiatives like clean energy technologies and cap-and-trade systems (Lieberthal and Sandalow 2009, 27). However, international cooperation on climate change will be hard to achieve, especially during the current global economic crisis.

The Intergovernmental Panel on Climate Change (IPCC) projects with high confidence that green house gas emissions will cause global temperatures to rise (Lieberthal and Sandalow 2009, 7-8). As temperatures rise, water will become increasingly scarce in Asia, Africa, and the southwestern United States (Fingar 2008, 6). Water scarcity is caused by a variety of factors, including ecological changes like decreased precipitation, increased evaporation, and reduced river flows. It is also caused by anthropological changes like urbanization, agricultural methods, and industrialization. Water scarcity debilitates people by causing food and water shortages, increasing health problems and disease, and increasing the potential for civil disorder as people compete for limited resources and others migrate from more severely impacted areas (Fingar 2008, 7). The Panel estimates that climate change will increase water stress for hundreds of millions of people, especially in Northern China. (Parry, et al. 2007, 16).

The Panel projects that climate change will cause warmer days and nights over land, more frequent heat waves, more frequent and heavier precipitation, increases in the severity of droughts, higher monsoon activity, and higher sea levels. Each of these phenomena will impact China's water resources. Higher temperatures will increase glacier and snow melts, increase water demands, and intensify water quality problems like algal blooms (Parry, et al. 2007, 18). The Panel estimates that heavier precipitation and flooding will further contaminate surface and groundwater resources, increasing the prevalence of infectious diseases and associated mortality rates. More severe droughts will increase the risk of malnutrition and the risk of water and food-borne diseases. A higher frequency of monsoons and higher sea levels could further increase the risk of injuries, deaths, and disease (Parry, et al. 2007, 18).

According to the IPCC, annual average river runoff and water availability will decrease by 10 to 30 percent in some dry regions at mid-latitudes. Most of China is located in the mid-latitudes. According to the Panel, climate change, population growth, industrialization, and increasing demands due to higher standards of living will decrease the availability of water by the 2050s. The panel contends that these factors will limit sustainable development (Parry, et al. 2007, 13).

The Panel projects heavier and more frequent rainfalls, which will increase the risk of flooding. Due to increased precipitation, crop yields will probably increase 20 percent in China and throughout East and South-East Asia. However, floods and droughts are likely to cause higher incidents of gastro-intestinal infections caused by microbial contamination. Diarrhea diseases, including cholera, an acute infection caused by the ingestion of contaminated water or food, will increase mortality rates, especially in

highly populated Chinese coastal regions. Increases in coastal water temperatures caused by climate change could worsen the problem (Parry, et al. 2007, 11-13).

The Panel estimates that water supplies dependent on glaciers and mountain snow will decline (Parry, et al. 2007, 11). China depends on water from over 15,000 glaciers in the Himalayas. The glaciers feed major Chinese river systems, including the Yellow, Yangtze, and Mekong Rivers. The glaciers also feed the Ganges and Indus Rivers, which bring water to the subcontinent (Marquand 1999). The Panel anticipates that climate change will cause the glaciers to recede during the next thirty years, causing flooding and rock avalanches in the region. As the glaciers recede, river flows will decrease, limiting downriver water supplies (Parry, et al. 2007, 13).

If IPCC forecasts prove accurate and international environmental policies remain as they are, by 2050, climate change is likely to impact China and the United States. China will have less water, suffer from more frequent floods, and will be more susceptible to infectious diseases and malnutrition. In the United States, western states will experience more wildfires, less rainfall, and more frequent heat waves. The United States and China generate over 40 percent of the world's greenhouse gases (Lieberthal and Sandalow 2009, 1-10). Currently, China emits the largest share of sulfur dioxide, mercury, and carbon dioxide (Blair and Hills 2007, 17).

International Cooperation on Climate Change

The Council on Foreign Relations recommends that US leaders form an international partnership for climate cooperation. Rather than relying on global summits to negotiate climate change treaties, the Council envisions a new informal approach. It recommends that the United States form an international partnership, composed of 12

states that agree on pollution mitigation policies and a common means to measure progress. According to the Council, a small group approach would be more effective than a global approach because developing states may be less willing to agree to global mitigation policies and targets. The Council recognizes that the small group approach would have to include the world's largest emitters: the United States, China, European Union, Japan, Brazil, India, and Indonesia (Pataki, et al. 2008, 80-82).

