Woodrow Wilson International Center for Scholars

CHINA ENVIRONMENT SERIES

10

ISSUE 10, 2008/2009

金木水火土

Understanding the Limits of Chinese Air Pollution Reporting

Environmental Mass Incidents in Rural China

China's Mercury Problem: A Sleeping Giant?

Mangrove Conservation with Chinese Characteristics

Public Health and Air Pollution in Chinese Cities

Plus: Notes from the Field, Spotlight on NGOs

EDITOR
Jennifer L. Turner

MANAGING EDITOR
Linden J. Ellis

PRODUCTION EDITOR
Lianne Hepler

RESEARCH ASSISTANTS
Jing Chen
Kimberly Go
Tod Kaiser
Elisa Chih-Yin Lai
Rongkun Liu
Ma Tianjie
Zhimin Mao
Erika Scull
Mayu Suzuki
Pei-Yu "Catherine" Tai

COVER PHOTO
Villagers begin to clean up the algae-filled Chaohu lake in Hefei on June 5, 2008 in East China's Anhui Province, China. For the past few years, blue-green algae has become a chornic problem in the west part of Chaohu Lake, which is China's fifth largest body of fresh water and the drinking water source for about 320,000 people.

Photo Credit: Wang Zhiqiang/ChinaFotoPress/Getty Images

ABOVE PHOTO
Beginning in 2007 with support from the U.S. Agency for International Development, karst researchers at Southwest University Beibei and the China Environmental Health Project at Western Kentucky University (CEHP WKU) set up a demonstration field site at Qingmuguan (Chongqing, China) to promote collaborative karst research to help poor communities better access water and study pollution impacts on karst groundwater. The Qingmuguan site will serve as a new study area where students from both countries can benefit from learning new approaches to karst water investigation.

Photo Credit: Brian Hame

Woodrow Wilson International Center for Scholars

CHINA ENVIRONMENT SERIES

ISSUE 10, 2008/2009

THIS ISSUE OF THE CHINA ENVIRONMENT SERIES MADE POSSIBLE BY SUPPORT FROM:

USAID FROM THE AMERICAN PEOPLE

Rockefeller Brothers Fund
Philanthropy for an Interdependent World

CHINA ENVIRONMENT SERIES

THE CHINA ENVIRONMENT FORUM

For ten years the China Environment Forum (CEF) has implemented projects, workshops, and exchanges that bring together U.S., Chinese, and other Asian environmental policy experts to explore the most imperative environmental and sustainable development challenges in China and to examine the opportunities for business, governmental, and nongovernmental communities to collaboratively address these issues. The networks built and knowledge gathered by meetings, publications, and research activities have established CEF as one of the most reliable sources for China-environment information and given CEF the capacity to undertake long-term and specialized projects on topics such as environmental health, food safety, water management, nongovernmental organization (NGO) development, and municipal financing for environmental infrastructure. The Wilson Center's Environmental Change and Security Program and Asia Program periodically cosponsor meetings with the China Environment Forum. The China Environment Forum meetings, publications, and research exchanges over the past year have been supported by generous grants from the U.S. Agency for International Development, Rockefeller Brothers Fund, Waters Corporation, and the U.S. Environmental Protection Agency. Jennifer L. Turner has directed the China Environment Forum since 1999.

CONTENTS

SPOTLIGHT ON NGO ACTIVISM IN CHINA

FEATURE BOXES

FOREWORD

Jennifer L. Turner, Editor

The nexus of pollution and health in China—the main theme of this issue of the *China Environment Series*—was an oft-reported issue in 2008, with the main story being Beijing's poor air quality in the run up to the summer Olympic Games. While most articles and broadcasts focused on the impact of the pollution on the performance of Olympic athletes, many media stories did examine the broader environmental, economic, and human health challenges facing China and the new policies and projects the government has been taking to address them. Over nearly a decade the Beijing municipal government adopted stricter air pollution control policies and moved out hundreds of dirty industries, but pollution from trucks and cars in the city and from factories in the provinces surrounding the capital still meant smoggy skies. Some last minute measures—such as halting construction, ordering factories outside the city to shutdown temporarily, and prohibiting private cars on the roads—did succeed in clearing the air in time. Although since the Beijing's Olympics, air quality has again worsened. The effort to clean up Beijing for the Olympics is a microcosm of the challenges facing the rest of the country, while national environmental policy is strict at the local level implementation is weak, which means health problems linked to pollution are worsening in China. In this issue of the *China Environment Series*, we have compiled a collection of articles that aim to get behind headlines to examine some of the broader health impacts of pollution and natural resource degradation and to delve into some emerging policies and projects that hold some promise for addressing environmental health problems in China.

The lead feature article by **Steven Q. Andrews** delves into China's air pollution and health challenges in an examination of the regulatory, technical, and political obstacles that currently hinder the transparency and effectiveness of the country's vast urban air quality monitoring systems. Steven Andrews argues that while Chinese citizens can access a wealth of information on air quality, this information is not accurately informing them of actual health threats. Our second feature article by **Ma Tianjie** shines a light on a different aspect of the pollution-health nexus, namely, the growing number of environmental mass incidents that erupt after governments ignore—often for years—citizen complaints about excessive pollution that threatens their livelihoods and health. Ma Tianjie examines the growth in such protests and analyzes a large-scale environmental protest sparked by industrial pollution in a small village in Zhejiang Province that involved thirty to forty thousand villagers and thousands of armed police.

The topic of environmental health sparked a broad range of articles in our Commentary/Notes from the Field section with many authors discussing problems and solutions to pollution-health issues. For example, the magnitude of mercury pollution in China has long been an underreported topic and we greatly benefited from the insights **Celia Y. Chen** provides in her commentary based on extensive field research into the sources of mercury pollution in China. **Saleem Ali** also looks at another sensitive and relatively under-explored pollution problem, namely the poorly regulated mining sector in China. **Monica Liau's** examination of the challenges in promoting ecotourism in Yunnan Province includes an important observation that tourism that protects the environment also can have a positive health impact on communities. Two authors look at whether China's business sector could offer some solutions to the country's pollution problems—with **Sean Gilbert** reflecting on how the concept of corporate social responsibility is evolving in China and **Jacob Park** relating the challenges and opportunities for greening China's mobile phone and telecommunication industries.

We were lucky to receive a commentary by researchers **Sumi Mehta, Aaron J. Cohen, Davida**

Schiff, Daniel Greenbaum, Nick Moustakas, and Robert O'Keefe who introduce the Public Health and Air Pollution in Asia (PAPA) Program that was initiated by the Boston-based Health Effects Institute to inform regional decisions about improving Asian air quality to promote health. Their commentary focuses on environmental health research trends in China and on some promising PAPA-supported pollution-health studies that are building the capacity of Chinese researchers. We have included two commentaries that examine indoor air pollution, which is the fourth largest cause of death in China, mainly due to poor quality cook stoves in rural areas. **Emmy Komada** writes about the biogas work that the Chinese nongovernmental organization (NGO) Global Environmental Institute is carrying out to bring clean energy sources to poor rural communities in western China. **Jill Baumgartner** and **Nina Trautmann Chaopricha** make a strong case for how clean cook stoves in rural China could bring major health improvements and significant reductions in the greenhouse gas black carbon.

Guizhen He, Yonglong Lu, and Lei Zhang examine lessons learned from China's 2008 snow crisis in their analysis of how the country could create better risk assessment and emergency disaster systems that could better protect ecological and human health after natural disasters and pollution accidents. The China Environment Forum has long been interested in bottom-up policymaking trends in China, which can come in the form of protests, court cases, petitions, and laws empowering the public. The issue of public participation in environmental policymaking is addressed in **Xiang Fang's** analysis of how citizens in eastern Guangdong used lobbying of People's Deputies to successfully oppose provincial plans to build a nuclear power plant in their area. In her commentary on China's evolving laws on water and property rights **Sonya Schiller** argues that if Chinese people have clearer water use rights this could ultimately promote conservation and better protection of water and health of citizens. **Liu Yi**—the lead campaigner for the China Mangrove Conservation Network—shares stories on how an impressive network of NGOs and communities emerged to jointly research and protect China's highly threatened mangroves. **Daniel Pulver** relates another story of an NGO network coming together to become environmental health advocates around water pollution in Beijing. Two other commentaries examine the role of provinces becoming environmental leaders—**See-Won Byun** on Jilin Province's involvement in the Greater Tumen Initiative and **Lei Bi** and **Qian Wang** on Hainan Province's efforts to promote energy efficiency.

The number and diversity of our Spotlights on NGO Activism in China boxes grew again this year and I hope readers will enjoy as much as we did learning about groups working in remote areas—such as the **Xinjiang Conservation Fund's** eco-toilet project in Xinjiang and the **Hengduan Mountain Society's** research and policy advocacy linked to protecting rivers in western China. While *CES* has long featured articles and commentaries on dynamic environmental groups on university campuses, we were excited to learn details about the activities of the **China Youth Climate Action Network**, a relatively new NGO raising awareness and promoting action on university campuses to stem China's CO_2 emissions. Four of our spotlight and feature boxes highlight international and Chinese groups working to green businesses in China, which is an important emerging trend that CEF will be exploring more deeply in meetings and online research briefs in 2009.

The main support for this issue of *CES* is from the **Rockefeller Brothers Fund**, which has become the leading funder of environmental health-related work in China. We are pleased to feature a number of boxes in this issue of *CES* that highlight the environmental health work supported by RBF, such as the **Social Science Research Council's** China Environment and Health Initiative, **Business for Social Responsibility's** Water and Environmental Health: Building Constituencies in Southern China project water, and the **Yunnan Health and Development Research Association's** environmental health community projects, research, and websites.

Our partnership with Western Kentucky University (WKU) on the **U.S. Agency for International Development**-supported China Environmental Health Project (CEHP) continued this year, which enabled the China Environment Forum to publish more online CEHP research briefs, carry out our meeting work, and cover some of the staff and publication costs for this issue of the *China Environment Series*. We are very grateful for USAID's continued support of our work. Under this project CEF has continued its outreach and information dissemination work linked to WKU's karst water and coal monitoring environmental health work in China. A summary and webcast of their May presentation at the Wilson Center in 2008 is available on the CEF

A Threatened River. The Urumqi River flowing through the Houxia Valley (pictured above) where state-owned enterprises produce cement, rubber and other polluting resources. The Urumqi River is the drinking water source for Urumqi, the capital of Xinjiang. With support from Pacific Environment, the grassroots group Xinjiang Conservation Fund (XCF) has been working on water pollution issues in the Urumqi River basin. More information on XCF's water work in Xinjiang is discussed in a Spotlight Box on page 168. Photo Credit: Daniela Salaverry

website. Please see an overview of WKU's coal monitoring work in **Wei-Ping Pan's** Coal City box this issue of *CES*. In 2009 we will be working with WKU's **Chris Groves** to create a Circle of Blue (COB) multi-media story on karst water issues in southwest China, which will be launched online late summer. See www.circleofblue.org/reign for our previous COB story on desertification in Inner Mongolia.

In addition to thanking all of our authors and funders, I would like to thank the anonymous reviewers who provided extremely valuable input to our feature articles—this is the sixth year we have been using the blind review process and it has helped to strengthen our feature articles considerably.

The army of CEF research interns continues to grow and this year's group gave us invaluable editing, writing, and translation assistance that helped us get this publication out the door. Special acknowledgement of Jing Chen, Zhimin Mao, and Ma Tianjie who helped translate and edit some boxes and commentaries that came to us in Chinese, which in effect gave "voice" in English to some amazing Chinese environmentalists. Other talented and patient interns who edited and did extra research for this publication included: Kimberly Go, Tod Kaiser, Elisa Chih-Yin Lai, Rongkun Liu, Erika Scull, Mayu Suzuki, and Pei-Yu "Catherine" Tai. Everyone worked hard on this publication, but I must single out Tod Kaiser who we discovered possessed a talent for doing wonderfully thorough edits. Thus, we gave Tod the tough job of "closer," which means he was tasked with the final nitpicky clean-up edits before submitting the publication for layout. When CEF interns are not helping with the publication they are researching and writing CEHP research briefs, which has become the biggest draw to our website—these talented individuals deserve a long round of applause for all that they do to make CEF a great project.

As usual I am grateful for Lianne Hepler's swift and careful design for the layout of this publication. She does such quality work that it inspires me to do my work even better. Last but never ever least is Linden Ellis who is the managing editor for the *China Environment Series*. Linden deserves a huge thank you (and probably some time off!) for all her work on this publication. Linden possesses a sharp editing eye, an organized mind, and a great sense of humor, all invaluable skills in pulling together this publication.

FEATURE ARTICLE

Seeing Through the Smog: Understanding the Limits of Chinese Air Pollution Reporting

By Steven Q. Andrews

Although the debate over exact statistics rages, as many as 400,000 premature deaths could be avoided each year if Chinese cities met domestic air quality standards. Over the past decade, the Chinese government has been promoting environmental information disclosure as a new policy tool, both to raise public awareness of pollution problems and to strengthen enforcement of pollution control laws. Two of the most extensive environmental information disclosure initiatives have been public air quality reports and ranking Chinese cities by air quality. Utilizing a comprehensive dataset of weekly (1998–2000) and daily (2000–2007) Air Pollution Index (API) reports, this paper not only examines air quality trends, but also evaluates the limits of the API system to accurately communicate air quality problems. The API system has been weakened both by irregularities in the monitoring and the central government's move in June 2000 to relax national air quality standards. This paper discusses the significant discrepancies that exist between analyzed pollution trends and reported progress in the Ministry of Environmental Protection's State of the Environment reports and Annual City Air Quality Rankings. Misinterpretation and/or manipulation of public air quality reporting in China have hindered the public awareness that it is ostensibly intended to promote. The Olympics held in Beijing in 2008 increased international and domestic awareness and concern for the quality of China's air and also exposed many of the inconsistencies between the API system and actual impacts on human health.

AIR POLLUTION QUANDARIES IN CHINESE CITIES

Although many cities in China have monitored air pollution for decades, this information was not publicly released until the late 1990s. In describing the publishing of weekly air quality reports that began February 28,1998, in Beijing, *The New York Times* reported: "For 20 years, local officials carefully measured this city's air pollution levels and equally carefully hid the results—fearing that the truth might tarnish the capital's image or lead to social unrest" (Rosenthal, 1998). *Nature* magazine (1998) accompanied a description of Beijing's weekly air quality reports with a cartoon depicting two people in a cloud of smog commenting: "At least in Beijing we now have weekly pollution reports." "Yes. If only we could see them." An official in Shanghai hesitant about the release of this information observed, "If we simply release the information to the public, the disadvantages would outweigh the advantages….They may say, the government did a bad job. Why did you give us such bad air?" (U.S. Embassy, 1998).

Despite initial insecurity on the part of officials, since 1998, every day millions of people throughout China read, watch, or hear air pollution reports published in newspapers, broadcast on television, and announced on the radio. An environmental official in Beijing heralded the transparency noting that, "Releasing the numbers is a revolutionary concept for the people and the government. We were worried that people would complain that air pollution is too serious. Instead, the consciousness of people has been raised. And they feel the Government trusts them with the facts" (Rosenthal, 1998).

API TO BLUE SKY: WHAT THE PEOPLE HEAR

China's pollution information includes reports on the atmospheric concentrations of three pollutants: particulate (TSP from 1998-2000, and PM_{10}

from 2000-2007); nitrogen oxide (NOx from 1998-2000 and NO_2 from 2000-2007); and sulfur dioxide (SO_2), which are averaged over 24-hour periods and multiple monitoring stations to produce a single API value for major cities ranging from 1 (clean) to 500 (hazardous). The APIs are calculated based on the average concentration of each pollutant, but only the highest API is reported by China's Ministry of Environmental Protection (MEP). Higher values indicate greater potential impact on human health. An API value of 100 or less indicates attainment of China's National Ambient Air Quality Standards (NAAQS) for residential and commercial areas and satisfactory air quality. However, both China's 1996 and revised 2000 NAAQS are far below World Health Organization (WHO) guidelines and public reporting does not take ozone and fine particulate into account.[1]

In the capital of Beijing, as well as in many other Chinese cities, days that meet the national standard are called "blue sky" days (BOCOG, 2006; *Shanghai Daily 2006;* Chongqing EPB, 2007; *People's Daily*, 2001; *Invest Guangzhou*, 2007). The annual numbers of these attainment days have become the most watched public metric of China's air quality progress (Beijing EPB, 2006; Shanghai EPB, 2006; Wuhan EPB, 2006). Although air quality in Chinese cities was previously ranked based on a compilation of annual average pollution concentrations, the 2006 rankings evaluated cities based on the percentage of days meeting the national air quality standards (SEPA, 2007). These changes in the rankings criteria have placed additional pressure on local officials to meet blue sky targets, as the results are published as part of a "name and shame" approach (OECD, 2007).

In 1994, 20 percent of Chinese cities with a population of over 2 million exceeded the Chinese national standard for nitrogen oxides, and this number would increase to 82 percent in 1998. (He & Chang, 2000). In 2005 and 2006, not a single one of the 559 cities monitored exceeded the national nitrogen oxides standard (SEPA, 2006 & 2007), a reflection of a weakened revised standard rather than reduced pollution.

Publicizing the API and where cities rank in terms of air quality keeps the public informed of air quality and potential health threats. However, misleading data presentation and revised laws have prevented the API system from accurately communicating air quality problems to the public. To better understand the challenges and opportunities that exist for China to strengthen air quality standards and reporting, this article analyzes the trends in 3,249 weekly and 171,101 daily API reports published online by MEP (www.mep.gov.cn) between 1998 and 2007. Beginning in 1998, only a handful of cities reported weekly monitoring data, but by mid-2000 46 cities were publishing API reports. In 2000, MEP began recording daily reports in 42 cities, and expanded the program to 86 cities by 2007. This article concludes with some comparison of the U.S. experience in developing air measurement tools and rankings.

EBB AND FLOW OF PUBLIC POLLUTION INFORMATION

Access and open discussion of pollution information in China has increased over the past decade, but there are times when some agency or individual deems certain information too sensitive. China's groundbreaking Green GDP project met an early demise after provincial officials stood up against efforts to publicize the local health and economic effects of pollution. Journalists, who since the late 1990s had been given fairly free reign to report on pollution issues were constrained significantly in the aftermath of the 2005 benzene spill on the Songhua River, and were instructed to put a positive spin on Beijing's pollution crisis in the months leading up to the 2008 summer Olympics. 2008 saw the passage of freedom of information legislation, under which MEP passed measures to promote access to environmental information, which will potentially give journalists more freedom to report on pollution problems once again (Gang, 2008).

INCONSISTENT RELEASE OF HEALTH EFFECTS

In 1997, the World Bank's seminal study of China's environmental quality—*Clear Water, Blue Skies*—estimated that 178,000 premature deaths could be avoided per year if China met its own national air quality standards (World Bank, 1997). Officials in MEP continued to cite this shocking estimate for years (Johnson, 2005). The long-awaited update, *Cost of Pollution in China: Economic Estimates of Physical Damages,* done by the World Bank in collaboration with MEP is still in its conference edition, but in 2007 the updated estimates of mortality and morbidity in China due to air pollution were removed (World Bank, 2007). According to the United Kingdom's *Financial Times*, the Chinese government deemed the

Figure 1. Primary Pollutants of Concern 1998–2000

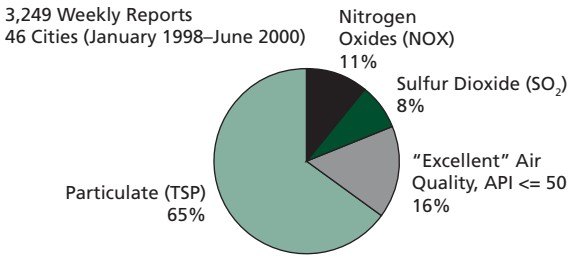
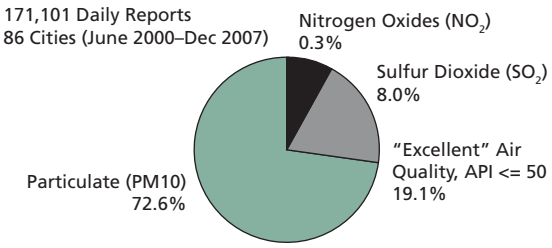


Figure 2. Primary Pollutants of Concern 2000–2007



Source: Author's calculations from MEP online monitoring reports

estimate of 350,000 to 400,000 premature deaths per year due to urban air pollution as too sensitive, which could lead to social unrest (BBC, 2007).