Strategic Context

In 2008, the NIC identified climate change as a strategic issue and published its findings in the *National Intelligence Assessment on the National Security Implication of Climate Change to 2030* (Butts 2008, 1). The NIA projects how climate change could impact US national security by 2030. It describes the causes of climate change in China, its impacts, China's capability to address the problems, and the potential for a humanitarian disaster.

The assessment informs national leaders on the relationship among stability, climate change, and the ability of governments to provide for the basic needs of their populations (Butts 2008, 1). Identifying water as a basic need, the assessment projects how climate change could exacerbate water scarcity in different parts of the world. It recognizes that climate change alone will not cause instability. Rather, climate change could worsen existing problems like poor leadership, weak political institutions, poor public health, poverty, economic migration, social tensions, and environmental degradation (Fingar 2008, 5). As the United States prepares to engage China on climate change, negotiators would benefit from understanding China's competing priorities,

current political and environmental conditions, and its ability to cooperate on environmental initiatives (Lieberthal and Sandalow 2009, 4).

Chinese Leadership

Chinese leaders are unlikely to agree to international agreements on climate change unless they receive assurances that protect China's global competitiveness and promote strong economic growth. At a minimum, party leaders estimate that China needs to achieve eight percent real GDP growth annually to maintain stability (Lieberthal and Sandalow 2009, 30-31). Strong growth promotes stability by creating jobs and meeting popular expectations for higher living standards. All other initiatives and policy goals complement this critical priority.

In the short term, economists project that Chinese GDP growth will decrease to six and one half percent (J. Wu 2009). In the long term, economic projections vary. As of March 2009, *The Economist* forecasts gradual increases to seven percent in 2010, and eight and one half percent in 2011 (The Economist 2009). Other economists project a gradual transition period leading to a long term economic slowdown (Bergsten, et al. 2006, 7). Amid periods of economic uncertainty and weak growth, like the present, China is unlikely to implement costly environmental initiatives.

Chinese leaders are more likely to advance environmental reforms during periods of strong economic growth. For example, in 2006, during a period of eight and one half percent growth, President Hu Jintao and the Central Committee introduced a series of environmental reforms. Under the "Harmonious Society" program, the Central Committee issued a five-year plan that called on cities to increase water prices, strengthen fines, monitor discharges, enforce pollution standards, improve treatment

methods, and build desalinization plants (Yardley 2007). China's legislature elevated China's environmental protection agency to a cabinet-level ministry. According to some observers, the move demonstrated the party's commitment to environmental reform. The initiative strengthened the environmental protection agency's ability to administer laws and regulations, obtain funding, coordinate with other agencies, and attract national visibility (Qiu and Li 2009, 10152).

As Chinese environmental reforms began to transform industry and take hold, the global economy began to lose momentum. In late 2008, as China's economy cooled, government budget and enforcement priorities changed. As numerous businesses laid off workers, decreased workers' pay, or went out of business, environmental initiatives to enforce environmental standards, implement discharge controls, and upgrade factories fell off the public agenda (The Economist 2009). Slower growth rate projections caused Chinese officials to reevaluate their environmental policies.

During the global economic crisis, Chinese officials plan to invest in infrastructure projects that create jobs. Yet, the same industries that contribute the most to infrastructure development: cement, steel, petrochemical, and aluminum, also produce the most pollution (Lieberthal and Sandalow 2009, 32). Chinese leaders may be open to initiatives that incorporate environmentally friendly technologies into water infrastructure projects.

Chinese leaders realize that the PRC had achieved economic growth at a high cost, damaging to the environment and social welfare. Yet, they understand that the risk of environmental issues giving rise to widespread civil unrest is minor. Chinese leaders are experienced in responding to civil unrest. By offering concessions to the protesters,

imprisoning their leaders, prohibiting media coverage, and circulating pro-government propaganda, party leaders quickly suppress civil disturbances. Sensitive to the possibility of economic woes giving rise to mass protests, Chinese leaders are strengthening policies designed to suppress unrest (The Economist 2009).

People with environmental concerns are more likely to resolve their disputes through peaceful means than through violence. In general, environmental proponents rely on petitioning government agencies, filing lawsuits, using political connections, mobilizing the media, educating the public, and staging small demonstrations (Jing 2003, 156-157). They are also more likely to focus their attention on specific grievances, corrupt local officials, and factory owners rather than national government organizations, reform movements, or party leaders. While some environmental protesters may resort to violence, such activities are rare and small in scale (Jing 2003, 143-144).

As long as China's annual growth rate remains below eight and one half percent, China's leaders will probably promote economic development at the expense of the environment. Party leaders estimate that the costs associated with environmental degradation: poor public health, lost productivity, and small-scale unrest, are far less troublesome than the costs associated with slower economic growth. They believe that economic growth will forestall other problems and preserves their legitimacy to govern. The inability of China's leaders to address the deepening water crisis demonstrates the degree to which China's leaders rely on economic growth to maintain control.

Weak Political Institutions

In the event Chinese leaders agree to an international agreement on climate change, Chinese political institutions are not capable of implementing nation-wide

environmental policies. China's strongest political institution is the CCP, which controls each of China's five levels of government: national, provincial, municipal, county, and township. The CCP develops national policies through its Central Committee. For a national policy to succeed, top party leaders have to agree that the policy issue is important enough to address, identify it as a high priority, and strive to oversee its implementation. This seldom happens. Compared with economic growth, environmental protection remains a non-critical issue. On most non-critical issues, the party reveals itself as a decentralized, corrupt, and poorly disciplined institution (Lieberthal and Sandalow 2009, 33). It is unlikely that an international agreement will convince Chinese leaders outside Beijing to consider environmental protection a critical issue. If national leaders agree to climate change initiatives, US negotiators should ensure that such agreements include verifiable methods of monitoring progress.

China's government is decentralized. The party enables officials at each level of government to act independently. Independently governed localities often compete against each other for rewards, investments, and resources. When officials successfully promote GDP growth, the party rewards them (Lieberthal and Sandalow 2009, 33-34). In contrast, regional cooperation and environmental stewardship yield minimal rewards. For example, in many areas, city governments do not cooperate with each other to invest in modern wastewater collection systems or treatment facilities. Although local officials build facilities required under national laws and regulations, they often construct inefficient plants with high maintenance costs or inadequate collection systems (Yusuf and Saich 2008, 171-172). By providing local officials with independence, the Chinese system of government promotes dynamism and entrepreneurism, which are essential for

economic growth. However, these qualities also inhibit environmental stewardship. Although national party leaders have attempted to create incentives for local officials to protect the environment, GDP growth remains their overriding concern (Lieberthal and Sandalow 2009, 33-34).

The one-party system enables corrupt officials to circumvent or frustrate national environmental policies. Often, party members and business leaders collaborate to increase profits and their personal wealth. Party officials frequently hold positions in key businesses, or require them to hire relatives. They use their political power to promote business activities by: underreporting environmental incidents, interfering with environmental legal actions brought before local courts, and overlooking environmental regulations in exchange for bribes and kick-backs. In addition, party officials provide well-connected businesses with favorable bank loans and tax benefits (Economy and Lieberthal 2007, 92-93). In 2005, President Hu Jintao advised party members that corruption threatened the party's legitimacy to govern; he pledged to eradicate the problem. However, Chinese leaders often use anti-corruption campaigns to strengthen their public support, attack enemies, and to enable friends to advance to higher positions in the party (Blair and Hills 2007, 25-26).

Finally, in many localities, undisciplined party officials pursue business opportunities at the expense of their party and governmental responsibilities. Many fail to recruit business leaders into the party or build party organizations within new enterprises (Dickson 2000-2001, 517). Instead, they choose to use their power to increase their profits, often to the detriment of governmental policies.

Overall, China's political institutions are decentralized, corrupt, and undisciplined. While national leaders build new environmental ministries and policies, local officials frequently disregard them. Their primary goals are to attract investments to their jurisdictions and to increase their personal wealth. In pursuit of these goals, they neglect their party and government responsibilities. China's water crisis demonstrates the inability of the party to respond to non-critical policy initiatives. As long as the environment remains a non-critical issue, party officials are unlikely to change. For cooperative climate change initiatives to take hold, US negotiators have to convince China's national leaders that environmental stewardship is a critical issue. The only way to do this is to demonstrate that environmental degradation threatens to undermine the party to the same extent as slow economic growth. At present, such an approach is unlikely to succeed. As environmental conditions worsen, national leaders may recognize that the environment is a critical issue.