Recent research published in the scientific literature by professors at the Department of Environmental Science at Peking University calculated mortality from ambient air pollution in China at 281,361 for 2004 (Zhang et al., 2007a). The same research group estimated that air pollution in 2004 resulted in 23,733 premature deaths for the city of Beijing alone (Zhang et al., 2007b).

CHINA'S AIR QUALITY STANDARDS

Main Pollutants of Concern

Although China's API is based on measurements of particulate (PM_{10}/TSP), nitrogen oxides (NO_2, NOx), and sulfur dioxide (SO_2), only a single index value and the pollutants with the greatest potential health impact are indicated in public reporting. The pollution monitoring reports between 1998 and 2007 became more widespread and comprehensive after 2000, shifting from weekly to daily and nearly doubling the number of cities. As Figures 1 and 2 illustrate, particulate remains the biggest health threat, and the government's years of targeting sulfur dioxide emissions has succeeded in holding atmospheric concentrations relatively steady. The percentage of excellent air quality reports (API of 50 or less) grew slightly in the latter seven years, but the increase in sample size makes clear conclusions about progress difficult.

With the exception of ozone, China reports the main pollutants for which WHO provides guidelines.[2] The environmental health threats of these main pollutants are discussed below:

- *Particulate (PM_{10}/TSP)*—Particulate matter includes both solids and liquids that can be either emitted directly or formed in the atmosphere when other pollutants react. Particles less than 100 micrometers are called total suspended particulate (TSP); less than 10 micrometers are called coarse particulate (PM_{10}), and less than 2.5 micrometers are called fine particulate ($PM_{2.5}$). Particulate less than 10 micrometers can enter into the lungs and cause serious health damage. However, particulate less than 2.5 micrometers have been found to be a better indicator of the impacts of particulate pollution on human health. As a result, many countries and WHO have switched from standards based on TSP to PM_{10} and then to $PM_{2.5}$, although WHO also maintains a PM_{10} standard. China switched to measuring from TSP to PM_{10} in 2000, and there is currently limited monitoring of $PM_{2.5}$. Particulate matter, especially $PM_{2.5}$, has been linked to illnesses and premature death from heart and lung disease with both short-term exposures over single days and long-term exposure over years (WHO, 2005).

- *Nitrogen Oxides (NO_2/NOx):* Nitrogen dioxide is a toxic gas and has often been used as an indicator of combustion-related pollutants including road traffic. In 2000, China switched from measuring nitrogen oxides to measuring nitrogen dioxide consistent with changes in the United

States and many countries around the world. Nitrogen dioxide is a key precursor (in addition to volatile organic compounds (VOCs)) of surface ozone and of nitrate aerosols, which form a significant fraction of the $PM_{2.5}$ mass (U.S. EPA, 2003; WHO, 2005).

- *Sulfur Dioxide (SO_2)*: A colorless and reactive gas, SO_2 is produced from the combustion of fuels that contain sulfur including coal and oil. The highest levels of SO_2 are usually located near industrial areas, with major emissions coming from power plants and industrial boilers (U.S. EPA, 2003). The Chinese government has undertaken major campaigns (e.g., mandating desulfurization equipment on new plants) to slow SO_2 emissions, but the continued rapid growth of coal-fired power plants appears to have kept atmospheric concentrations in major cities relatively steady.

- *Ozone*: Composed of three atoms of Oxygen (O_3), ozone in the upper atmosphere helps protect humans from ultraviolet rays; ground level ozone causes significant health effects. Some researchers have calculated that the health effects of ozone are of comparable magnitude as particulate (ECON Centre, 2002). Ozone is formed when nitrogen oxides emitted by cars, power plants, industrial boilers, refineries, chemical plants and other sources react with VOCs emitted by these and other sources when exposed to sunlight. The health effects of ozone include inflammation and damage to the lining of the lungs, increased susceptibility to respiratory infections, irritation to the respiratory system, and difficulty breathing. Although China has an hourly ozone standard, ozone is not generally included in API reporting. Certain cities, including Beijing from 1998-2000 reported an ozone API, but reporting has not been consistent, and Beijing has now officially stopped measuring ozone, although it has announced plans to measure it again in the future (UNEP, 2007).

HEALTH IMPACTS OF AIR POLLUTION IN CHINA

The studies by Zhang and the World Bank calculate air quality based on annual average concentrations of total suspended particulate (TSP) and coarse particulate (PM_{10}). The statistic that only 1 percent of China's 560 million city dwellers breathe air considered safe by the European Union has been often repeated (World Bank, 2007; Kahn & Yardley, 2007). However, an assessment of annual average coarse particulate (PM_{10}) concentrations and WHO global guidelines presents an even bleaker picture. Not a single one of the 108 cities included in MEP's 2006 city rankings achieved the WHO guidelines for annual average coarse particulate concentrations (SEPA, 2006; WHO, 2005).

The World Bank and Zhang studies used annual average particulate concentrations as an indicator of the overall impacts of air pollution. The premature death numbers (281,361 nationwide and 23,733 for Beijing) due to air pollution in 2004 were based on the use of a single indicator pollutant to calculate the health effects of pollution to avoid overestimation of the impacts (Zhang et al., 2007a; Kunzli et al., 2000), and therefore did not take into account the complex combinations of pollutants.

The health impacts for 2004 in China and 2002 in Beijing have been previously calculated and are summarized in Box 1 (Zhang et al., 2007a, b). These two studies by the same research group actually used different threshold concentrations to calculate the health impacts of air pollution. If the zero-effect threshold used in the study for Beijing was applied to the China-wide study (based on WHO findings that health risks are present at any level of exposure) then the estimated health impacts would be much higher (WHO, 2005).

For example, the Beijing study also estimated the mortality for Beijing in 2004, which they found to be 23,733 (Zhang et al., 2007b). However, the China-wide study using the same population and annual average PM_{10} concentration estimated the mortality at 17,886 (Zhang et al., 2007a), because they assumed that health effects of PM_{10} pollution did not begin until annual average PM_{10} concentrations exceeded 40 micrograms per cubic meter ($40\mu g/m^3$). The China-wide study calculates that the economic cost of air pollution using $40\mu g/m^3$ is $29.178 billion in 2004 (in 2004 USD), while using the zero-effect threshold it is $40.740 billion USD for 2004—40 percent higher than the impacts calculated using the higher threshold (Zhang et al., 2007b). This means that if the same zero-threshold analysis had been applied for all of China that there would have been an estimated 400,000 premature deaths[3] due to air pollution in 2004, which is on the high-end of the estimate included in the censored 2007 World Bank report (BBC, 2007). In light of these studies, it merits investigation whether China's API system adequately informs the public of these serious health risks.

BOX 1.

ESTIMATED NUMBER OF CASES ATTRIBUTABLE TO PARTICULATE AIR POLLUTION IN 111 CHINESE CITIES.

Source: Zhang et al., 2007b. (Parentheses indicate 95 percent confidence interval)

- **Mortality** 281,361 (190,279 – 359,575)
- **Chronic Bronchitis** (681,081 (240,454 – 980,158)
- **Respiratory Hospital Admission** 69,037 (47,564-89,191)
- **Cardiovascular Hospital Admission** 99,931 (44,344-151,900)
- **Outpatient Visits—**internal medicine 3,037,669 (2,413,209-3,661,982)
- **Outpatient Visits—**pediatrics 673,008 (461,887-874,720)
- **Acute Bronchitis** 2,100,733 (912,762-2,893,975)
- **Asthma Attacks** 2,655,022 (1,573,426-3,516,391)

ESTIMATED NUMBER OF CASES ATTRIBUTABLE TO PARTICULATE AIR POLLUTION IN URBAN DISTRICTS OF BEIJING IN 2002.

Source: Zhang et al., 2007a. (Parentheses indicate 95 percent confidence interval)

- **Mortality for individuals 30 years and older** 25,146 (18,325-30,479)
- **Chronic Bronchitis** 62,342 (32,547-80,725)
- **Respiratory Hospital Admission** 9,070 (6,444-11,499)
- **Cardiovascular Hospital Admission** 10,064 (4,684-15,026)
- **Outpatient Visit to Internal Medicine** 361,579 (208,848-509,993)
- **Outpatient to Pediatrics** 120,100 (46,033-190,546)
- **Acute Bronchitis** 162,929 (85,632-211,566)
- **Asthma Attacks** 221,522 (153,278-272,345)

Note: The 2002 health effects study was based on Beijing's urban population of 9.5 million and annual average PM_{10} concentration of 165μg/m^3.

GAPS IN CHINA'S AIR QUALITY STANDARDS AND MISLEADING STATISTICS

The daily air quality reports that are open to the public are misleading for a number of reasons, most striking is the fact air emissions in compliance with the China's air emission standards may not indicate safe levels of air pollution. Moreover, China's API reporting system does not clearly communicate health impacts. While considerable data is collected and posted online, and monitoring stations are sometimes moved to less polluted areas, skewing long-term data.

National ambient air quality standards were first promulgated in 1996, and then revised in 2000. Notably, the 1996 Chinese national ambient air quality standards are considerably less stringent than the 2005 WHO standards.[4] The 2000 revisions to the 1996 Chinese standards for nitrogen oxides and ozone further reduced the stringency of these standards. (See Table 1).

Particulate Concentrations

In 2005, air quality reports revealed that the annual average PM_{10} concentration in many Chinese cities was far above WHO, U.S., and even Chinese

Table 1: Chinese Air Quality Standards and WHO Guidelines

		CHINA 1996	CHINA (2000)	WHO (2005)
Particulate (TSP)	Daily	300	--------	--------
	Annual	200	--------	--------
Fine Particulate (PM10)	Daily	150	150	50
	Annual	100	100	20
Nitrogen Oxices (NOx)	Daily	100	--------	--------
	Annual	50	--------	--------
Nitrogen Dioxide (NO_2)	Daily	80	120	--------
	Annual	40	80	40
Sulfur Dioxide (SO_2)	Daily	150	150	20
	Annual	60	60	--------
Ozone		160 (1 hour mean)	200 (1 hour mean)	100 (8 hour mean)

Pollutant concentrations are indicated in micrograms per cubic meter of air (μg/m³).
Note: Shaded areas indicate where revised 2000 Chinese standards are higher than the 1996 Chinese standards.

standards: Harbin (104μg/m³), Nanjing (110 μg/m³); Wuhan (111μg/m³); Chengdu (120μg/m³); Shijiazhuang (133μg/m³); Datong (154 μg/m³); and Lanzhou (157 μg/m³). Guilin, which had the best air quality of ranked cities, with an annual average PM_{10} concentration of 29 micrograms per cubic meter (29μg/m³) in 2005, was still 45 percent above the WHO guideline of 20μg/m³. Kunming publicly reported that its air quality met the Chinese national standard on 353 out of 356 days, but its annual average PM_{10} concentration of 83μg/m³ was over four times the WHO guideline. Only 5 percent of Chinese cities included in MEP's ranking were below the U.S. standard of 50μg/m³ for PM_{10}, although 53 percent of the cities met the Chinese standard of 100μg/m³—a level five times higher than WHO guidelines.

Although Beijing was not included in MEP's 2006 rankings, the annual average PM_{10} concentration in Beijing for 2006 was 161μg/m³—no better than 2002, a year for which over 25,000 premature deaths were calculated in the capital based on annual average PM_{10} concentrations (BJEPB, 2006; Zhang et al., 2007b).

Sulfur Dioxide and Nitrogen Dioxide Concentrations

A large number of cities in China continue to be above the Chinese standard for sulfur dioxide and the WHO standard for nitrogen dioxide. WHO has not set a guideline for annual average levels of sulfur dioxide, but there is a daily average guideline of 20μg/m³ (WHO, 2005).[5] In the 2006 rankings, 92 percent of China's cities had an annual average SO_2 concentration more than the WHO daily average guideline and would, therefore, likely exceed an annual average guideline were it to exist. The Chinese annual average standard for SO_2 is 60μg/m³, a level which 30 percent of cities exceeded in 2005. Although no cities in China were above the current Chinese annual average standards for nitrogen dioxide of 80μg/m³ in 2005, 22 percent were above WHO guidelines (and 1996-2000 Chinese standard) of 40μg/m³.

These deteriorating trends in air quality are often blamed on local government protectionism, which permits rampant violation of pollution control laws (Xinhua, 2007b). Only about 500 of the 70,000 environmental violations reported from 2003-2005 had been dealt with by the spring of 2006, because local governments "actively encourage enterprises to violate environmental regulations and then protect them from punishment when they do" (Economy & Lieberthal, 2007).

API: WORST ENCOUNTER VS. AVERAGE ENCOUNTER

The API system used in China is based on the Air Quality Index (AQI) system used in the United

Table 2: API (China) and AQI (US) Health Effects and Colors

API CHINA	AIR QUALITY DESCRIPTION	REPORTED COLOR (BEIJING)	REPORTED COLOR (GUANGZHOU)
0-50	Excellent	Blue	Light Blue
51-100	Good	Green	Light Green
101-150	Slightly Polluted	Yellow	Yellow
151-200	Lightly polluted	Orange	Yellow
201-250	Moderately pol-luted	Red	Peach
251-300	Moderately-heavily polluted	Light Purple	Peach
>300	Heavily polluted	Brown	Pink

AQI U.S.	AIR QUALITY DESCRIPTION	REPORTED COLOR
0-50	Good	Green
51-100	Moderate	Yellow
101-150	Unhealthy for sensitive groups	Orange
151-200	Unhealthy	Red
201-250	Very Unhealthy	Purple
251-300	Very Unhealthy	Purple
>300	Hazardous	Maroon

For the air quality to meet the WHO guidelines, the Air Pollution Index value for PM_{10} would need to be $\leq$ 50, for SO_2 it would be an API $\leq$ 20, and for NO_2 there is no daily guideline.

States (U.S. EPA, 2006). However, there is an important distinction that should be made: the U.S. AQI is based on the highest reading in a city, not an average as it is in China.[6] The result is that the AQI represent the "worst" case a person is likely to encounter; while the API in China represents the "average." Similar index systems exist in many other countries around the world; however, the United States and many other countries measure ozone and fine particulate matter ($PM_{2.5}$). For the air quality in China to meet WHO guidelines the API value for PM_{10} would need to be 50, and for SO_2 the API value would need to be 20. A value reported as a "Blue Sky" day with an API of 100 for PM_{10} would indicates a level of fine particulate three times WHO guidelines. Although the U.S. and Chinese systems have some similarities, they differ in describing how the level of pollution impacts health. Specifically, the Chinese API system uses more benign descriptions that often understate the levels of health threat. For example, an API of 151-200 is called "lightly polluted" in China, compared to "unhealthy" in the United States. (See Table 2 and Box 2).

Code Yellow or Good?

Another difference is that in the United States color designations and descriptions for different air quality levels are standardized, but in China local EPBs are able to determine the colors (if any) that are used to report air quality, and have frequently changing descriptions. For example, during the period of the 2008 Olympic Games the Beijing EPB went through three revisions on its website of how API values were described. Initially, API values from 51-100 were described as "good," then "moderate," then "medium," and finally to "Grade II." Post-Olympics, API values between 51 and 100 are again being described as "good" in Beijing—a code green day. In the United States, AQI values between 51-100 are described as "moderate"—code yellow.

Misleading Comparisons

Even though the API (China) is based on the AQI (U.S.), comparisons between the two systems are problematic. Because of the significant differences in the systems these comparisons can under represent the health threats from air pollution in China. In 2006, Los Angeles—often considered the most polluted city in the United States—did not report a single day where a single monitoring station exceeded the Chinese 24-hour PM_{10} standard of 150μg/m^3 (SCAQMD, 2007)[7]. In China, a PM_{10} concentration of this level is equal to an API of 100—still designated by the color blue in Beijing. In 2007, Beijing had 265 days where at least one of the monitoring stations in the city exceeded this level (Beijing EPB, 2007).

In Beijing, the number of days exceeding the Chinese hourly ozone standard was 101 in 1998

BOX 2. **Confusing Colors**

The metropolitan area in the United States with the highest annual average PM_{10} concentration during the 1990-1994 period was Visalia-Tulare-Porterville, California. The annual average PM_{10} concentration over these five years, based on a single monitoring station near a major road, was 60.4 μg/m³. The highest daily average recording during these five years, at this, the most polluted monitoring station in the United States was 207 μg/m³—a day that would have an API of 178 in China and be classified as "lightly polluted."

The Natural Resources Defense Council's report *Breath-taking: Premature Mortality Due to Particulate Air Pollution in 239 American Cities* estimated that approximately 64,000 premature deaths from cardiopulmonary causes could be attributed to air pollution each year in the United States based on an analysis of 1990-1994 data. The report ranked Los Angeles sixth worst out of 239 cities, its annual average PM_{10} concentration during the 1990-1994 period was 43.8 μg/m³. New York City was ranked 76th out of 239 metropolitan areas, and its annual average PM_{10} concentration during this period was 28.8 μg/m³. Although one monitoring station in New York reported one day where the PM_{10} concentration hit 130 μg/m³ (equivalent to an API of 90 and a "good" classification in China), the highest reported value at the other 14 stations in New York over these five years was a 95 μg/m³ (equivalent to an API in China of 72 and a "good" classification). Los Angeles' annual average PM_{10} concentration, which placed it in the bottom (most polluted) 5 percent of U.S. cities during the 1990-1994 period, would have been in the top (least polluted) 5 percent of Chinese cities during 2004. The worst air quality recorded at any of the 14 monitoring stations in New York between 1990 and 1994 was exceeded on over 70 percent of days in Beijing from 2003 to 2007. Simply put, the Chinese estimate of 281,361 premature deaths due to air pollution in 2004 (Zhang, et al., 2007a) used far more conservative calculations of the health impacts of air pollution than the 1996 NRDC report.

and 119 in 1999, and although that number decreased since the change in the hourly standard was revised from 160 to 200μg/m³, there have still been 57-90 days per year above the standard from 2001-2005, with the highest hourly concentration on record being reported in 2005 (Duan et al., 2007). Again, ozone is not considered for the API reporting system, although a methodology does exist (U.S. National Academies & CAS, 2008). The Shanghai Environmental Monitoring Center has started trial reporting of daily ozone concentrations for four monitoring stations within urban areas of the city on their website (www.semc.com.cn). On May 14, 2008, the highest reported hourly concentration was 182μg/m³, a level above the 1996 Chinese standard, but in accordance with the revised standard. Archived data is not currently available.

Miscalculations

The monitoring and reporting of air quality in China is performed in accordance with standards established by the MEP. The 2005 Automated Methods for Ambient Air Quality Monitoring (HJ/T 193-2005) governs the placement and methodology of stations (SEPA, 2005). The *Technical Rules Concerning Ambient Air Quality' Daily Report* specifies the procedures for reporting air quality (SEPA, 2000).

The daily API report is based on measurements made at selected monitoring stations within a city. Pollutant concentrations at these stations are measured from 12 noon the previous day to 12 noon on the day of the report, and the averaged 24-hour concentration for each pollutant for each monitoring station is then divided by the selected monitoring stations to determine each pollutant concentration for the day. These pollutant concentrations are not publicly released, but instead are converted into index values, of which the dominant pollutant is then widely reported.

The table of pollutant concentrations and equivalent API breakpoints is the same in the Chinese

In June 2008, Beijing authorities ordered a two-month ban on construction in the city to help guarantee cleaner air for the summer Olympic Games in August 2008. Photo Credit: Andrew Chang

and English versions of the technical regulations.[8] However, the sample calculation from pollutant concentrations to API values in the English version of the technical regulations contains a significant error that results in the under calculation of actual pollution levels. The discrepancies between the 1998-2000 and 2000-2007 breakpoints and reporting systems will be discussed following a description of the 2000 revisions to the national air quality standards.

Mobile Monitoring Stations

In addition to having high standards, monitoring stations in China have sometimes been shifted with drastic impacts on reported air pollution trends.[9] The monitoring station locations in Beijing had been constant during the 1998-2005 period, but in 2006 the two monitoring stations in high traffic areas were removed, and replaced with three non-traffic monitoring stations (CNEMC, 2006). Although there has been a reported 10.8 percent decrease in Beijing's annual average NO_2 level between 1998 and 2006, the two stations in traffic areas have reported annual average NOx concentrations 100 percent higher than the non-traffic stations (BJEPB, 1998). This indicates that all the reported decrease in NO_2 concentrations in Beijing from 1998-2006 may be due to the changing locations of monitoring stations. Furthermore, in 2008 Beijing began using three additional monitoring stations outside of the urban districts and beyond the sixth ring road to measure the city air quality, likely ensuring further "improvements" in air quality for all pollutants (Andrews, 2008c).

In Guangzhou, there has been a reported 3 percent decrease in NO_2 concentrations between 1999 and 2006; however, the lowest reported annual average concentration during this period occurred in 2000 (61 μg/m^3) and the overall decrease during this period may be suspect as well. *The New York Times* has suggested that Guangzhou and other cities may have also strategically placed monitoring stations in areas with below average pollution levels (Bradshear, 2008).

REVISIONS TO THE 1996 NATIONAL AIR QUALITY STANDARDS

China revised the 1996 National Air Quality Standards in 2000, but there appears to be some confusion on official websites and even among experts on the new standards. For example, two recent major publications relating to air pollution in China, *Costs of Pollution in China: Economic Estimates of Physical Damages* (World Bank & MEP, 2007), as well as *Energy Futures and Urban Air Pollution: Challenges for China and the United States* (NAS & CAS, 2008), both include errors in describing the Chinese National Ambient Air Quality Standards (CNAAQS). Specifically, these two publications both incorrectly state that the current daily (80μg/m^3) and annual average (40μg/m^3) standards for NO_2, which were the original standards established in 1996, not the less stringent revised standards that were set in

Table 3: API Breakpoints and Concentrations For Selected Pollutants

	AFTER JUNE 2000			BEFORE JUNE 2000		
	PM_{10} ($\mu G/M^3$)	NO_2 ($\mu G/M^3$)	SO_2 ($\mu G/M^3$)	TSP ($\mu G/M^3$)	NO_X ($\mu G/M^3$)	SO_2 ($\mu G/M^3$)
0-50	0-50	0-80	0-50	0-120	0-50	0-50
50-100	50-150	80-120	50-150	120-300	50-100	50-150
100-200	150-350	120-280	150-800	300-500	100-150	150-250
200-300	350-425	280-565	800-1600	500-625	150-565	250-1600
300-400	420-500	565-750	1600-2100	625-875	565-750	1600-2100
400-500	500-600	750-940	2100-2620	875-1000	750-940	2100-2620

Source: Technical Rules Concerning Ambient Air Quality Daily Reports (SEPA, 2000)

2000 when localities began measuring NO_2 instead of NOx (SEPA, 2000). At that time, the daily standard for NO_2 was raised to (120ug/m^3) and the annual average standard was doubled to (80μg/m^3).

China's MEP also does not include notice of the revised standard accompanying the description of air quality reporting on its website. The technical regulations governing the daily API reports included on the MEP website provides a link to the unrevised 1996 CNAAQS (SEPA, 2000). However, the MEP 2005 and 2006 *Annual State of the Environment* reports that all cities in China met the national NO_2 standard (SEPA, 2005 & 2006). Of the 108 cities included in the 2005 rankings, 22 percent exceeded the 1996 CNAAQS for NO_2, including many major cities.

In 2006, the annual average NO_2 concentration in Beijing was 66μg/m^3 and in Guangzhou it was 67μg/m^3 (BJEPB, 2007; GZEPB, 2007). Under the 1996 standards, Beijing and Guangzhou would have exceeded the annual average NO_2 standard in 2006 by 65 percent and 67 percent, respectively. Under the revised standards, both were in compliance (SEPA, 2000). In 1998, NOx was still used to gauge compliance with the 1996 CNAAQS. That year, Beijing and Guangzhou had the highest concentrations of NOx in China at 151 μg/m^3 and 124 μg/m^3, respectively (Ministry of Statistics, 1999). Beijing's annual average NOx concentration that year was over three times the permissible limit of 50μg/m^3, and Guangzhou's was also far above the standard. For 1998, the annual average NO_2 concentration in Beijing was 74 μg/m^3, 85 percent higher than the 1996 CNAAQS standard of 40 μg/m^3 (BJEPB, 2002). Yet, the 1998 NO_2 concentrations for Beijing would be in compliance with the 2000 revisions to the 1996 CNAAQS. For 1999 (1998 data unavailable), the annual average NO_2 concentration in Guangzhou was 69μg/m^3, 73 percent higher than the 1996 CNAAQS standard, but similarly, the air quality would have been in compliance under the 2000 revisions to CNAAQS.

CHANGES TO THE API REPORTING SYSTEM

In June 2000 when daily API reporting began, MEP made changes to the reporting system so that equivalent or roughly equivalent pollution concentrations were reported as having less of a health impact. (See Table 3.) This change also had a significant impact on the number of "Blue Sky" days being reported in cities.

- NOx/NO_2—From 1998-2000 an API of 100 was equivalent to a NOx concentration of 100. Beginning in 2000, an API of 100 was equal to a NO_2 concentration of 120 μg/m^3. Although the NOx/NO_2 ratio varies, in Beijing the ratio was approximately 2/1 in 1998 and 1999.[10] An API of 100 from 1998-2000 indicating a concentration of NOx of 100 μg/m^3 was approximately equal to an NO_2 concentration of 50 μg/m^3. Under the 2000 revision, NO_2 concentrations twice as high at 120 μg/m^3 are reported as an API of 100.

- SO_2—A pollutant concentration of 250 μg/m^3 was equal an API of 200 between 1998-2000.

Figure 3:

Daily PM_{10} concentrations in Beijing at 22 monitoring stations with a record from 2003-2007. The graphed fit line indicates a normal distribution. A PM_{10} concentration of 150 μg/m^3 equals an API of 100. In 2003, an API right above or right below the API = 100, PM_{10} = 150 μg/m^3 breakpoint was of approximately equal likelihood. One clear indication of manipulated data in 2007 is the fact that 191 days were reported with an API of 100 (off the chart), and 0 days with an API of 101.

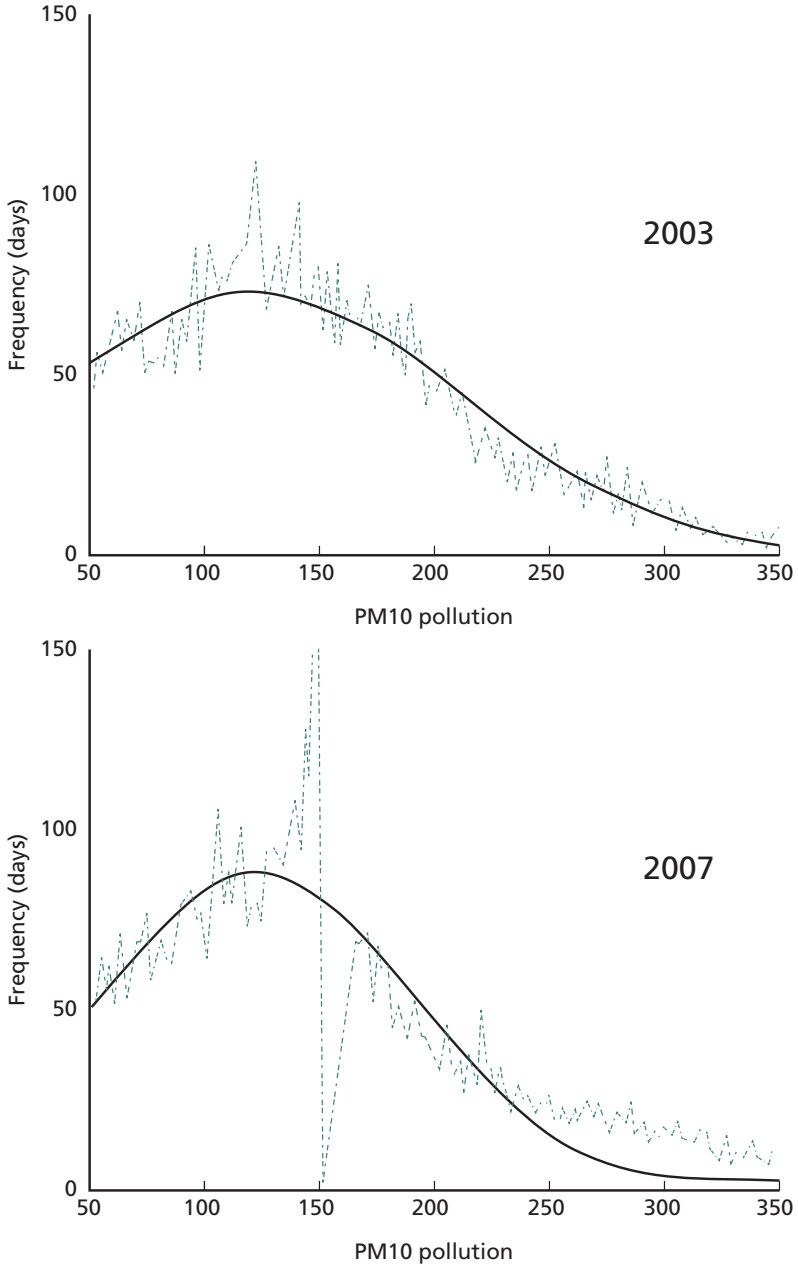


Table 4. Chinese Cities and Years With Largest Bias in Reporting Near the API = 100 National Standard

RANK	CITY	YEAR	# DAYS JUST BELOW STANDARD API 96-100	# DAYS JUST ABOVE STANDARD API 101-105	% DAYS WITH API = 96-105 MEETING STANDARD	API >105
#1	Chengdu (1)	2007	52	0	100%	46
#2	Xian	2007	48	0	100%	70
#3	Changchun	2006	23	0	100%	24
#4	Kunming	2006	22	0	100%	2
#5	Shenyang (1)	2003	77	1	98.7%	66
#6	Chongqing	2003	56	1	98.2%	127
#7	Chengdu (2)	2005	43	1	97.7%	70
#8	Shenyang (2)	2004	73	2	97.3%	63
#9	Shijiazhuang (1)	2006	36	1	97.3%	78
#10	Changchun (1)	2005	32	1	97.0%	24
#11	Suzhou (1)	2004	31	1	96.9%	59
#12	Changchun (2)	2004	29	1	96.7%	20
#13	Tianjin (1)	2002	28	1	96.6%	90
#14	Nanjing (1)	2003	54	2	96.4%	66
#15	Weinan	2004	27	1	96.4%	73
#16	Dalian	2006	26	1	96.3%	26
#17	Beijing (1)	2006	50	2	96.2%	123
#18	Nanjing (2)	2004	40	2	95.2%	69
#19	Kaifeng	2004	39	2	95.1%	65
#20	Hangzhou	2003	38	2	95%	70
#21	Shenyang (3)	2007	34	2	94.4%	39
#22	Anshan	2007	50	3	94.3%	68
#23	Suzhou (2)	2001	33	2	94.2%	33
#24	Shijiazhuang (2)	2003	46	3	93.9%	151
#25	Tianjin (2)	2003	42	3	93.3%	98
#26	Chengdu (3)	2006	54	4	93.1%	60
#27	Shenyang (4)	2006	50	4	92.6%	40
#28	Qingdao	2002	24	2	92.3%	29
#29	Shenyang (5)	2005	47	4	92.2%	44
#30	Beijing (2)	2007	57	5	91.9%	114

Parenthesis used to indicate respective ranking of cities that appear in the list multiple times. Note: Strikingly, while the bias in reporting is quite pronounced in many cities since the air quality standards were relaxed, many of the same cities did not experience any bias in the initial years of reporting. Potentially showing that the pressure to appear green got stronger as pollution problems increased, even after laxer standards. See list below:

#2 Xian (2000) reported 51.2% of 41 days with an API of 96-105 as meeting standard.
#5 Shenyang (2000) reported 57.1% of 28 days with an API of 96-105 as meeting standard.
#5 Chongqing (2001) reported 46.2% of 52 days with an API of 96-105 as meeting standard.
#9 Shijiazhuang (2000) reported 43.5% of 23 days with an API of 96-105 as meeting standard.
#11Suzhou (2002) reported 47.4% of 19 days with an API of 96-105 as meeting standard
#13 Tianjin (2001) reported 57.8% of 45 days with an API of 96-105 as meeting standard.
#17 Beijing (2001) reported 50.0% of 24 days with an API of 96-105 as meeting standard.

However, beginning with daily reports, an average SO_2 concentration of 250 μg/m^3 became equal to an API of 116.

- TSP/PM_{10}—From 1998-2000 a TSP concentration of 500 μg/m^3 was equal to an API of 200. A TSP concentration of 500 μg/m^3 corresponds to a PM_{10} concentration of approximately 250 μg/m^3. However, a PM_{10} concentration of 250 μg/m^3 has been equal to an API of 150 since the change in standards.

"BLUE SKY" BIAS

When asked by a reporter from *The New York Times* whether Beijing's tally of "Blue Sky" days was being manipulated, Du Shaozhong, the deputy director of the BJEPB responded: "People used to ask me whether the ratings are scientific, or if we are playing tricks. But this is the most advanced scientific equipment in the world" (Yardley, 2007). The likelihood of an API right below (API 96-100) or right above (API 101-105) the API = 100, national standard should be approximately equal. However, as many Chinese cities have now begun reporting air quality based on the number and percentage of days meeting the national standard, the annual "Blue Sky" tally has become increasingly important.

According to a 2001 description of the "Blue Sky" days for Beijing published in *Xinhua News Agency*, the environmental protection work is a very scientific process, with automated monitoring and calculating of air quality, so that there is no way that the numbers can be modified (Xinhua, 2001); however, "Blue Sky" trends show irregularities. Specifically, in Beijing, annual targets began being set in 2004 for individual monitoring stations, in addition to the annual city target (Beijing Municipal Government, 2004). In 2003, before the targets were set, there does not appear to be any bias in reported pollutant concentrations near the PM_{10} = 150 μg/m^3, API = 100 "Blue Sky" boundary. However, in 2007 there is a pronounced spike with a very large number of values being reported right below and at the boundary, and no numbers being reported right above. Daily averaged PM_{10} concentrations typically follow a log-normal distribution which is included in Figure 3 (WHO, 2005).

Although several articles have now raised questions as to whether Beijing has manipulated reported data near the "Blue Sky" boundary, no known study has examined other cities in China for possible irregularities (Andrews, 2008a,b,c; Ramzy, 2008; Yardley, 2008b). An analysis of daily API values from 2001-2007 for all cities in China with public reporting provides startling results. (See Table 4 and Figure 4).

The Blue Sky bias in Beijing is compelling for two reasons. First, neither the city nor the monitoring station API values appear to have a bias in the initial year of reporting. In 2001, Beijing reported 24 days in the API 96-105 range and 12 of them were reported as "Blue Sky" days. In 2003, the first year Chinese cities reported monitoring station data; API values of 100 or 101 for individual monitoring stations were approximately equally likely. In 2006 and 2007, there is a strong bias right near the API = 100 "Blue Sky" boundary in both the monitoring station and city data. Second, this apparent bias near the "Blue Sky" boundary is completely eliminated when calculating the daily air quality using the same monitoring stations that had been used in prior years (Andrews, 2008a). In the run-up to the Olympics, officials in Beijing were under great pressure to increase the annual number of "Blue Sky" days (Xinhua, 2007b). (See Box 3).

Beijing has received considerable news media attention regarding the reporting of API values near the "Blue Sky" boundary, but the irregularities seen in Beijing for 2006 and 2007 are far from the most pronounced (ranking as the 17th and 30th largest, respectively). Cities with a strong bias near the boundary are located in all geographic areas, and include some of the most and least polluted cities in China. Many of the cities that have the largest bias interestingly appear to have had no bias during the initial years of reporting, for example:

- *Xian, Shaanxi*. Xian reported 48 days in 2007 with an API of 96-101, and 0 days with an API of 101-105. In contrast, during the first year of public reporting in 2000, Xian had 41 days with an API of 96-105. 21 of these days were reported with an API of 96-100 and 20 were reported with an API of 101-105.

- *Chongqing Municipality*. In Chonqing, 55 days in 2003 were reported as having an API of 96-100, and 1 day with an API of 101-105. For 2001, 52 days were reported with an API in this same range right above and below the national standard from 96-105, and of these, 24 were reported as meeting the standard with an API of 96-100 and 28 were reported as barely exceed-

BOX 3. **Olympic Air Quality**

Hailie Gebreselassie, gold medal favorite in the men's marathon, brought international attention to Beijing's pollution with his announcement in March 2008 that he would not be competing because "the pollution in China [was] a threat to [his] health."[1] Then four U.S. cyclists sparked an international media storm when they arrived in the Beijing airport wearing gas masks just before the Olympics began.[2] Much to the relief of athletes and organizers, the air quality overall during the Olympics was relatively good. But the haze obscuring the capital in late July and early August, which lingered through the initial days of competition, and again appeared on several days following the closing ceremonies,[3] was not due to fog as the president of the International Olympic Committee and Chinese officials described.[4]

As the Games were about to begin, the Beijing Environmental Protection Bureau (BJEPB) downplayed the smog, insisting that "[w]e should judge whether there is pollution by scientific statistics, not by what our eyes can see."[5] The BJEBP was referring to many organizations taking pictures of daily air quality as a gauge of pollution levels,[6] partially the British Broadcasting Corporation (BBC)[7] and the Associated Press (AP),[8] which began taking their own readings of pollution levels in addition to daily photos. Notably, even the Chinese Ministry of Science and Technology (MOST) project (funded by the European Space Agency) that was forecasting daily pollution levels had predicted the air quality for the opening ceremonies would fail the Chinese standards. That same day, MOST insisted that the forecasts stop being made public for undisclosed reasons.[9]

On the day of the opening ceremonies, both the AP and BBC measured pollution levels above the Chinese national standard, but the BJEPB insisted that the air quality met the standard based on their own measurements.[10] On the second day of competition, a typically smoggy summer day in Beijing, one-third of the cyclists in the grueling 158-mile race failed to finish due to the heat, humidity and pollution.[11] The haze soon cleared, lowering the pollution hype by the news media and all the blue sky days during the Games would lead Gebreselassie to regret having pulled out of the marathon. Although it should be noted that the measurements—made by the BJEPB, AP, and BBC—of average daily pollution levels from August 8-24 were all above the daily World Health Organization guidelines.

Improving Beijing's air quality has been a challenging task that began in the mid-1990s in earnest by shifting the city's dependence on coal for heating to natural gas. Winning the Olympic bid in 2001 empowered the Ministry of Environmental Protection and the BJEPB to adopt more aggressive auto emission fuel standards than the rest of the country and to shut down hundreds of dirty factories in the city. As the Games approached

> **"…not only does Beijing have far fewer cars overall than most developed countries, the emissions and fuel efficiency standards are actually better than those in many countries, including the United States."**

temporary restrictions were enforced, such as banning heavy tucks from the city center and halting all construction projects in the city.[12] The request and then order for private car owners to restrict their driving was one of the largest public participation efforts of the Olympics. The campaign, called "Drive one less day a month so that the capital can have one more blue sky day," sought to put the blame for Beijing's pollution on the rapidly increasing number of car owners. Yet, not only does Beijing have far fewer cars overall than most developed countries, the emissions and fuel efficiency standards are actually better than those in many countries, including the United States.