Public Health Problems

Poor sanitation, wastewater treatment, and sewage collection capabilities make China's population susceptible to disease. Deteriorating water quality contributes to widespread health problems, especially among women, the young, the elderly, the infirm, and the poor. Each day, a quarter of China's population drinks water contaminated with chemical or microbial pollutants. Contaminated water endangers public health in many of China's most heavily populated areas. Long-term exposure to contaminated water may cause acute poisoning or contribute to chronic health problems, such as hepatitis, cirrhosis, various cancers, cardiovascular disease, hypertension, respiratory diseases, skeletal deformities, neurological diseases, and digestive ailments. Contaminated water

also contributes to birth defects, at-risk pregnancies, and spontaneous abortions (World Bank 2007a, 41-44). Sharing water sources and sanitation facilities compounds the problem.

Poverty

More than 400 million Chinese live in poverty, earning less than two dollars a day (Blair and Hills 2007, 15-16). Most live in rural areas, where they lack basic needs such as clean water. Each day, many rely on unimproved water sources and sanitation facilities, making them more susceptible to disease (World Bank 2007a, 40). To earn their incomes, rural residents work in high polluting activities such as: agriculture, mining, or small industries, worsening their health problems. A low standard of living and recurring diseases inhibit the ability of the poor to obtain an education, increase their incomes, and raise their families (United Nations Children's Fund 2005, 1-8).

Impoverished rural townships often lack the funds to improve rural water sources or sanitation facilities. They also struggle to regulate or monitor wastewater discharges generated by mines, small industries, and farms. In the event China agrees to cooperate on climate change initiatives, poor rural townships lack the ability to implement environmental policies.

Economic Migration

Seeking to increase their incomes and improve their standard of living, many rural residents migrate to urban areas in search of higher paying jobs. Income levels between rural and urban populations vary by more than 300 percent. During an economic downturn, migrant workers are likely to receive less income or lose their jobs, forcing

many to return to rural areas. Others are likely to remain in the cities where they participate in public demonstrations or criminal activities (Blair and Hills 2007, 15-18). One of the major differences between rural and urban areas is access to improved water sources and sanitation facilities. Better access to clean water is probably one factor that encourages rural residents to migrate and remain in China's burgeoning cities.

Social Tensions

Rising incomes are generating a prosperous middle class, which seeks a more accountable and responsive government. They seek higher standards of living, more political participation, improved social welfare programs, and greater access to basic needs like clean air and water (Blair and Hills 2007, 15-20). Many advance reform through organized groups or the internet. Widespread dissatisfaction over environmental problems has led many to form environmental groups.

Today, over 285,000 registered NGOs operate within China (Blair and Hills 2007, 17). Over 2,000 NGOs are organized for environmental purposes. Chinese officials realize that government agencies are not capable of protecting the environment on their own and that NGOs have a critical role in the CCP's vision of a "civil society." The government encourages NGOs to cooperate with media investigations of pollution incidents and allows for public participation in environmental planning efforts (Economy 2004, 129). Wary of any threat to party control, however, the government attempts to monitor NGO activities. Government regulations prevent NGOs from coordinating activities with other groups or developing expansive networks. Notably, the government discourages Chinese environmental groups from collaborating with foreign groups and

groups from other provinces. Party leaders seek to control NGOs. However, due to institutional weakness, their efforts are ineffective.

Prosperity is also causing China's demographics to change. As more people gain access to basic health care, people are living longer. Some observers anticipate that China's aging population will strain the government's ability to provide social welfare services. Many elderly parents will become more dependent on their working age children (Blair and Hills 2007, 18). At the same time, contaminated water increases the prevalence of disease among the elderly, making them more reliant on government health care and support from family members. Meanwhile, China's one-child policy and a cultural preference for male children are contributing to a gender gap. As many families use abortion to choose male over female children, 118 male births take place for every 100 female births. Today, China has 40 million more men than women (Blair and Hills 2007, 18). Contaminated water worsens the gender gap because women and girls, who frequently prepare family meals, tend gardens, or fetch water from nearby wells, are more exposed to unsafe water than men and boys. Pregnant women are also more susceptible to disease.

Environmental Damage

As China's population grows in wealth, it is consuming more water than ever, compelling China to deplete water resources faster than they naturally recharge. Inefficient agricultural methods, soil erosion, poor discharge controls, and a toxic combination of agricultural, industrial, and domestic waste are contaminating China's rivers and aquifers. According to Chinese government estimates, environmental problems cost China between 8 and 13 percent of GDP annually. Losses due to water

shortages cost $42 billion annually in lost agricultural and industrial output (Blair and Hills 2007, 16). The costs of environmental degradation counterbalance the benefits brought about by economic growth.