Contrary to fears that Beijing would experience a drastic slide in air quality regulation and monitoring after the Olympics, the BJEPB announced in late 2008 that a total ban of heavily polluting

trucks will begin in October 2009.[13,14] Even more crucial was the BJEPB announcement that it will start measuring ozone and fine particulate matter ($PM_{2.5}$) following the Games, which will hopefully lead to greater public understanding of Beijing's "fog." These new policies underscore that progress in keeping Beijing's air cleaner may not be reversed.[15] Hopefully the increased public awareness of air pollution threats will lead to more demands that Beijing's skies become even cleaner in the future.

NOTES

1. Thomas, Katie. (2008, March 11). "Citing Pollution, Gebrselassie Opts Out of Olympic Marathon." *The New York Times.* [Online]. Available: http://www.nytimes.com/2008/03/11/sports/othersports/11olympics.html?scp=9&sq=marathon%20beijing%20olympics&st=cse.

2. "Sarah Hammer." (2008). *Yahoo Sports*. [Online]. Available: http://sports.yahoo.com/olympics/beijing/usa/sarah+hammer/220806.

3. Ford, Peter. (2008, October 16). "After popular blue skies during Olympics, Beijing brings back pollution controls." *Christian Science Monitor*. [Online]. Available: http://www.csmonitor.com/2008/1016/p07s02-woap.html.

4. "Beijing pollution efforts hailed." (2008, August 7). *BBC.* [Online]. Available: http://news.bbc.co.uk/2/hi/asia-pacific/7546872.stm.

5. "Environmental group recognizes Beijing's efforts to clean up air." (2008, July 28). *Xinhua.* [Online]. Available: http://news.xinhuanet.com/english/2008-07/28/content_8826923.htm.

6. "Clearing the Air: China's Environmental Challenge." (2008). *Asia Society*. [Online]. Available: http://www.asiasociety.org/beijingair/.

7. "In pictures: Beijing pollution-watch." (2008). *BBC.* [Online]. Available: http://news.bbc.co.uk/2/hi/in_pictures/7506925.stm.

8. "Sensing Air Quality at the Olympics." (2008) *Associated Press.* [Online]. Available: http://hosted.ap.org/specials/interactives/_international/oly_fea_pollution/index.html?SITE=WIRE&SECTION=HOME.

9. Spencer, Richard. (2008, August 9). "Beijing Olympics: British smog-monitoring unit ordered to close down." *Telegraph.* [Online]. Available: http://www.telegraph.co.uk/sport/othersports/olympics/2531259/Beijing-Olympics-British-smog-monitoring-unit-ordered-to-close-down.html.

10. "Daily Air Pollution Report." (2008, August 8). *Beijing Environmental Protection Bureau.* [Online]. Available: http://www.bjepb.gov.cn/air2008/Air.aspx?time=2008-8-8.

11. Coonan, Clifford and Randall, David. (2008, August 10). "Triumph, tears and violent death in Beijing's five-ring circus." *The Independent.* [Online]. Available: http://www.independent.co.uk/sport/olympics/triumph-tears-and-violent-death-in-beijings-fivering-circus-889753.html.

12. Haizhou, Zhang. (2008, June 25). "Beijing bans high-emission vehicles to ensure Green Olympics." *China Daily*. [Online]. Available: http://www.chinadaily.com.cn/china/2008-06/25/content_6791647.htm.

13. Xuequan, Mu. *ed.* (2008, October 1). "Beijing to remove 300,000 heavily polluting vehicles in one year." *Xinhua.* [Online]. Available: http://news.xinhuanet.com/english/2008-10/01/content_10140010.htm.

14. "Ozone, particle pollution to be included in monitoring." (2008, August 5). *China Daily.* [Online]. Available: http://www.chinadaily.com.cn/olympics/2008-08/05/content_6903737.htm.

15. Yunjie, Cheng. (2008, September 1). "Beijing rules out post-Games livability setback." *Xinhua.* [Online]. Available: http://news.xinhuanet.com/english/2008-09/01/content_9751587.htm.

> **"Five out of 10 Chinese cities that had been ranked in 1998 as among the most polluted in China remained among the most polluted in 2006."**

ing the standard with an API of 101-105.

- *Chengdu, Sichuan Province*. Chengdu's reported API values in 2006 and 2007 had, respectively, the largest and seventh largest bias near the "Blue Sky" boundary of any city and year in China. Even with this bias, Chengdu, with 301 "Blue Sky" days in 2006 (84 percent) of the year, still ranked in the bottom (worst) 25 percent of Chinese cites. With substantially fewer days meeting the national standard in 2006 (34 less) and 2007 (17 less) than in 2001, officials in Chengdu have likely been under pressure to improve the air quality. Assuming that in 2007, half of the 52 days reported with an API of 96-105 had not actually met the standard, then Chengdu would have had 26 fewer "Blue Sky" days, and the air quality would have been the worst during the 2001-2007 period.

- *Kunming, Yunnan Province.* Kunming's reported API values for 2006 are found to have had the sixth largest bias. This is unexpected, because Kunming has some of the best air quality in China. With only three days above the national standard in 2006, Kunming was ranked ninth of 108 cities placing it in the top 10 percent nationally. However, assuming that for 2006, of the 22 days reported with an API of 96-105, half had not actually met the standard, Kunming would have had 11 fewer "Blue Sky" days. This would have dropped Kunming 15 rankings to 24th place, and the air quality would have tied for worst during the 2001-2007 period.

Although at least one Chinese city has been criticized by MEP for moving monitoring station locations in order to report "cleaner" air (*Environment News*, 2006), MEP has not publicly criticized Beijing. Research has found that changes in Beijing's monitoring station locations on January 1, 2006, and further changes on January 1, 2008, have had significant impacts on the reported number of "Blue Sky" days (Andrews, 2008a,b,c). BJEPB has reported that these 2006 changes at least were done in accordance with national regulations (*Sydney Morning Herald*, 2008). In his piece examining the dynamics of local governance, Cai Yongshun (2000, p.786) observed, "[w]hile some officials achieve success based on their achievements, some do so by manipulating statistics. This phenomenon is called 'good statistics lead to promotion' (*shuzi chu guan):* officials get promoted by over-reporting their achievements and under-reporting their failures. They can also pressure lower-level officials to report fake statistics (*guan chu shuzi*)." According to MEP's Minister Zhou Shengxian, "those who fabricate [environmental indices] will be dealt with appropriately" (Xinhua, 2007a), but China's underfunded environmental watchdog and its local bureaus have faced considerable difficulties in punishing the rampant problem of local government manipulation of environmental data. The May 2008 Environmental Information Disclosure Measures may, however, help MEP in this regard, for it aims to create more transparency around all pollution-related data.

RANKINGS OF CHINESE CITIES UNDER API

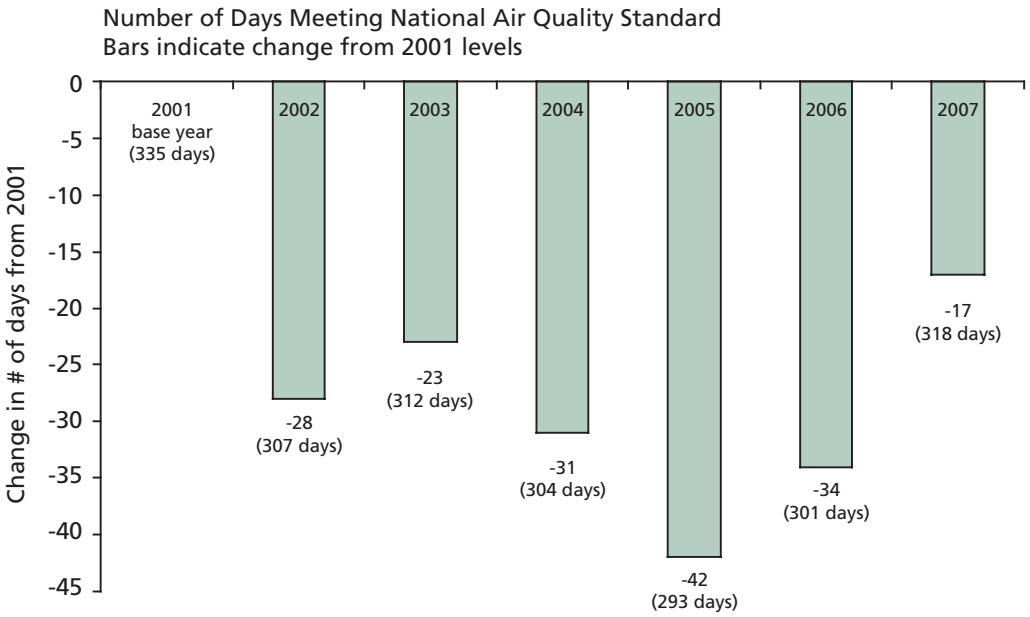
Rankings in China are very significant for the evaluation of government officials. In 1998, cities were ranked according to a total index (*zonghe wuran zhishu)*—not to be confused with the weekly/daily API. In 1998, Beijing was ranked as having the third worst air quality with a total value of 6.898. This was calculated in the following manner:

- The annual average NOx concentration in 1998 was 151μg/m^3, and the annual average standard was 50μg/m^3. So Beijing's annual average NOx concentration was 3.02 times the annual average standards.

- The annual average TSP concentration in 1998 was 378μg/m^3, and the annual average standard was 200 ug/m3. Beijing's TSP level was 1.89 times the standard.

- The annual average SO_2 concentration in 1998 was 120μg/m^3, and the annual average standard

Figure 4: Chengdu Air Quality Reporting



was 60μg/m^3. Beijing's SO_2 level was 2.0 times the standard.

- The 3.04 times NOx standard + 1.89 times TSP standard + 2.0 times SO_2 standard equals 6.89—Beijing's comprehensive API for the year.

- The comprehensive API values for other cities were calculated in the same manner (See Tables 5 & 6).

In 2006, Chinese cities were ranked according to the annual number of days meeting the national standard. Ranking cities according to the number and percentage of days meeting the national standard has also been used as one of the primary indicators of air quality in the United States (U.S. EPA, 2003). Five out of 10 Chinese cities that had been ranked in 1998 as among the most polluted in China remained among the most polluted in 2006. These include the following: Beijing, Datong, Urumqi, Lanzhou and Taiyuan. However, comparing the total index values between 1998 and 2006 is problematic for two main reasons. First, as noted previously, Beijing was over three times the annual average NOx standard in 1998, but in compliance with the revised NO_2 standard. Therefore, using NO_2 instead of NOx results in significantly lower total index values. Second, the relationship between TSP/PM_{10} concentrations and the TSP/PM_{10} standards also affects the reported index. (See Tables 5 and 6).

SEEING THROUGH THE SMOG

Air Quality Trends in 5 Major Cities

Analysis of annual average PM_{10}, NO_2, and SO_2 levels from 2000-2005 in five major cities does not indicate any clear trends in air quality. The five cities, indicated in figures 5-7, had the five highest annual average concentrations of NOx in 1998: Beijing (151μg/m^3); Guangzhou (123μg/m^3); Shanghai (100 μg/m^3); Wuhan (94 μg/m^3); and Urumqi (87 μg/m^3). All five of these cities exceeded the 1996 annual average NO_2 standard of 40ug/m^3 for all six of these years, but all of the cities have consistently been in compliance with the revised 2000 annual average NO_2 standard of 80μg/m^3. The cities had annual average PM_{10} concentrations above the national standard (100μg/m^3) in 2001 and continued to exceed the national standard in 2005. Beijing and Urumqi have had a decrease in annual average SO_2 concentrations during this period, but Guangzhou, Shanghai and

Table 5. 10 Most Polluted Cities in China—1998 SEPA Rankings (1998 Data, μg/m^3)

RANK	CITY	TOTAL INDEX	TSP STANDARD - 200	NOX STANDARD - 50	SO_2 STANDARD -60
#1	Taiyuan	8.41	523 (2.62x)	66 (1.32x)	276 (4.6x)
#2	Shizuishan	7.06	741 (3.71x)	---	145 (2.42x)
#3	Beijing	6.90	378 (1.89x)	151 (3.02x)	119 (1.98x)
#4	Urumqi	5.90	504 (2.52x)	87 (1.74x)	104 (1.73x)
#5	Jilin	5.75	560 (2.8x)	81 (1.62x)	80 (1.33x)
#6	Datong	5.56	594 (2.97x)	---	117 (1.95x)
#7	Lanzhou	5.49	632 (3.16x)	65 (1.3x)	---
#8	Zibo	5.49	---	59 (1.18x)	142 (2.27x)
#9	Yibin	5.34	249 (1.25x)	59 (1.18x)	175 (2.92x)
#10	Chonqing	5.34	---	56 (1.12x)	183 (3.05x)

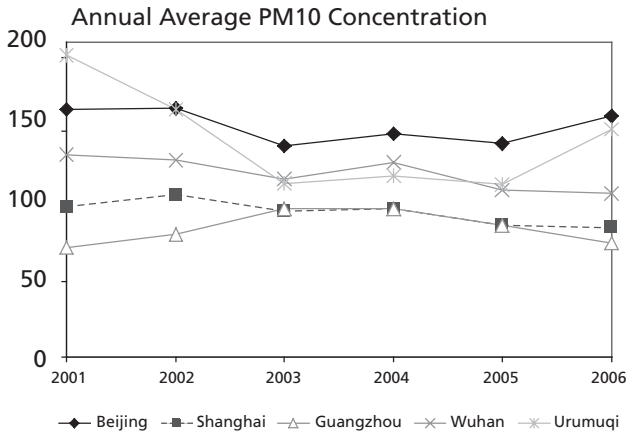
Source: Ministry of Statistics, 1999
Parentheses indicates how many times city value was above national standard
Note: Daily reporting did not being until June 2000.

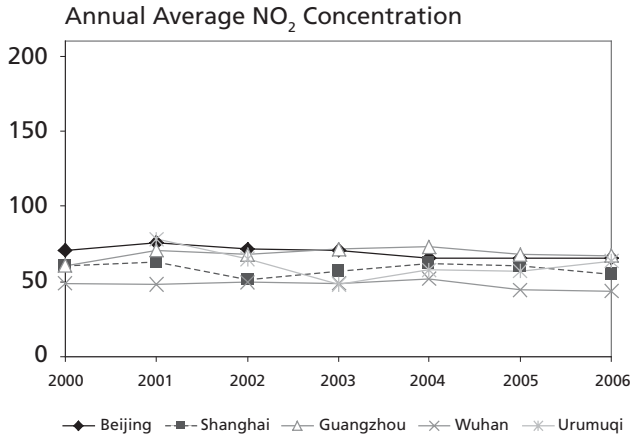
Table 6. 10 Most Polluted Cities in China—2006 SEPA Rankings (2006/2005 Data, μg/m^3)

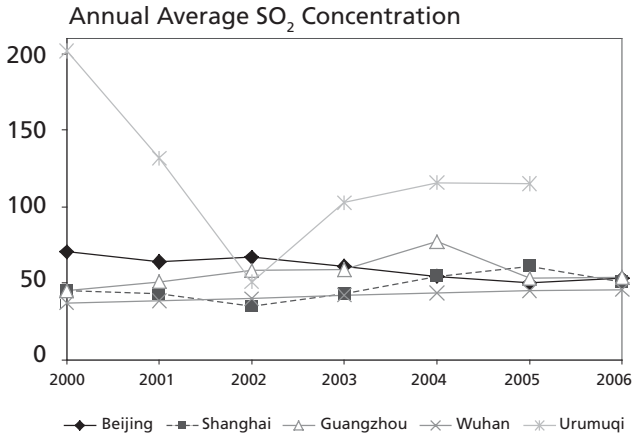
RANK	CITY	% DAYS WITH API ≤100	PM_{10} STANDARD 100	NO_2 STANDARD 80	SO_2 STANDARD = 60	TOTAL INDEX*
#1	Linfen	53.54%	184 (1.84x)	54 (0.68x)	177 (2.95x)	5.47
#2	Lanzhou	56.16%	157 (1.57x)	38 (0.48x)	68 (1.13x)	3.18
#3	Datong	65.48%	154 (1.54x)	37 (0.46x)	96 (1.60x)	3.60
#4	Beijing	66.03%	142 (1.42x)	66 (0.83x)	50 (0.83x)	3.08
#5	Urumqi	67.40%	115 (1.15x)	56 (0.70x)	117 (1.95x)	3.80
#6	Jinchang	68.77%	92 (.092x)	24 (0.3x)	112 (1.87x)	3.09
#7	Yueyang	69.90%	143 (1.43x)	26 (0.33x)	48 (0.8x)	2.55
#8(tie)	Weinan	71.50%	146 (1.46x)	46 (0.58x)	83 (1.38x)	3.42
#8(tie)	Xiangtan	71.50%	126 (1.26x)	38 (0.48x)	64 (1.07x)	2.80
#8(tie)	Pingdingshan	71.50%	147 (1.47x)	43 (0.59x)	67 (1.12x)	3.12
(#11)	Taiyuan	71.51%	139 (1.39x)	20 (0.25x)	77 (1.28x)	2.92

% Days with API ≤ 100 is for 2006, all pollutant concentrations are for 2005
*Note: Total index stopped being used in 2003.
Source: SEPA, 2007

Figures 5-7







Note: All pollutant concentrations are in µg/m3 Sources: Shanghai EPB 2002-2006; Guangzhou EPB 2002-2006; Wuhan EPB 2001-2006; BJEPB 2002-2006; He & Chang 2000 [Urumqi data].

Wuhan have all had increases. Although there appears to be some improvements for some cities in some years, there do not appear to be any nationwide, sustained improvements.

Long-term trends are difficult to determine from MEP's composite *State of the Environment* reports, which usually do not differentiate between the number of cities included in annual national statistics. For instance, the 2007 *Economic Costs of Pollution* contains figures showing the long-term trends in major cities in China for TSP, SO_2, and NOx from 1980-2004 accompanied by the following disclaimer: "The averages in each year are arithmetic average—unweighted by population—of available readings for 'major cities.' The set of cities varies from 53 to 97, depending on the year" (World Bank, 2007). In MEP's *1997 Report on the State of the Environment* it was reported that 28 percent of the 93 monitored cities met the national standard for particulate (SEPA, 1997). In the *2006 Report on the State of the Environment* it was reported that 62.4 percent of the 559 monitored cities met the national standard for all pollutants (SEPA, 2006). However, it is unclear what 93 cities were monitored in 1997 and what percentage of these cities met the air quality standard in 2007. Furthermore, changes in the pollutants monitored (NO_2/NOx and TSP/PM_{10}) and the 2000 revisions of the national standards further complicate any comparisons that may be made between these numbers.

Satellite Imagery and Remote Sensing Studies

Although publicly reported annual average concentration of nitrogen dioxide appears to be relatively constant for major Chinese cities, studies that have been done using satellite imagery have found significant increases. A major study published in *Nature* analyzing 1996-2004 data found an increase of approximately 50 percent for nitrogen dioxide concentrations over the industrial areas of China (Richter et al., 2005). This study prompted the international news media to dub Beijing the "pollution capital of the world" (Watts, 2005). Other research similarly found through analysis of satellite imagery that the emissions calculated for NOx, derived using data from the *China Energy Statistics Yearbook* were considerably underestimated (Akimoto et al., 2006).

AIR QUALITY REPORTING AND PUBLIC PARTICIPATION

According to Pan Yue, deputy director of MEP, "people should participate more than planting trees or cleaning rubbish. They should join the policy-making." He observed that for this greater public involvement to happen, relevant departments and enterprises must publish their environmental information (Xinhua, 2007d).

In 1997, *China Environment News* published a series of reports on vehicle emissions, representing the first public disclosure of the air pollution that results from leaded gasoline. These reports raised public awareness, and resulted in government officials examining ways to ban leaded gasoline in urban areas leading the head of MEP to comment that environmental protection in China will only be successful with the assistance of the mass media (Bo, 1998).[11]

In Beijing, one of the largest campaigns has been a public interest environmental activity to encourage car owners to drive one less day so that the capital can have one more "Blue Sky" day a month (Xinhua, 2006). This campaign appears to be placing the responsibility for the city's air quality problems on the one group that has the greatest ability to actually pressure government officials—the rising middle class. However, in the transport sector a larger pollution source is diesel consumption, which is twice as high as gasoline use and is much dirtier and growing faster in China (National Bureau of Statistics, 2006). Tests done by Chinese and U.S. researchers in Tianjin found that diesel engines in trucks and buses accounted for 93 percent of all nitrogen oxides from vehicles in China, and 97 percent of particulate (Bradsher, 2007).

Recent efforts by the Chinese NGO Institute of Public and Environmental Affairs (IPE) to develop China's first online water and air pollution maps represent a notable step towards making environmental quality information more accessible to the public. [*Editor's Note: See Spotlight Box on IPE by Boyle and Chen in this issue of CES*]. However, the air pollution website is hampered by many of the issues discussed in this paper: irregularities in monitoring and reporting of air quality, the 2000 revisions of the 1996 air quality standards, and a lack of access to information (IPE, 2008). One notable omission on the website is that no data for Beijing is included on any of the websites rankings of air quality in China.

> **"Although daily reports inform the public about air pollution levels, these reports have understated the impacts of air pollution on human health."**

In the United States, the push from NGOs has been instrumental for greater air pollution controls (American Lung Association, 2008). As noted in Box 1, the 1996 report by the U.S.-based Natural Resources Defense Council (NRDC), titled *Breath-taking: Premature Mortality Due to Particulate Air Pollution in 239 American Cities,* illustrated the importance of U.S. NGOs in promoting greater attention to air pollution and health problems. NRDC estimated that approximately 64,000 premature deaths from cardiopulmonary causes could be attributed to air pollution each year in the United States based on an analysis of 1990-1994 data. Given that China has a population over four times that of the United States, the estimated 281,361 premature deaths due to air pollution in China for 2004 (Zhang, 2007a) appears rather low.

Although air quality in the United States has improved since the 1990-1994 period, the latest report—*State of the Air: 2008*—by the American Lung Association started with the shocking statistic: "Two out of every five people—42 percent—in the United States live in counties that have unhealthful levels of either ozone or particulate pollution. Almost 125 million American live in 215 counties where they are exposed to unhealthful levels of air pollution" (American Lung Association, 2008). With Chinese air quality far worse then the United States, a crucial question is whether (and when) comparable reports will begin to be published in China. Accurate information is needed for the Chinese public to realize the true impacts of air pollution on human health.

A CALL FOR GREATER TRANSPARENCY

Transparency regarding environmental information in China has been markedly increasing since the mid-1990s. Public reporting of air quality

began following the 1996 *State Council Decision on Environmental Protection* as part of a deliberate strategy to encourage citizens to put pressure on local governments to enforce environmental regulations (U.S. Embassy, 1998). In 2006, the message from Zhou Shengxian, the minister of MEP remained the same: "environmental indices will be published for public supervision" (Xinhua, 2007a). In May of 2008, the National People's Congress passed *Regulations on Government Disclosure of Information*, a comprehensive freedom of information legislation. MEP will implement the environmental aspects of this freedom of information legislation through *Measures of Environmental Information*, which was also adopted in May 2008. These new measures will help push transparency into government law, regulations, standards, and information on environmental quality. Some Chinese environmental NGOs, such as the Institute of Public and Environmental Affairs have been taking advantage of this growing openness in information, but they too suffer from poorly collected data techniques and independently collecting such data could be politically sensitive and is often impractical.

Despite the progress made in opening up access to environmental information, there still a lack of transparency in Chinese environmental statistics, which makes it difficult to ascertain the true state of Chinese air quality and analyze reported trends. Although daily reports inform the public about air pollution levels, these reports have understated the impacts of air pollution on human health. A day on which particulate concentrations are three times WHO guidelines can still have an API as high as 100 and be classified as "good." A day on which particulate concentrations are five times WHO guidelines can still have an API as high as 150 and still be classified as "slightly polluted." A day on which particulate concentrations are seven times WHO guidelines can still have an API as high as 200 and still be classified as "lightly polluted." Not a single one of the 108 cities included in MEP's 2006 city rankings achieved WHO guidelines for annual average particulate concentrations.

Transparency in public reporting has been further hindered as China weakened its air quality standards in 2000; at a time when other countries and WHO have been setting more stringent guidelines (Luo, 2007). Not only were the standards changed, but equivalent concentrations of NO_2/NOx, TSP/PM_{10} and SO_2 began being reported as having lower API values—indicating less significant health impacts when daily reporting began in June 2000. Although the calculation methodologies to go from API values to pollutant concentrations are straightforward, an error in the sample calculation on the MEP website has lead to misunderstandings of the true severity of pollution levels—inaccuracies that have been replicated in several leading reports on air pollution in China. Although the establishment of "Blue Sky" targets and well-publicized tallies of the number of days meeting the national standard has resulted in an easily understood metric for air quality, it strongly appears that pollution levels near this boundary are being manipulated in many major cities.

In 1997, air quality information was first publicly released as part of deliberate strategy by the central government to put pressure on local government officials to enforce national regulations. In 2006, government officials continued to state that environmental information is published for "public supervision." However, without accurate and transparent public reporting on the atmospheric environment, the public's ability to fulfill this role will continue to be largely diminished.

ACKNOWLEDGEMENTS

David Andrews provided assistance with data analysis and development of Figure 3, Chris Muffels aided the data acquisition process, Elin Quigley gave comments on an early version of this manuscript, Kevin Hsu provided research advice, and Dana Graef provided valuable support. Princeton-in-Asia provided funding for the initial stages of this project.

Steven Q. Andrews is currently enrolled in the Epstein Program in Public Interest Law and Policy at the UCLA School of Law. He was previously an environmental consultant based in Washington, DC. This project began when he was a Princeton-in-Asia fellow in Beijing. He can be reached at: sandrews@alumni.princeton.edu.

REFERENCES

Akimoto, Hajime; Ohara, Toshimara; Kurokawa, Jun-ichi; Horii, Nobuhiro. (2006). "Verification of energy consumption in China during 1996-2003 by using satellite observational data." *Atmospheric Environment*. *40*:7663-7667.

American Lung Association. (2008). *State of the Air: 2008*. New York City, NY. [Online]. Available:

http://www.stateoftheair.org/.
Andrews, Steven Q. (2008a, September 26). Inconsistencies in air quality metrics: 'Blue Sky' days and PM10 concentrations in Beijing. *Environmental Research Letters 3:034009. Available:* http://www.iop.org/EJ/abstract/1748-9326/3/3/034009
Andrews, Steven Q. (2008b, January 9). Commentary. "Beijing's sky blues." *Wall Street Journal Asia.* [Online]. Available: http://online.wsj.com/article/SB119983312470175979.html?mod=Commentary-US.
Andrews, Steven Q. (2008c, February 22). Commentary. "More blue skies in Beijing" *Wall Street Journal Asia*. [Online]. Available: http://online.wsj.com/article/SB120362001824083529.html.
Beijing Environmental Protection Bureau. (1998). *Annual Environmental Statement 1998*. [1998 *Beijingshi huanjingzhuangkuang gongbao]*. [Online]. Available: http://www.bjepb.gov.cn/bjhb/Portals/0/Skins/index/tabid/66/Default.aspx.
Beijing Environmental Protection Bureau. (2002). *Annual Environmental Statement 2002*. [2002 *Beijingshi huanjingzhuangkuang gongbao].* [Online]. Available: http://www.bjepb.gov.cn/bjhb/tabid/68/InfoID/2618/frtid/375/Default.aspx.
Beijing Environmental Protection Bureau. (2006). *Annual Environmental Statement 2006*. [2006 *Beijingshi huanjingzhuangkuang gongbao].* [Online]. Available: http://www.bjepb.gov.cn/bjhb/portals/0/fujian/zwgk/2006.pdf.
Beijing Environmental Protection Bureau. (2008). *Daily Air Quality Report* (January 1, 2003 – December 31, 2007). Beijing, China. [Online]. Available: www.bjepb.gov.cn.
Beijing Municipal Government. (2004). *Air Pollution Control Plan #10*. [*beijingshi renminzhengfu guanyufabubenshi dishijiaduankongzhidaqiwurancuoshi de tonggao].* http://www.bjepb.gov.cn/bjhb/tabid/151/Default.aspx
Bo, Wen. (1998). "Greening the Chinese media." *China Environment Series*. Woodrow Wilson Center, Washington DC. Issue 2.
Bradsher, Keith. (2007, December 8). "Trucks power China's economy, at a suffocating cost." *The New York Times*. [Online]. Available: http://www.nytimes.com/2007/12/08/world/asia/08trucks.html.
Bradsher, Keith. (2008, June 6). "China reports decline in 3 major pollutants, reversing trend." *The New York Times*. [Online]. Available: http://www.nytimes.com/2008/06/06/world/asia/06pollute.html.
British Broadcasting Corporation. (2007, July 3). "China 'buried smog death finding.'" [Online]. Available: http://news.bbc.co.uk/2/hi/asia-pacific/6265098.stm.
Cai, Yongshun. (2000). "Between state and peasant: Local cadres and statistical reporting in rural China." *China Quarterly*, No. 163, pp. 783-805.
China National Environmental Monitoring Center. (2006). *National List of Monitoring Stations in 113 Major Cities*. [*Quanguo 113 gezhongdianchengshi huanjingkongqijiancedianwei qingkuang zanbiao].* Beijing, China.
China Statistical Yearbook. (2006). National Bureau of Statistics. [Online]. Available: www.stats.gov.cn/tjsj/ndsj/index.htm.
Chinese Ministry of Statistics. (1999). "Annual average concentration of nitrogen oxides in major cities." [*Quanguobufen nanbeichengshi tanyanghuawu nongdu nianjunzhi]. China Statistical Yearbook*. Beijing, China. [Online]. Available: www.stats.gov.cn/tjsj/qtsj/hjtjzl/hjtjsj1999/t20031230_402371720.htm.
Duan, Jingchun; Tan, Jihua; Yang, Liu; Wu, Shan; Hao, Jimin. 2008. "Concentration, sources and ozone formation potential of volatile organic compounds (VOCs) during ozone episode in Beijing." *Atmospheric Research* 88:25-35.
Econ Center for Economic Analysis. (2002). *Environmental Challenges in China: Determinants of success and failure.* Commissioned by the World Bank. Oslo, Norway. [Online]. Available: http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2004/02/12/000265513_20040212164110/additional/310436360_20050276090204.pdf.
Environmental News. (2006). "Arbitrary changes to air quality monitoring locations criticized." [*suiyi biandong kongqizhiliang jiancedianwei shoutongbaopiping*]. Shanghai Environmental Protection Bureau. [Online]. Available: http://www.envir.gov.cn/info/2006/7/719215.htm.
Environmental Protection Agency. (2003). Draft Report on the Environment 2003. Washington, DC. [Online]. Available: http://www.epa.gov/roe/roe/pdf/EPA_Draft_ROE.pdf.
Gang He. (2008). "Freedom of information and environmental protection in China." *Earthtrends*. [Online]. Available: http://earthtrends.wri.org/updates/node/324.
Guangzhou Environmental Protection Bureau. (2007). *Annual Environmental Statement 2006*. [2006 *niandu guangzhoushi huanjingzhiliang tongbao]*. [Online]. Available: http://www.gzepb.gov.cn/zwgk/hjgb/200706/t20070605_47991.htm.
He, Kebin & Chang, Chen. (2000). "Present and future pollution from urban transport in China." *China Environment Series. Issue 3*. Washington, DC, pp. 38-50.
He, K.; Huo, H.; Zhang, Q. (2002). "Urban air pollution in China: Current status, characteristics, and progress." *Annual Review of Energy and Environment* 27,397–431.
Invest Guangzhou. (2007). "Sulfur dioxide reduced for better air quality." Guangzhou City Government. [Online]. Available: http://www.investguangzhou.

gov.cn/upload/resource/govContent/content.jsp?contentId=3824.

Jiang, Dahe; Yang, Zhang; Xiang, Hu; Yun, Zeng; Tan, Jian Guo; DeMin, Shao. (2004). "Progress in developing an ANN model for API forecast." *Atmospheric Environment* 28, 7055-7064. [Online]. Available: http://www.cababstractsplus.org/google/abstract.asp?AcNo=20053125162.

Johnson, Tim. (2004, October 25). "Air pollution taking a heavy toll in China, experts say." *San Jose Mercury News*.

Kahn, Joseph & Jim Yardley. (2007, August 26). "As China roars, Pollution reaches deadly extremes." *The New York Times*.

Kunzli N, Kaiser R, Medina S, Studnicka M, Chanel O, Filliger P, et al. (2000). "Public health impact of outdoor and traffic related air pollution: a European assessment." *Lancet*. 256:795-801.

Luo, Changping. (2007, October 9). "Beijing battles for a blue-sky Olympic." *Caijing*. [Online]. Available: http://www.caijing.com.cn/20071009/32851.shtml.

Nature. (1998, April 30). Vol. 392.

Natural Resources Defense Council. (1996). "Breathtaking: Premature mortality due to particulate air pollution in 239 American cities." [Online]. Available: http://www.nrdc.org/air/pollution/bt/5600.asp.

Organization for Economic Co-Ordination and Development. (2007). OECD *Environmental Performance Review for China*. 337pp.

Ramzy, Austin. (2008, March 14). "Is Beijing manipulating air pollution statistics?" *Time*. [Online]. Available: http://www.time.com/time/world/article/0,8599,1722450,00.html.

Richter, A.; Burrows, J.; Nu, C; Granier, C.; Niemeier, U. (2005). "Increase in troposphere nitrogen dioxide over China observed from space." *Nature* 437, 129-132.

Rosenthal, Elisabeth. (1998, June 14). 1998. "China officially lifts filter on staggering air pollution data. *The New York Times*.

Shanghai Environmental Protection Bureau. (2002). *Shanghai Environmental Bulletin 2001.* [*shanghaishi-1huanjingzhuangkuanggongbao].*

Shanghai Environmental Protection Bureau. (2003). *Shanghai Environmental Bulletin 2002.* [*shanghaishi-1huanjingzhuangkuanggongbao].* [Online]. Available: http://www.envir.gov.cn/law/bulletin/b2003/.

Shanghai Environmental Protection Bureau. (2005). *Shanghai Environmental Bulletin 2004.* [*shanghaishi-1huanjingzhuangkuanggongbao].* [Online]. Available: http://www.sepb.gov.cn/huanjingzl/main199.html.

Shanghai Environmental Protection Bureau. (2007). *Shanghai Environmental Bulletin 2006.* [*shanghaishi-1huanjingzhuangkuanggongbao].* [Online]. Available: http://www.sepb.gov.cn/seicm/editor/filemanager/file/2007bulletin/index.htm.

Shi, Jiangtao. (2008, May 14). "Hazy on the detail: The government says Beijing's air is better, but experts doubt its claims—and its commitment to cleaner air after the Games." *South China Morning Post*.

South Coast Air Quality Management District. (2007). "2006 air quality." Diamond Bar, California. [Online]. Available: http://www.aqmd.gov/smog/AQSCR2006/aq06card.pdf.

State Environmental Protection Administration. (1997). *State of the Environment in China 1997.*

State Environmental Protection Administration. (2000). Notice regarding Environmental Air Quality Standards (GB3095-1996) List of Revisions. [*guanyufabu <huanjingkongqizhiliangbiaozhun> xiugaidandetongzhi].* [Online]. Available: http://www.sepa.gov.cn/info/gw/huangfa/200001/t20000106_61586.htm.

State Environmental Protection Administration. (2000). "Technological rules concerning *Ambient Air Quality Daily Report*." Chinese National Environmental Monitoring Center. [Online]. Available: http://www.zhb.gov.cn/english/airqualityinfo.htm.

State Environmental Protection Administration. (2005). "Automated methods for ambient air quality monitoring." [*huanjingkongqizhiliangzidongjiancejishuguifan].* [Online]. Available: http://www.sepa.gov.cn/tech/hjbz/bzwb/dqhjbh/jcgfffbz/200601/t20060101_71675.htm.

State Environmental Protection Administration. (2006). *Chinese Cities Environmental Management and Policy 2005 Annual Report*. [2005 *quanguochengshi huanjinghuanliyuzhonghezhengzhi naindubaogao]* 52pp. [Online]. Available: http://www.sepa.gov.cn/cont/city/csgl/200609/P020060908504129865605.pdf.

State Environmental Protection Administration. (2006). *2005 Report on the State of the Environment in China*. [Online]. Available: http://english.sepa.gov.cn/down_load/Documents/200710/P020071023479859455977.pdf.

State Environmental Protection Administration. (2007). *Chinese Cities Environmental Management and Policy 2006* Annual Report. [*2006 Quanguochengshi huanjingguanliyuzhonghezhengzhiniandubaogao]* 66pp. [Online]. Available: www.sepa.gov.cn/info/gw/huanban/200706/W020070621296991445359.pdf.

State Environmental Protection Administration. (2007). *Report on the State of the Environment in China 2006*. [Online]. Available: http://english.sepa.gov.cn/standards_reports/soe/SOE2006/200711/t20071106_112569.htm.

Sydney Morning Herald. (2008, February 27). "Bad air days as Olympic hosts fiddle the figures."

UN Environment Programme. (2007). *Beijing 2008 Olympic Games. An Environmental Review.* 163pp. [Online]. Available: http://www.unep.org/sport_env/Activities/beijingConf07/media/.

U.S. Embassy, Beijing, Environment, Science, Technology & Health Section. (1998). "P.R.C. air pollution: How bad is it?" [Online]. Available: http://beijing.usembassy-china.org.cn/report0698air.html.

U.S. Environmental Protection Agency. (2003). *Air Quality Index: A Guide to Air Quality and Your Health*. Washington, DC. 10pp. [Online]. Available: http://airnow.gov/index.cfm?action=aqibroch.index.

U.S. Environmental Protection Agency; National Renewable Energy Laboratory; Department of Environmental Science, Tsinghua University; School of Public Health, Peking University; School of Public Health, Yale University. (2005). *Energy Options and Health Benefits: Beijing Case Study*.

United States Environmental Protection Agency. (2006). *Guidelines for Reporting of Daily Air Quality – Air Quality Index*. Washington, DC. 31pp. [Online]. Available: http://www.epa.gov/ttncaaa1/t1/memoranda/rg701.pdf.

U.S. National Academies & Chinese Academy of Sciences. (2008). *Energy Futures and Urban Air Pollution: Challenges for China and the United States*. Washington, DC. [Online]. Available: http://www.nap.edu/catalog.php?record_id=12001.

Wang, Shigong; Yuan, Wei; & Shang, Kezheng. (2006). "The impacts of different kinds of dust events on PM_{10} pollution in northern China." *Atmospheric Environment*. 40,7975-7982.

Wang, X.; Mauzerall, D.L.; Hu, Y.; Russell, A.G.; Larson, E.D.; Woo, J.; Streets, D.G.; & Guenther, A. (2005). "A high-resolution emission inventory for eastern China in 2000 and three scenarios for 2020." *Atmospheric Environment.* 39:32, 5917-5933.

Watts, Jonathan. (2005, October 31). "Satellite data reveals Beijing as air pollution capital of the world." *The Guardian*.

World Bank. (1997). *Clear Water, Blue Skies: China's Environment in the New Century*. Washington, DC.

World Bank & State Environmental Protection Agency. (2007). *Cost of Pollution in China: Economic Estimates of Physical Damages. Conference Edition.* Washington, DC. [Online]. Available: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/EXTEAPREGTOPENVIRONMENT/0,,contentMDK:21252897~pagePK:34004173~piPK:34003707~theSitePK:502886,00.html.

World Health Organization. (2005). *Air Quality Guidelines: Global Update 2005*. World Health Organization Regional Office for Europe: Copenhagen, Denmark. [Online]. Available: http://www.euro.who.int/air/activities/20050222_2.

World Health Organization. (2005). *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. Global update 2005. Summary of risk assessment.* 22pp. [Online]. Available: http://www.who.int/phe/health_topics/outdoorair_aqg/en/index.html.