Negotiation Strategy

In June 2009, a US diplomatic team visited China to prepare for the next global climate change meeting, which will take place in Copenhagen in late 2009. During the visit, Chinese representatives advanced three positions. First, developed states, principally the United States and European Union, should share clean energy technologies and related intellectual property rights. Second, the United States and European Union should cut their greenhouse emissions to a level 40 percent less than what they emitted in 1990. Third, the United States and European Union should provide financial assistance to developing states to help them implement climate change initiatives. Chinese representatives called for their Western partners to contribute between one half and one percent of annual GDP (MacKenzie 2009).

Aware that US leaders consider climate change a top priority, Chinese negotiators will seek to obtain emission cuts, technology, and aid from the United States. They understand US domestic political pressures and opportunities as well as electoral cycles and time restraints. They also monitor US leadership statements. During the April 2009 Major Economies Forum on Energy Security and Climate Change, Secretary of State Clinton stated that the United States: "is fully engaged and ready to lead and determined to make up for lost time, both at home and abroad" (MacKenzie 2009).

Chinese negotiators are unlikely to agree to emission cuts. Instead, they will probably agree to decrease China's emission growth rate, a policy emphasized under

current environmental plans. US negotiators should agree to similar terms. Rather than seeking to gain an agreement through emission cuts, US negotiators should emphasize the November 2006 recommendations made by China's Task Force on Environmental Governance. The task force called on the government to make environmental stewardship a national priority, provide economic incentives for businesses to introduce environmentally friendly technologies, encourage public participation through NGOs, and to develop cooperative environmental agreements (China Council for International Cooperation on Environment and Development Task Force on Environmental Governance 2006, 7-8).

Until Chinese leaders make environmental stewardship a national priority, US negotiators should be wary of Chinese commitments. If Chinese leaders agree to climate change initiatives, they will have to rely on weak political institutions that are probably not capable of implementing environmental standards. Until China's annual GDP growth returns to eight and one half percent, the Central Committee is unlikely to emphasize environmental stewardship over economic growth. Similarly, Chinese provincial, city, and township leaders are unlikely to implement environmental initiatives that endanger their personal wealth or business connections. Any climate change agreement should include clear performance standards and an effective method to monitor progress.

By emphasizing the economic costs of climate change, US diplomats may be able to negotiate terms that create incentives for US and Chinese companies to cooperate on the development of environmentally-friendly technologies. Clean energy technologies would enable China to build more environmentally-friendly power generation facilities that would reduce greenhouse emission rates and decrease chemical contamination levels

in China's rivers. Wastewater treatment technologies would enable the PRC to build new infrastructure, provide jobs, and sustain economic growth (Wiener 2008, 1816-1817). Such initiatives would also decrease the prevalence of disease and malnutrition, thereby contributing to a stronger workforce and wider domestic market.

Cleaner air and water would also attract foreign investment. Today, foreign firms perceive risks in doing business in China. Water problems risk supply chains and production facilities. Contaminated water risks workers' health, increasing insurance and medical costs. Pollution incidents also cause operations to stop unexpectedly. Most importantly, water problems risks companies' international reputations and product marketability. Companies that sell unsafe Chinese-made products risk alienating buyers and investors (Economy and Lieberthal 2007, 93-96).

Technological cooperation could reverse this negative trend. Negotiators should note, however, that US firms would be more likely to take part in efforts that encourage cooperative technological development than initiatives involving technology transfer. American business leaders are concerned that transfers would require them to forfeit their intellectual property rights (Lieberthal and Sandalow 2009, 69).

Chinese leaders recognize the important role of environmental NGOs and the value of expert government staff members and business people who understand environmental issues. United States negotiators should encourage international education programs on environmental management and technology development. Such a program would benefit Chinese NGOs, government ministries, and business. It would also enable the members to build informal networks with experts outside China.

Chinese leaders understand the problems brought about by climate change. They also realize they cannot address the problem alone. In the short term, the United States may have an opportunity to collaborate with China on environmentally-friendly business incentives, technological developments, and educational exchanges. By the time the global economic crisis ends, the United States and China will be in a better to position to further strengthen their climate change partnership.

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