Wuhan Environmental Protection Bureau. (2007). *2006 Wuhan City Environmental Situation Report. [2006nianwuhanshihuanjingqingkuanggongbao]*. [Online]. Available: http://www.whepb.gov.cn/CMSWEB/hjzl.aspx?level=2&channel=%e7%8e%af%e5%a2%83%e8%b4%a8%e9%87%8f%2c%e7%8e%af%e5%a2%83%e7%8a%b6%e5%86%b5%e5%85%ac%e6%8a%a5.

Xinhua. (2001, December 27). "Beijing welcomes number 201st Blue Sky Day. 4 days early completing target." [*beijinghuanyingdi201gelantian tiqian4tian-shixianshifumubiao].* [Online]. Available: http://news.xinhuanet.com/newscenter/2002-12/27/content_672268.htm.

Xinhua. (2006, June 6). "The far-ranging significance of 'driving your car one less day' for the capital's "Blue Sky". ["*meiyueshaokaiyitianche" huodongguanhushoudu "lantian" de yiyishenyun"].* [Online]. Available: http://news.xinhuanet.com/environment/2006-06/06/content_4650917.htm.

Xinhua. *(*2007a, May 10). "China to automate real-time monitoring of air polluters." [Online]. Available: http://news.xinhuanet.com/english/2007-05/10/content_6081061.htm.

Xinhua. (2007b, December 31) "Beijing completes this year's target of 245 Blue Sky days" [*beijing-wanchengjinnian245gelantianmubiao*]. [Online]. Available: http://news.xinhuanet.com/society/2007-12/31/content_7342684.htm.

Xinhua. (2007c, February 12). "China fails to achieve pollution control goals in 2006." [Online]. Available: http://news.xinhuanet.com/english/2007-02/12/content_5731364.htm.

Xinhua. (2007d, April 26). "Gov'ts, firms ordered to release pollution figures." http://news.xinhuanet.com/english/2007-04/26/content_6028436.htm.

Yardley, Jim. (2007, December 29.) "Beijing's Olympic quest: Turn smoggy skies blues. *The New York Times*.

Zhang, M, Son, Y.,Cai, X. (2007a). "A health based assessment of particulate air pollution in urban areas of Beijing in 2000-2004." *Science of the Total Environment*.

Zhang, M.; Song, Y.; Cai, X.; Zhou, J. (2007b). "Economic assessment of the health effects related to particulate matter pollution in 111 Chinese cities by using economic burden of disease analysis." *Journal of Environmental Management.*

NOTES

1. WHO also established last stringent interim targets to assist developing countries in tracking progress over time in reducing population exposure to pollution. The WHO interim target-1 for daily PM_{10} concentrations is 150 $\mu g/m^3$ and the WHO interim target-1 for annual

PM10 concentrations is 70 μg/m^3. According to the WHO if more than 3 days have particle concentrations above 150 μg/m^3 the country has failed the interim-1 target, so even though China's daily PM_{10} standard is the same as the WHO PM_{10} interim-target 1, the interpretation is quite different, as China considers compliance with the daily standard on a daily rather than annual basis.

2. MEP has developed a methodology for including ozone concentrations in API reporting, and there has been limited public reporting in selected cities.

3. With a confidence interval from approximately 300,000 to 500,000 premature deaths per year.

4. Technically, WHO publishes air quality guidelines and not standards. However, consistent with statements by Chinese government officials and reports in Chinese publications, this article uses the terms guidelines and standards interchangeably. (See for example: Press conference: Beijing air quality, official website of the Beijing Olympic Games, August 8, 2008. Available: http://en.beijing2008.cn/live/pressconference/mpc/n214514906.shtml

5. While WHO does not provide a recommended annual SO_2 concentration guideline, when an annual guideline is provided for a pollutant, the guideline is generally much lower than the daily standard.

6. Some U.S. cities also include average API values, but maximum API values (from individual monitoring stations) are used to calculate the number of days failing the national standards. Although some Chinese cities report individual monitoring station data, this data is not widely used in evaluating air quality.

7. Note that according to the EPA Extreme Event Regulations high wind days are excluded from compliance consideration.

8. The Chinese and English versions of the SEPA technical regulations were removed from the MEP website prior to the Olympics in spring 2008 and currently remain unavailable online (2/1/09).

9. Note that not all monitoring stations are used in calculating the city air quality (Andrews, 2008b,c).

10. In 1998 and 1999 the annual average NOx concentrations for Beijing were 151μg/m^3 and 140 μg/m^3 and the annual average NO_2 concentrations were 74 μg/m^3 and 77 μg/m^3. This gives an approximate NOx/NO2 ratio of 2/1 (2/0.98 in 1998 and 2/1.1 in 1999) (BJEPB 1999)

FEATURE BOX

Water and Environmental Health: BSR Takes Action to Break Southern China's Water Crisis

By Linda Hwang

Since 1992, Business for Social Responsibility (BSR) has been working with companies to integrate social and environmental responsibility into their corporate strategies. In 1995, BSR began work with apparel and manufacturing companies to reduce environmental impacts in the textile and apparel industry. Wastewater from dye baths is often rated as the most polluting among all industrial sectors. The pollution load is characterized by high color content, suspended solids, salts, nutrients, as well as toxic substances such as heavy metals and chlorinated organic compounds.

More than a dozen leading companies—including Nike, Gap, and Levi Strauss & Company—were successfully recruited to form a working group to discuss impacts to water resources within their supply chains. The group found that: (1) no comprehensive or consistent global policy or regulation existed to effectively manage supplier and company practices and expectations related to wastewater quality, and (2) regulation and enforcement for water quality varied from country to country. BSR and the companies recognized an opportunity to reduce environmental impact through the development of global water quality guidelines, supported by the textile and apparel industry. The working group developed these guidelines and today they are embedded within a *Supplier Training Manual* developed by BSR, which also includes a set of recommendations for collecting, testing and treating wastewater. This manual is currently being used by textile mills, laundries, and dye factories in southern China's Guangdong Province, which supply a number of global apparel and retail brands.

In Guangdong Province, a growing population, ongoing industrialization, and inefficient industrial use of water have significantly increased demand on water resources. In 2005, the majority of pollution complaints received by the Guangdong Environmental Protection Bureau were related to water pollution. Coupled with the fact that Guangdong is responsible for 13 percent of China's economic growth, the availability of freshwater has become the crucial factor for the future growth of the region and for China as a whole. Now more than ever is sound management of Guangdong's water resources critical for sustainable development in China.

WATER QUALITY IMPACTS ON PEOPLE AND ECOSYSTEMS

More than 700 million people in China suffer from sanitation conditions that fail to meet World Health Organization global standards, and a quarter of the country's total population lacks access to clean drinking water. Based on China's 2003 National Health Survey, the World Bank estimates that China has 9 million cases of diarrhea linked to water pollution annually; the Organization for Economic Co-operation and Development reported in 2007 that nearly 61,000 people die from diarrhea due to polluted water each year—half of which are rural children. According to the Stockholm Environment Institute and the UN Development Programme, deaths from liver cancer—which is associated with high levels of inorganic substances in surface water—have doubled since the 1970s. China now has the highest liver cancer death rate in the world. As the following reports show, health problems from unclean water are particularly severe in Guangdong Province:

- The *Nanfang Daily* reported in 2008 that 12.62 billion tons of "polluted materials" and 8.3 bil-

lion tons of wastewater were discharged into the waters off Guangdong in 2007, up 60 percent from the five years earlier.

- According to Guangdong officials, more than 40 percent of the province's rural inhabitants do not have access to safe drinking water.

- The Dong River—a major source of water for Hong Kong—has shown a steady increase in ammonia levels over the last 10 years, with certain sections of the river becoming unsuitable for human consumption.

> **"Now more than ever is sound management of Guangdong's water resources critical for sustainable development in China."**

In addition to its impacts on human health, water quality and quantity also influences biodiversity—an essential component of maintaining the structure, function, and resilience of ecosystems. As biodiversity diminishes, there is a related decline in the performance of ecosystem services, such as the collective benefits of clean water, air, and timber. In other words, poor water quality can impair fundamental cycles that are needed to provide clean water, clean air and productive soils in functioning ecosystems and healthy economies. Forest rehabilitation efforts in Guangdong have a high potential to enhance biodiversity and reduce surface runoff of water and soil leaching, leading to reductions in the flow of harmful chemicals into lowland areas, particularly local water sources.

CHALLENGES IN MANAGING SOUTHERN CHINA'S WATER RESOURCES

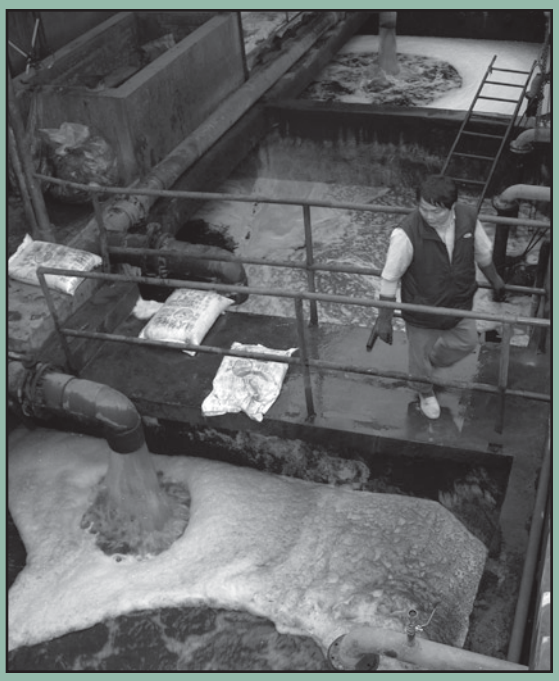
By some estimates, China may grow from its current population of 1.3 billion to 1.6 billion people in 2030. With increasing economic development, a higher standard of living, shifting eating habits, and almost half of the population living in urban areas, China's water resources will become increasingly scarce.

A second challenge relates to lack of information regarding best practices for suppliers' water management operations, as well as oversight and control at the factory level. BSR's research and work with factory managers has found that water management is not a pressing concern for factories, and that current involvement from global apparel and retail brands may partially contribute to that attitude. The primary contributors to this predicament are (1) inconsistency of brand monitoring and enforcement programs, (2) lack of knowledge among factories about the economic and environmental health benefits of sound water management practices, and (3) insufficient sharing of best practices for managing water usage and wastewater discharge among apparel retail brands and factories.

Lastly, though many research studies have examined this region's water quality management, few initiatives have considered the role of the private sector in reversing the degradation of water resources. Six industries account for about two-thirds of all industrial water demand: electric power, iron and steel, petroleum production and refining, chemicals, papermaking, and textile dyeing. Multinational organizations headquartered outside of China, Chinese companies with global operations, as well as local companies all have a part to play, but none have effectively engaged China's water resource management problems. Nonetheless, options are plentiful, including more sustainable management of supply chains, increasing water efficiency in operations, direct engagement with local stakeholders, and investments in the ecosystem services that affect water quality and availability.

BSR'S SOLUTIONS FOR CHINA'S WATER CRISIS

To address regulatory, technical and capacity barriers, in July 2008, BSR launched the Water and Environmental Health: Building Constituencies in Southern China project to focus on water quality, as well as the health of workers and the surrounding environment. This two-year project, made possible with generous support from the Rockefeller Brothers Fund, leverages BSR's China Training Institute (CTI), offering extensive experience in supply-chain management as a platform to support



Aeration and biological treatment at a wastewater treatment plant in Guangdong Province.
Photo Credit: Business for Social Responsibility

these efforts. CTI seeks to improve management practices of consumer product suppliers by delivering training to factory management that promote sound labor and environmental practices in Chinese export facilities; it will allow BSR to target areas where there has been minimal progress but where action by global companies will produce the most significant impacts.

From its China headquarters in Guangzhou, China, BSR's Water & Environmental Health program will consist of three major initiatives:

1. WATER MANAGEMENT IN CHINA'S APPAREL AND TEXTILE SECTOR

Building on existing relationships with members of the Sustainable Water Group and their suppliers, BSR is working with mills, laundries and dye houses to better understand water management at the factory level by conducting a comparative study on water quality management in a dozen Guangdong factories. The results of the study will be incorporated into the design and development of a customized, web-based, water information database for factory managers. The study's results will also be used to develop CTI's water management curriculum. BSR's work with multinational corporations and their suppliers is aimed at establishing long-term systemic change to improve water management practices in this sector in southern China. Findings and activities from this sector are being applied to other industries operating in the region.

2. WORKER ENGAGEMENT IN WATER QUALITY, SANITATION AND HYGIENE

Many factories in southern China include onsite dormitories that can house up to 20,000 workers. It is possible to deliver water quality, sanitation and hygiene education to worker communities while strengthening the capacity of local NGOs to act as service providers. BSR's aim is to develop a program that incorporates experiences from HERproject (www.herproject.org)—a program that delivers women's reproductive health education via peer-to-peer training—to help factory managers and workers understand the link between water quality and health.

3. STAKEHOLDER ENGAGEMENT FORUMS

Finally, BSR will present its findings at two forums in Guangzhou to build the link between water quality and environmental health in southern China. As the capstone component of BSR's proposed work with the Rockefeller Brothers Fund, the forums will ensure alignment between key stakeholders from the private sector, Chinese government, local and international NGOs, and academia. The first forum, a stakeholder engagement, will identify critical factory successes that have led to increased water efficiency, water reuse and sound management of wastewater, in addition to helping participants understand their respective roles and activities needed to build awareness and long-term capacity to improve water quality, ecosystems and human health. The second forum will create a broad network of actors at the intersection of water and health who can continue to self-organize after the formal BSR project concludes in 2010.

Linda Hwang is the manager of Environmental Research & Development at Business for Social Responsibility (BSR). To find out more about BSR's water-related initiatives in China, contact her at lhwang@bsr.org.

FEATURE ARTICLE

Environmental Mass Incidents in Rural China: Examining Large-Scale Unrest in Dongyang, Zhejiang

By Ma Tianjie

China is witnessing an alarmingly rapid increase in social unrest linked to pollution, especially in rural areas. Although pollution-catalyzed group petitions, protests and even violent riots are so widespread and severe, officials have dubbed them the euphemistic term "environmental mass incidents." Examination of a specific environmental mass incident that occurred in Zhejiang Province in 2005, along with reports and studies of other pollution-related mass incidents in China, highlight some of the drivers behind this rising unrest. Notably, not all serious pollution problems lead to violent protests, but the recipe for unrest is often cases in which an "entrepreneurial" local government allows heavy pollution to occur and shuts down any effective grievance relief channels. China's central government is increasingly viewing environmental mass incidents as a security threat, which is a mindset that closes off opportunities for dialogue, transparency, and institutional reforms, which could lessen tensions and potentially prevent major conflicts over pollution from erupting.

THE EMERGENCE OF ENVIRONMENTAL MASS INCIDENTS IN RURAL CHINA

An alarming sign of China's quickly deteriorating environmental situation is the rapidly increasing number of disputes, unrest and even riots linked to—often long unresolved—pollution problems. Chinese government documents, news media reports, and academic studies often refer to severe environmental conflicts involving large groups of people as "environmental mass incidents" (*huanjing qunti xing shijian*). (See Box 1 on official definitions of this term). High-level environmental officials, such as deputy minister of the Ministry of Environmental Protection (MEP) Pan Yue, have on different occasions highlighted the emerging crisis of pollution protests. According to Pan, in 2005 alone there was a 29 percent increase in environmental mass incidents from the year before (Wang, 2006). The Chinese government and Communist Party are concerned about these protests, and China's leadership considers environmental protest one of the four major sources of social unrest in the country (Economy, 2004).

Digging Behind Unclear Numbers

Determining the actual figure of environmental mass incidents through publicly available sources is challenging. In his discussion of the 29 percent increase in 2005, Pan Yue did not reveal the actual number of protests that year. Nevertheless, several indicators used by different Chinese government agencies may reflect the scale of the problem. One indicator is the number of mass incidents in general. According to Zhou Yongkang, minister of the Ministry of Public Security, between 1994 and 2004 the number of mass incidents (protests involving 100 persons or more) in China increased from about 10,000 a year to 74,000 (French, 2005). Chinese public security sources in the mid-2000s estimated that among these mass incidents about 30 percent are related to unemployment, by far the largest source of social unrest in China. Another 27 percent of these incidents stems from issues related to land grabs, a particularly serious source of social disturbance in rural China. The estimate for environmental mass incidents could then be approximately 5,000 a year (based on the 74,000 figure in 2004), given that such incidents are one of the remaining major sources of social unrest.[1]

BOX 1. "Environmental Mass Incidents" in Public Discourse

Mounting concerns over social unrest induced by environmental degradation are reflected in the emergence of the term "environmental mass incident" in the public discourse, including news reports, policy documents, and scholarly writings.[1] Although the exact origin of this term is not clear, it is quite obvious that it derives from the more general term "mass incident" (*quntixing shijian*), which is a reflection of increasing social unrest in Chinese society in general. The vice president of the Central Party School (*zhongyang dangxiao*) wrote an important article in 2006, in which he defined a mass incident "the manifestation of the people's increasingly confrontational and sharpened internal conflicts, [which are] serious social conflicts that affect, disturb and harm normal social order" (Wang, 2006). The phrase is given a more detailed definition in legal documents such as *The Implementation Rules for the Anticipation and Handling of Mass Incidents in Shenzhen* (*shenzhenshi yufang he chuzhi quntixing shijian shishi banfa*),[2] which delineated eight forms of mass incidents:

1. Large-scale collective petition (*shangfang*);
2. Illegal gatherings, protests and demonstrations involving large number of participants;
3. Illegal strikes;
4. Groups of people surrounding and sabotaging party, government and jurisdictional buildings and other important facilities;
5. Blockade of major transportation lines or illegal occupation of public places involving large numbers of people;
6. Collective obstruction of key national, provincial and municipal construction projects;
7. Group attack and/or abduction of civil servants; and,
8. Other activities that are induced by people's internal conflicts that harm public orders.

In the same regulation, mass incidents are divided into four different levels according to the number of participants: Level I (5-30 people); Level II (30-300 people); Level III (300-1,000 people); and Level IV (more than 1,000 people).

Another important indicator of conflicts caused by environmental issues would be the statistics on environmental complaints (*huanjing xinfang*), which refer to complaints (by letter or in person) filed with environmental bureaus all over the country. According to the 2006 *China Environmental Statistics Yearbook*, the number of environmental letters and complaints increased almost 70 percent from 369,712 cases in 2001 to 616,122 cases in 2006 (SEPA, 2006). The relationship between environmental complaints and environmental mass incidents, however, is not straightforward. Increasing complaints about air, water, and noise pollution could be indicators of the growing number of mass incidents. Alternately, the increase may also suggest that the complaint system is working well and that people have confidence knowing their voices are being heard. Thus, the complaint system could diffuse tensions and lead to fewer cases of mass incidents. As Anna Brettell observed, Chinese authorities actually encourage environmental complaints and have standardized the complaint system as a way to prevent disputes and channel grievances, which contributes to the rise in complaints (Brettell, 2007).

Statistics on environmental disputes (*huaning jiufen*) represent yet another source to tap into the environmental mass incident trend. According to a MEP director, there was a significant rise in the number of environmental disputes from 51,000 in 2004 to 128,000 in 2005 (Lu, 2005 & 2006). Although MEP statistics do not clearly define the term environmental dispute,[2] it still serves as an indirect indicator of increasing trends in conflicts caused by pollution in China.

Although environmental unrest in urban centers such as Xiamen often get wide attention in the domestic and international press (see Box 2), China's rural areas actually have seen more outbreaks of environmental mass incidents (Dai, 2006). The general background of this discrepancy, according to one government official, is the unbalanced development between urban and rural areas, the relocation of urban pollution to the countryside, and the lack of environmental infrastructure in rural areas—all trends that make rural citizens particularly vulnerable to pollution (Dai, 2006).

Environmental Health Challenges in Rural China

The 2006 *National Rural Environmental Protection Action Plan* (*guojia nongcun xiaokang huanbao xingdong jihua*) released by the State Environmental Protection Administration (which was upgraded to the Ministry of Environmental Protection in March 2008) outlines the major environmental health challenges faced by today's rural communities in China.[3]

1. *Poor Sanitation:* Human and animal wastes are often released into the rural environment without any treatment. The 8 billion tons of sewage water and 120 million tons of daily wastes produced annually in China's rural areas that are not properly treated are major sources of water contamination. The Ministry of Health reports that nearly 200 million rural Chinese drink water that is making them sick (OECD, 2007). Moreover, 60,000 Chinese citizens—nearly half of which are rural children—die each year from diarrhea caused by contaminated water (OECD, 2007).

2. *Accelerated Relocation of Pollution to Rural Areas*: With the nationwide restructuring of industries and stricter pollution enforcement in urban areas, heavily polluting industries are moving to the large number of "industrial zones" established in rural areas. Weak enforcement of pollution regulations in these zones has made these township and village enterprises major sources of unchecked pollution.

3. *Soil Contamination from Agricultural Production:* The overuse of chemical fertilizers and pesticides has led to serious environmental consequences including contaminated food, loss of biodiversity, and decreased land productivity. Twelve million tons of food crops are contaminated with heavy metals from agricultural runoff every year.

4. *Water shortages and water contamination:* Less than 40 percent of China's rural areas have access to tap water. One hundred ninety million rural citizens drink water containing pollutants well beyond government standards. News reports and anecdotal evidence collected by researchers and nongovernmental organizations indicate that cancer villages are a growing phenomenon in rural China, particularly in areas near polluted rivers (Gill & Lu, 2007).

Severe rural environmental degradation directly affects the livelihoods of farmers. The negative impact is manifested in two ways: (1) the deteriorating quality of soil and water that affects basic agricul-

BOX 2: An Urban Mass Protest Migrates to Rural Areas: Opposition to the Chemical (PX) Plant in Xiamen and Zhangzhou

Protest against the proposed construction of a chemical plant in Xiamen, a large coastal city in southern China's Fujian Province, was an environmental mass incident that caught wide international attention in 2007. The case is unusual in that it was a large-scale peaceful demonstration in a big urban center that attracted high-level involvement of mainstream news media reporting. Moreover, the relatively "benign" interactions between the public and the government led to a tentative resolution applauded by many. The Xiamen case demonstrates how improved public participation serves as a pressure valve and prevents the upgrading of environmental conflicts. However, the relocation of the chemical plant to Zhangzhou resulted in violent conflict between local residents and the government, illustrating the unresolved problem of environmentally vulnerable rural communities and the relative institutional marginalization of rural residents in comparison with their urban counterparts.

The buildup to the environmental mass protest was unique in that it was catalyzed from above. Specifically, during the March 2007 Chinese People's Political Consultative Conference (CPPCC) meeting in Beijing, a chemistry professor at Xiamen University led 105 CPPCC members in putting forth a proposal to discuss the then imminent construction of a large chemical plant near a densely populated area in Xiamen.[3] The proposal, which made information public for the first time, listed the serious health concerns associated with the particular chemical product (paraxylene or "PX") and asked for the relocation of the project. After learning about the CPPCC proposal, high officials in the Xiamen municipal government reportedly held a meeting to "unify thinking" (*tongyi sixiang*) and recommended that subordinates ignore the CPPCC proposal.[4] The municipal government also initiated a public relations campaign to communicate the economic benefits of the project through press conferences and newspaper articles. But, these efforts failed to alleviate the public's suspicions. Xiamen residents, especially property owners living near the proposed site, expressed serious concern through numerous Internet forums. On June1, 2007, tens of thousands of people went onto the streets in Xiamen to peacefully protest against the project. The demonstration was reportedly triggered by a widely sent text message that asking people to "take a walk."[5] And private citizens posted live videos of the peaceful protesters on the Internet.

The official position on the project changed significantly after this large-scale environmental mass incident. The Ministry of Environmental Protection demanded a "planning environmental impact assessment" (*guihua huanping*) for the whole city of Xiamen, which was later carried out by a group of experts from the Chinese Academy of Science who were convened by the municipal government. The assessment report was released to the public in December 2007. Two weeks later, the municipal government held a high-profile public hearing on the proposed construction, for which the participants were randomly drawn from a pool of Xiamen residents who volunteered through a live TV show. At the hearing, 80 percent of participants opposed the project.[6] Days after the public hearing, Chinese news media outlets reported that the Fujian provincial government decided to relocate the chemical project to Gulei Peninsula in Zhangzhou, a less developed rural town to the west of Xiamen. But, provincial officials immediately refuted the claim.[7]

The rumor of a possible relocation to Zhangzhou triggered unexpected turmoil in the town. On February 29, 2008, thousands of people living on Dongshan Island in Zhangzhou started protests against plans to relocate the plant in their community, which turned into a violent clash with police.[8] Unlike the Xiamen protest that received

extensive media coverage, the Zhangzhou case was largely unreported within China. Although further details about this environmental mass incident are largely missing, the undertone of injustice is still discernible from the rare reports that did emerge.[9] The sharp contrast between the two incidents triggered by the same project is illuminating. While the Xiamen environmental mass protest is being celebrated for the peacefulness, the "benign government/public interactions," and the relative media openness, the Zhangzhou case that happened in a rural setting was haunted by violence, rumors, and media censorship. The incident brought into serious question the strategy of relocation as a solution to environmental mass incidents. While the relocation eased tension in Xiamen, social tension was merely transferred to a rural area. Rural communities that already face many other livelihood challenges are increasingly feeling a sense of injustice in that they are increasingly being viewed as pollution havens for companies unable to meet stricter urban environmental regulations.

"…the relocation of the chemical plant to Zhangzhou resulted in violent conflict between local residents and the government, illustrating the unresolved problem of environmentally vulnerable rural communities and the relative institutional marginalization of rural residents in comparison with their urban counterparts."

> **"The Dongyang case demonstrates that the main drivers of unrest are 'entrepreneurial' local governments that permit pollution to occur and the lack of effective grievance relief channels…"**

tural production, and (2) the health impacts that directly threaten the lives of rural residents (Zhang & Gu, 2003). The growing cancer rate in rural areas of China (in the so-called cancer villages) is probably one of the most tragic consequences of pollution. Official data suggests that between 1988 and 2000, cancer rates in rural populations increased 33.4 percent. (Zhang & Gu, 2003). Even China's Ministry of Health has begun to report on the growing pollution and cancer links in urban and rural areas.

When rural citizens try to speak out on the growing environmental and health threats posed by pollution, they face many institutional obstacles that weaken their ability to combat serious pollution. Key institutional drivers of high pollution in China's rural areas include the mismanagement of public resources at a local government level, the tight alliance between officials and local industries, and inadequate investments in environmental protection infrastructure (Wang, 2006; Zhang & Gu, 2003). Despite the promulgation of measures requiring government transparency vis-à-vis environmental information and regulations mandating citizen involvement in environmental impact assessment (EIA) hearings, rural citizens continue to face difficulties in accessing information about government investments and industrial production. Moreover, EIA hearings are rarely done well, if at all, in rural areas. [*Editor's Note: See special issue on public participation and EIAs in* CES 8]. These institutional challenges that leave citizens disempowered create the context in which environmental mass incidents in China's rural areas should be understood.

Environmental degradation is increasingly becoming one of the key catalysts feeding the growing tension between the Chinese government and citizenry, especially in the countryside. An examination of the Dongyang case helps highlight some of the institutional and social factors triggering major social unrest around pollution in China's rural areas. The Dongyang case demonstrates that the main drivers of unrest are "entrepreneurial" local governments that permit pollution to occur and the lack of effective grievance relief channels for citizens—such as the environmental complaint system, the courts, and the news media. Such channels could go far to diffuse tensions and create necessary pressure on local governments to enforce existing pollution control regulations.

CATALYZING CONFLICT IN DONGYANG

In April 2005, a large-scale environmental mass incident sparked by industrial pollution in a small village in Dongyang, Zhejiang Province, shocked the Chinese authorities, news media, and the general public. The scale—involving thirty to forty thousand villagers and thousands of armed police—was previously unseen in a pollution incident in China. It was referred to by some people as a "peasant uprising" and by some media analysts as a "huge riot" (*Phoenix Weekly*, 2005). In her 2007 article in *Foreign Affairs*, Elizabeth Economy summarized the protest:

> After trying for two years to get redress by petitioning local, provincial, and even central government officials for spoiled crops and poisoned air, in the spring of 2005, 30,000-40,000 villagers from Zhejiang Province swarmed 13 chemical plants, broke windows and overturned buses, attacked government officials, and torched police cars. The government sent in 10,000 members of the People's Armed Police in response. The plants were ordered to close down, and several environmental activists who attempted to monitor the plants' compliance with these orders were later arrested.

The Dongyang case is probably the most well documented environmental mass incident in that it received extensive news coverage, governmental attention (as reflected in numerous reflective articles written by government officials), and academic scrutiny. This coverage is indeed unusual, as similar cases often get little official or academic attention. While these official and academic accounts help reveal how the conflict unfolded, this paper was not able to access first-hand information from those

who were directly involved, which means some important pieces of the story are inevitably missing. Moreover, the conclusions in this paper are also drawn from only one case and thus merit testing by empirical evidence, if possible, in future studies.

Long-Term Opposition

Although two years of unsettled petitions seems to be sufficient time for citizen discontent to build and catalyze a violent protest, the events in Dongyang actually developed over an even longer period. The real start of the conflict should actually be traced back to the establishment of a chemical industrial zone in 1999 near two villages of Huashui Town in Dongyang. As a key part of its developmental strategy, the local government gave strong priority to the introduction of chemical companies into Dongyang, promising attractive land use and energy use terms to investors. The chemical companies directly involved in the 2005 protest incident were located in an industrial zone called Zhuxi, which shares a river with two densely populated villages of more than 12,000 people, one of them located a mere 1,000 meters from the industrial zone ("Pollution starts," 2005). By 2004, 13 chemical companies had moved into the area, producing products from herbicides to plastic products and generating a combined annual revenue of approximately 200 million Yuan (~$25 million) (Hu, 2005).

From the very beginning, the industrial zone met with resistance from the villagers. For example, in 2001, when the Dongnong Pesticide Company, the major chemical company in the zone, first signed a land use contract with the Huaxi (which later changed its name to Huashui) government and Wu village, Wang Wei, the party secretary of the village refused to sign his name. Instead, he investigated the company and wrote a provocative article called, "A Portrait of Dongnong," in which he revealed that the company was notorious for its pollution and had been driven out by several villages where it had formerly been located. Wang printed 1,000 copies of this article and distributed them to citizens in and around Wu village. The pamphlet led to violent incidents, in which one official was wounded and villagers destroyed some of the equipment in one of the factories. Wang Wei, together with another 11 villagers, was later arrested and in 2002 he was sentenced to three years in prison (*Phoenix Weekly*, 2005).

The conflict between villagers and the industrial zone, however, was not at all subdued by the arrest, for anger continued to grow over the massive amount of untreated wastewater flowing into rivers and poisoning the villagers' crops. In July 2003, all the rice grown in Xishan village was completed destroyed because of the herbicide produced in the industrial zone ("Pollution starts," 2005). The damages to local agriculture were so serious that farmers had to buy more expensive vegetables from urban areas to feed their families. The villagers also suffered health problems from gases leaking from the factories, which sometimes were so offensive that people could not open their eyes (*Phoenix Weekly,* 2005).

Under such conditions, the villagers continually used the official complaint (*xinfang*) channels to petition environmental protection bureaus in Dongyang, Jinhua (the municipality one level higher in the administrative hierarchy), Hangzhou (the provincial capital), and Beijing. Once the villagers received a reply from the Zhejiang Environmental Protection Bureau stating that some of the chemical companies in the industrial zone "were violating the rules," however, the government did not shut down these factories (*Phoenix Weekly,* 2005). The villagers also sought help from the news media. In early 2005, Wang Zhongfa, a local villager, went to Beijing to find journalists who could write about the situation. *Phoenix Weekly* (2005) reported that Wang also accompanied a journalist to interview one of the companies several days before the large-scale conflict.

Expired Patience

In March 2005, the conflict started to intensify when villagers were turned away after trying to meet the mayor on "Dongyang Mayor Reception Day." Frustrated, the villagers started to build bamboo tents to blockade the road into the industrial zone. Elderly people from the village stayed to guard these tents. On March 28, hundreds of local government officials and police raided and burnt some of the tents, but villagers kept up the blockade. Three days later, the Dongyang government released a notification announcing all 13 factories in the industrial zone would suspend production and make adjustments (*tingchan zhengdun*). Meanwhile, official warnings were also issued to deter "a small bunch of ill-willed criminals" who "instigate the rabble to harm the social order." On April 6, an ultimatum was announced to those villagers who refused to leave the bamboo tents and Wang Zhongfa, a leader who had gone to Beijing to petition and had accompanied a journalist to the industrial zone, was arrested (*Phoenix Weekly,* 2005).

Undeterred by the police raid and arrests, the villagers continued with their blockade. Then in the early morning on April 10, the local government convened about 3,500 local police and government employees who tried to remove the tents by force—an act that unexpectedly provoked even stronger resistance by the villagers. Twenty to thirty thousand villagers were reported to have gathered and the situation finally turned violent, as described by Economy. Although no one died, dozens were injured, several quite seriously. Strikingly, the local authorities failed to clear the blockade on April 10. Many policemen and government employees were reported to have fled the scene in the face of overwhelming opposition from the villagers.

Initial Fallout

Not surprisingly, this large-scale environmental mass incident attracted high-level attention. Both the governor and party secretary of Zhejiang Province issued orders for local officials to properly deal with the issue.[4] A team led by Ministry of Environmental Protection officials and provincial environmental authorities investigated the industrial zone, which led to the order for the major polluting companies, including Dongnong Pesticide, to shut down or move out of the zone ("Pollution starts," 2005). Only on May 20, after seeing the machinery from the factories removed the week before, did the villagers finally take down the tents.[5] Later that year in December, eight government officials, including the party secretary and mayor of Dongyang, were punished as being responsible for the April environmental mass incident ("Seriously punishing," 2005). Most of them were removed from their original positions, but some only received a "warning." In contrast, eight villagers charged with harming social order were arrested ("Eight villagers," 2006).

The incident also triggered another unexpected development that offers insights into the level of official sensitivity vis-à-vis this incident. A group of Zhejiang activists, after witnessing the unrest in Dongyang, decided to establish an environmental nongovernmental organization (NGO) called Green Watch in Hangzhou to monitor pollution from industrial enterprises in the province. The NGO organizers were not allowed to register under the provincial bureau of civil affairs, the government agency overseeing NGOs. Moreover, Zhejiang security officials arrested Tan Kai, the founder of Green Watch, on dubious charges officially unrelated to the NGO (Buckley & Turner, 2005).

EXPLORING HOW POLLUTION DEVELOPS INTO UNREST

The Dongyang incident raises many questions, such as whether it represents an inevitable clash between industrialization and environment in China or whether the uprising is more a result of mismanagement by political institutions. The intermediate factors leading to the escalation of the conflict into major social unrest are central to understanding the protest.

Pondering the Drivers

In order to better understand the rising number of environmental mass incidents in rural China, it is necessary to put them into a larger analytical framework that reveals the political, social, and economic processes behind them. In her book, *The River Runs Black*: *The Environmental Challenge to China's Future*, Elizabeth Economy emphasized "the role of political institutions and politics in shaping a country's environmental and developmental pathway," (Economy 2004, 14) asserting that environmental degradation is not simply a result of economic development, globalization, or population growth. The emphasis on "political institutions and politics" is particularly important to the analysis of environmental mass incidents in China. To be sure, the increasing environmental unrest in rural China does represent the bitter truth that rapid industrialization comes at a high price. However, it is also true that not all environmental problems lead to violent conflict in China. The growing unrest over pollution indicates disturbing political problems underlying the "black rivers," which are more a result of local political reality than a "natural" consequence of industrialization.

Studies directly looking at environmental protests or environmental mass incidents in China have revealed several different drivers of the increasing turmoil. A widely cited study on this issue, Jing Jun's "Environmental Protest in Rural China" analyzes in detail two environmental protest cases in China—one water pollution protest spanned two decades in Dachuan Village, Gansu Province and another surrounding people in Gaoyang Township, Chongqing being relocated by the Three Gorges Dam (Jing, 2003). Jing Jun's conclusion emphasizes the changing state-society relationship and the growing consciousness of community and individual rights among ordinary citizens as the driving forces of emerging environmental protests. More recent studies, such as Zhang (2007), attribute the

rise in environmental mass incidents to specific political economic situations such as the state-corporate alliance at the local level. Zhang's study is particularly critical of the role played by the local government. He maintains that local officials—who are empowered by higher-level political patrons—form close alliances with businesses on the local level. Protecting local industry is crucial for local officials who are largely evaluated for promotions by their ability to push economic growth. These alliances, further strengthened by the necessity to find alternative sources for tax revenues due to declining revenues from the agricultural sector, has serious environmental consequences such as widespread negligence in EIAs and lax enforcement of pollution control laws at the local level (Zhang, 2007). The structural changes induced by the post-1978 reforms have resulted in the "redrawing of the leadership role in the local landscape" and local governments have changed from regulators to the advocates (e.g., entrepreneurs) of their local enterprises (Jahiel, 1997, 84-85).

Besides a growth-oriented local state that is ill-prepared to address environmental problems, scholars also direct our attention to other social and political elements such as insufficient dispute settlement mechanisms or grievance relief channels. The governance structure at the local level leads to environmental degradation in the first place and "eventually fails to check the violence by not providing civil means of dispute resolution" (Najam, 2003, 66). Minxin Pei argues that the rising environmental protests in China are just one symptom of a "failing state," which is neither able to provide public goods such as environmental protection nor equipped or willing to settle disputes and relieve tensions within the society due to the lack of "pressure valves" (Pei, 2002, 101). Among the so-called "pressure valves," researchers have paid close attention to the environmental complaint system, the court, and the news media.

Anna Brettell, in her study of China's environmental complaint system, pointed out that despite significant standardization and improvement since the 1990s, the system still suffers from insufficient accountability from officials charged with the responsibility to respond to the complaints at the local level and the lack of high-level oversight (Brettell, 2007). In his case studies of anti-dam protests, Andrew Mertha has noted the limited ability of the Chinese news media to cover contentious environmental issues (such as dam construction) in a way that can reframe the issue to bring broad support for policy change, which could possibly prevent environmental conflicts from developing into a political showdown (Mertha, 2008).

Notably, some Chinese NGOs have been using the news media to increase public awareness of some unsavory local governments that permit polluting industries or approve dams without required EIAs. One of the more striking examples of savvy NGO use of news media was when Chinese green groups joined with environmental journalists to carry out a national campaign against planned dams on the Nujiang—one of China's last wild rivers. Subsequent reporting created considerable public discussion on the Internet leading Premier Wen Jiabao to halt the planning of the dams. The Chinese NGO Center for Legal Assistance for Pollution Victims has notably been adept at notifying the news media about class action pollution cases, which promotes transparency—a powerful tool that sometimes helps "encourage" local governments and industries to cooperate in such cases (Ellis, 2007). Pollution victims who can fairly access courts are clearly less likely to protest in the streets.

The Alliance of Local Governments and Dirty Industry

The Dongyang case provides us with an opportunity to examine the arguments on drivers more closely. Ultimately, the Dongyang case illustrates how an "entrepreneurial" local government makes the rural community especially vulnerable to environmental damages, while insufficient grievance relief channels further exacerbate local government and citizen tensions that can then catalyze a major environmental mass incident.

One key aspect of this case is the initial establishment of the Zhuxi Industrial Zone and the nature of some of companies inside the zone. Most of the companies introduced to the Industrial Zone were chemical companies producing products such as pesticides or fluorides. Dongnong Pesticide Company, which was the center of the controversy surrounding the pamphlet circulated by Wang Wei in 2001, is not the only company with a notorious pollution record. According to a reflective article written by a government official involved in the handling of the Dongyang case, among the 13 companies, 11 had received some form of punishment by the Dongyang Environmental Protection Bureau in 2004, and seven were companies relocated from the urban part of Dongyang (Hu,

BOX 3. Other Cases of Rural Environmental Mass Incidents in Zhejiang

Besides the Dongyang case, three other environmental mass incidents occurred in Zhejiang Province in 2004 and 2005.[10] These cases are unique in that they were widely covered in government, news media and academic reports, but thousands more such incidents occurring in rural China take place without outside scrutiny.

THE NINGBO HUAGUANG STAINLESS STEEL CASE

Because of serious dust emissions and noise problems, on November 21, 2004, a violent conflict broke out between villagers and the staff of Ningbo Huaguang Stainless Steel Company. More than 500 villagers were involved in a group fight with company staff, which led to the total suspension of the company's production. The Ningbo government arrested 19 people (including some villagers) after the November conflict. It also initiated a cleanup campaign, inviting experts and villagers to make suggestions on possible improvements and having government inspectors stationed in the company to supervise the progress. On April 6, 2005, not convinced by the company's improvements, more than 200 villagers staged a sit-in blockading the company from resuming production.

THE CHANGXING TIANNENG BATTERY CASE

On June 27, 2005, after high levels of lead were detected in the blood of more than 200 children, hundreds of Changxing villagers broke into Tianneng Battery Company and demanded the suspension of production. The conflict lasted for five days and was only temporarily quieted by the local government, with several people injured in the process. Two months later, the conflict reemerged, with thousands of villagers involved in a violent riot against the police. A few people were injured and many police cars were destroyed. After the incident, the government arrested and sentenced several villagers to jail.

> **"After the incident, the local environmental protection bureau initiated daily pollution inspection, sampling and monitoring…conducted an environmental assessment…and issued reports on how the company needed to address pollution…."**

THE XINCHANG JINGXIN PHARMACEUTICAL COMPANY CASE

On July 4, 2005, a conflict broke out when villagers living near Xinchang Jingxin Pharmaceutical Company asked the company for compensation because of serious odor problems and damages to rice crops. The initial conflict resulted in the temporary suspension of production. But on July 15, believing the facility was resuming production (the official explanation was that officials and company staff were checking some of the hazardous substances stored in the facility), a few hundred villagers tried to blockade the facility, which led into a violent confrontation with the police. More than 10,000 villagers from nearby villages were drawn into the confrontation. The unrest only dissolved after a heavy rain storm. A few villagers were arrested later by the police. After the incident, the local environmental protection bureau initiated daily pollution inspection, sampling, and

monitoring on Jingxin Pharmaceutical Company. It also conducted an environmental assessment for the whole Xinchang River Basin and issued reports on how the company needed to address pollution problems based on the assessment.

NOTES

1. There are different English translations for this term, including environmental group events or environmental mass affairs.

2. A Chinese text of this law is available at: http://www.chinalawedu.com/news/2005/10/ma507163131015002304.html.

3. Yuan, Yue. (2007, October 15). "The Xiamen PX incident," *Life Weekly*. [Online]. Available: http://review.jcrb.com/200803/ca684330.htm

4. "A hundred CPPCC members cannot stop Xiamen PX project. (2007). (*baiming weiyuan nanzu xiamen PX xiangmu*)," *Liaowang Dongfang Weekly*, May.

5. Yuan, Yue. (2007, October 15).

6. Zhu, Jingruo and Shengyang Jiang. (2007, Dec 19). "Continue, suspend or relocate: The PX incident teaches everyone a lesson," *People's Daily*. [Online]. Available: http://news.xinhuanet.com/fortune/2007-12/19/content_7277221.htm.

7. Zhou, Xifeng. (2007, Dec. 19). "Rumor says PX plant will relocate to Zhangzhou, Official denies," Xinhua. [Online]. Available: http://news.xinhuanet.com/local/2007-12/19/content_7277860.htm.

8. Associated Press. (2008, March 5). "Thousands demonstrate against plan to build chemical factory in southern China." [Online]. Available: http://www.iht.com/articles/ap/2008/03/05/asia/AS-GEN-China-Factory-Protests.php.

9. Li Xin, "From Xiamen to Zhangzhou: the Fate of Three People Who Care about the PX Project (*cong Xiamen dao zhangzhou: sange PX xiangmu guanhuzhe de mingyun*)," *New Century Weekly*, March 10, 2008

10. Sources include: Dai, Beijun. "Handling environmental mass incidents in Zhejiang Province: Practice and thinking." Government Research Report, 2006, [Online]. Available: http://hbj.zj.gov.cn/corpus/2005/3.htm; Zhang, Yulin. (2007). "State-Corporation alliance and environmental conflicts in rural China—Using three 'environmental mass incidents' in Zhejiang Province as analytical focus." The Universities Service Centre for China Studies Paper Collection (Chinese University of Hong Kong). [Online]. Available: http://www.usc.cuhk.edu.hk/wk_wzdetails.asp?id=5920; Shaoxing Municipal Environmental Protection Bureau (2005). "Summary of work 2005." [Online]. Available: http://www.chinacitywater.org/hyfx/hyzs/25585-1.shtml; Gui, Aizong & Daohe Zhuang. (2005, July 27) "A toxic surrounded village fights for life." *Democratic Newsletter*. [Online]. Available: http://asiademo.org/gb/news/2005/07/20050727.htm#art06.

2005). More importantly, two of the companies were industrial fluoride makers.

In a MEP notification issued as early as 1997, the fluoride industry was identified as "heavily polluting," and new development of it banned due to the fact that fluoride supply already exceeded market demands. This notification was passed to provincial level environmental bureaus, and, in the case of Zhejiang Province, had been distributed with a detailed implementation guideline attached (Hu, 2005). These requirements were all ignored by the Dongyang local government, which, instead, proactively welcomed the companies into the industrial zone through attractive terms of land and energy use.

By welcoming heavily polluting industry into a densely populated agricultural region, the local government was behaving like a classic "entrepreneurial government" prioritizing revenue generation (the role of an enterprise) over environmental protection (the role of a regulator/public good provider). There are two major incentives for the local government to behave in this manner. First, the pressure from the central government to "develop the economy" is still strong, given the current incentive system—local governments use the achievements of economic goals (e.g., GDP growth) as an exchange for political power and resources—as opposed to the previous system, which mainly used the leader's charisma and "revolutionary visions" as the criteria for career mobilization. Second, the taxation reforms that on one hand gave local governments the claim over the increased local tax revenue while on the other hand have substantially reduced their revenues from agriculture surpluses. Less revenue for agriculture has led local governments to turn their attention to the manufacturing sector for new sources of revenue (Jahiel 1997; Zhang, 2007). This transformation from regulator to "semi-enterprise" is then translated into a series of administrative behaviors deteriorating the rural environment, including negligence in making EIAs, inactions when corporations break environmental regulations, and insufficiently addressing farmers' complaints (Zhang, 2007).

Soliciting Pollution

To some extent, the behavior of the Dongyang local government reflects a disturbing trend in China that is driving dirty industries to rural areas or less-developed peri-urban areas. There are three major routes of pollution relocation within China (Wang, 2008):

(1) from upstream to downstream (especially across political jurisdictions);

(2) from urban centers to their periphery areas (mainly for the dumping of urban wastes); and,

(3) from the developed east to the less-developed west (especially common for heavy-polluting industries such as pulp and paper plants).

Even within the same province, highly polluting industries often migrate from more developed urban areas to less-developed rural communities. One extreme example is Jiangsu Province, where 6,770 industrial enterprises with an annual revenue over 5 million Yuan (~$700,000) have relocated from the highly industrialized southern part of the province to its less-developed northern part since 1994, with a large portion of the enterprises being highly polluting chemical plants or galvanizing facilities (Wang, 2008). Economy also notes that big cities in China often "pursue environmental cleanup by exporting their polluting industries to points just outside the city limits" (Economy, 2004, 120).

Although the Chinese authorities tend to see the pollution-relocation problem as the result of multiple factors including "a lack of attention to the rural environment, the absence of a coordinated environmental strategy for the whole country and an imbalanced development between urban and rural areas" (Dai, 2005), the role of a revenue-driven local state is unquestionably a key element. The relationship between the local state and pollution relocation is best demonstrated by the fact that a few less-developed provinces (including Jiangxi, Anhui, and Henan) have "Investment Soliciting Delegations" specifically targeting high-polluting companies being driven out of the developed provinces such as Zhejiang. Some of the delegations even include the directors of local environmental protection bureaus (Wu, 2008). This kind of "pollution-soliciting" literally creates a "race to bottom" within China, where local governments downplay environmental regulations to attract polluting businesses.

Vulnerable Communities

The Dongyang case also illustrates how growth is pursued by an entrepreneurial local state at the expense

of the livelihood of local people. As the industrial zone shared the main river with villagers, the polluted wastewater poisoned rice, wheat and rapeseed grown by the villagers. Besides agricultural production, the direct health impact was also serious. Among the health problems, the pollution-induced miscarriages were especially disturbing to the villagers (*Phoenix Weekly*, 2005). The trend of relocating pollution to rural areas is even more alarming as these citizens are often more vulnerable to environmental degradation than urban communities, for rural areas often do not have adequate environmental protection infrastructure (Dai, 2005). Pollution also undermines the food supply and livelihoods of rural farmers. Moreover, high costs limit the ability of rural citizens to access to healthcare, which means they are less able to deal with pollution-induced illnesses.

The situation is further exacerbated by the fact that the villagers often have few institutional channels to have problems redressed. The final outbreak of large and violent pollution protests shows deep frustrations that are often more about their political situation than the environment. In studies of environmental disputes throughout Asia Najam (2003) has observed that weak institutional governance is often the intermediate element between environmental degradation and conflicts. In the Dongyang case, villagers rejected the establishment of the industrial zone at the very beginning. Yet their wariness and strong expressions of resistance were never represented or even considered in any of the official decision-making processes. Wang Wei, the village leader, tried to boycott the industrial zone by refusing to sign on the land use contract but failed. Those leading the opposition then resorted to an unorthodox method of resistance by disseminating information about the pollution history of the chemical company, trying to mobilize resistance from the villagers. These efforts did not lead to any positive feedback from local authorities but instead were met with repression. Those sending out alarms were arrested and silenced.

The deadlock situation in the villager's efforts to petition different levels of government showed some of the key shortcomings of the complaint system—the lack of accountability and high-level oversight (Brettell, 2007). China's complaint system has undergone some systematic improvement since the 1990s. Since then, all government departments at the provincial, municipal, autonomous region, city, and prefecture levels are required to set up offices responsible for complaints that are specifically related to their work. Within the environmental complaint system, there are institutional arrangements for bureau staff to receive complaints and visits, often in an around-the-clock manner. There are also procedural requirements stipulating initial investigations should be completed within two days, and that complainants should be notified of the result (Brettell, 2007). However, the current complaint system gives very wide discretion to the officials involved in handling of such complaints without very strong accountability for these decisions. There is no clear definition as to what counts as a "resolution" to a complaint. In some cases, an environmental bureau official can simply pass on some factual information to those who submitted the complaint without fixing the problem, and the official can still report the complaint as being resolved.[6] When dissatisfied citizens turn to an upper level complaint office (*shangfang*), the officials there are vested with even wider discretion, since no rule exists as to how they should respond to such complaints. Often they choose to turn the cases back to the subsidiary office or dismiss them completely.[7]

The Dongyang case is a textbook example of this kind of wide discretion. The provincial Environmental Protection Bureau in Zhejiang chose not to intervene even after acknowledging that some companies in the industrial zone in Dongyang were breaking the rules. Officials at the "Dongyang Mayor Reception Day" could simply turn the villagers away without even listening to their complaint.

Not In The News

The Chinese news media also played a limited, yet noteworthy, role in this case. From the very beginning, the villagers tried to bring their situation to the attention of the news media. Before the violent conflict broke out, at least two news media organizations—the provincial television station of Zhejiang and the local newspaper of Jinhua—had reported the issue (in June 2004 and January 2005, respectively).[8] The absence of issue framing by the media or the domination of an official frame such as "social stability," can close down the political space for dialogue and compromise (Mertha, 2008). In an interview about the Dongyang case, Mertha placed specific emphasis on the importance of early publicity and the use of a frame that can attract a larger audience, which can help diffuse the tension.[9]

In the case of Dongyang, the media reports before the major conflicts were largely limited to

Zhejiang Province, for efforts to attract the attention of national media were thwarted by the local officials who had Wang Zhongfa arrested after he took a Beijing journalist to the industrial zone. Thus, no story was told to attract a broader audience to the plight of the Dongyang villagers.

Quiet Courts

One other important element missing from all these efforts is the legal channel. Based on numerous reports on this unusual case, there is no indication that the local court ever got involved in the process. The absence of a lawsuit in such an intense dispute is remarkable. However, just as Jing has noted in his research, lawsuits are often useless in these cases. Sometimes local courts do not have jurisdiction over high-level state-owned factories. In more cases the polluting projects are seen as of "political importance," therefore "not subject to the possible scrutiny of the country's environmental laws" (Jing 2003, 219). Other restrictions on the full involvement of courts include the often vaguely drafted environmental laws that make it difficult to allocate liability, the interventions by local officials and the lack of legal training of many local judges (OECD, 2005). The lack of an independent legal system is another key reason for China's poor environmental record (Economy, 2007). It is therefore understandable that in Dongyang, either the villagers did not turn to the often costly and prolonged legal process, or that the local court chose not to be involved in the case.

Furthermore, civil society groups are often totally absent as a mediating factor in such disputes. As the Green Watch episode after the Dongyang incident has shown, civil society involvement in such confrontational cases is still subject to strict government control.[10] Under such circumstances, villagers are often left to struggle for themselves with very little outside support in terms of technical and legal expertise.

It was a mixture of threatened livelihood and a deep frustration over injustice and lack of voice that finally pushed the villagers to the streets. Their shouted slogans and posters not only demanded protection of their family's health and livelihoods, they also expressed anger over the injustice imposed on them: "Corrupt officials have their pockets full of money, people have their lives full of pain," "Rich people can buy houses outside the villages, poor people can only wait here for death!"[11]

In this sense, the environmental mass incident is more of a response than an initiative, more of a resistance than an offensive action. A very specific pollution issue rather than a broader political agenda drove this protest. When the issue is sufficiently addressed by the local authorities, the tension may quickly disappear. In the case of Dongyang, after the equipment was removed from the factories in May 2005, the villagers even helped the government to remove the blockade they had built. As researchers have pointed out, this kind of isolated and unorganized environmental unrest lacks the potential of becoming a "rural environmental movement" (Zhang, 2007). Moreover, while these and other similar rural protests generally do not extend beyond a single locality, expand to cover other issues, or turn into an "ideological or organizational challenge" to the state (Perry & Selden, 2003, 17), the central government has begun to view environmental mass incidents as sources of political instability.

IMPLICATIONS OF THE GOVERNMENT'S STABILITY MINDSET

Environmental protests like the Dongyang case are largely an expression of citizen opposition to corrupt local officials protecting polluting corporations and frustration over an inability to hold officials accountable. Despite the overwhelming focus of these protests on local wrongdoings, Chinese central officials view these environmental mass protests as a potential threat to political stability, although they describe these threats with considerable restraint—for example, they are still defined as "people's internal conflicts" (*renmin neibu maodun*).

MEP Minister Zhou Shengxian candidly noted that, "with the increase of environmental mass incidents, pollution has become the 'primer' for social instability" (Zhang, 2007). The chief director of the provincial EPA of Zhejiang Province, when writing about his findings about four big environmental mass incidents in his province during 2005, also started by warning that "environmental disputes have become the new cause of social instability" and that "if being used by a small bunch of ill-willed individuals, [such disputes] could seriously damage the Party-Mass relationship and the Party's image" (Dai, 2005).

Linking environmental degradation to political stability, which is arguably the core concern of the Chinese authorities, would definitely elicit more support for the environmental cause inside the government. Actually, Zhejiang Province, which suffered four consecutive large-scale environmental mass incidents in 2005 (including the Dongyang

case), was among the first provinces to initiate a high-profile greening campaign. Zhejiang officials initiated an "ecological province" project, which includes a "recycling economy 911 project" and a "pollution reduction 811 project." Xi Jinping, the governor of Zhejiang in 2005, emphasized openly that environmental mass incidents could "destroy the fruits of reform and opening."[12]

At the local level, all those counties in Zhejiang that suffered from severe environmental protests established a series of new environmental policies. In Dongyang, besides shutting down nearly half of the Zhuxi Industrial Zone (five companies were completely closed, three were ordered to suspend production);[13] banks were instructed not to give loans to polluting companies; management of polluting companies would be making public apologies; and factories were ordered to commit openly to good environmental practices. In Changxing, another county where large environmental protests broke out, 75 percent of the lead-acid battery industry was shut down, and systems were established to hold local officials personally responsible for pollution accidents ("Economic protection," 2007).

These initiatives do demonstrate the provincial government's response, albeit belated, to rural environmental concerns. But researchers such as Yulin Zhang (2007) also warn about the limited effect of bringing environmental issues into discussions of instability:

> Although [linking environment with stability] could attract some high-level attention, signed orders from high-level officials do not seem very effective in breaking the state-corporate alliance at the local level, nor is [this linkage] useful in redirecting local policy more towards addressing the needs of the people.

Many of the new policies adopted by Zhejiang Province following the Dongyang incident do have a heavy public-relations flavor and on the surface very strong self-policing elements. With the exception of the "green loans" policy, few of the new policies target breaking the strong state-corporate ties that fuel such pollution problems. Actually, two of the most polluting companies in the Dongyang case simply opted to move to another area,[14] which further shows that the ad hoc "campaign style" environmental policies restricted to specific regions could simply displace the problems instead of solving them. Moreover, by including environmental degradation into the stability mindset, the government potentially turns pollution incidents into highly sensitive situations that could limit the role of local community activists, courts, news media and/or NGOs to step in and play a mediating role.

Although the government is still very restrained in its reaction to environmental protests, it still sees them largely as being "manipulated by a small group of ill-willed individuals" who want to harm social order and produce chaos (Dai, 2005; Hu 2005). The deep-rooted suspicion that environmental protests are somewhat an organized challenge to the rule of the Party is identifiable in many of the official writings. For instance, in a reflective article written by an official from the Provincial Party Academy of Zhejiang, environmental mass incidents such as the Dongyang case are seen as particularly "well-organized." The village-level elder's association is even described as a "special interest group" behind the event (Tao, 2006). This mentality creates a political environment hostile to leading individuals such as Wang Wei and Wang Zhongfa, who could have played the role of what Mertha terms as "policy entrepreneurs" that engage other stakeholders (e.g., the news media, NGOs, and sympathetic officials). In engaging other stakeholders these "policy entrepreneurs" can potentially ease the confrontational situation by facilitating compromises. In other words, putting pollution issues into the stability mindset could further limit the political space for such individuals to monitor and expose pollution activities.

Another important detrimental element when environmental protests are viewed as security threats is the subsequent strict control of information. In Dongyang, for example, news media reports of the incident were heavily censored (*Phoenix Weekly*, 2005). Moreover in government policy papers, the control of information to "stop rumors" is often placed on high priority (Dai, 2005). This censorship can restrict important media reporting of local environmental problems that could help reframe the issue, open up space for policy changes, and avoid a political deadlock or even mass protests.

The Dongyang case has demonstrated that environmental mass incidents are an extreme response to the quickly deteriorating natural and political environment for rural communities. These mass incidents are citizens' response to severely threatened livelihoods and a fundamental deprivation of power. To address these issues of environmental

justice requires solutions that are founded on a concern for the security of people and serious government restructuring that would prevent local officials from abusing the environment in the first place. Ultimately, it should be a solution about empowerment rather than control, about participation rather than exclusion, about democratic decision-making rather than ad hoc cleanup campaigns.

ACKNOWLEDGMENTS

The author would like to thank Scot Tanner, Anna Brettell, and the two anonymous reviewers for their comments on this paper.

Ma Tianjie was a summer 2008 research intern at the China Environment Forum. Currently he is in his second year at American University pursuing a Masters at the School of International Service. He can be reached at tm2198a@american.edu

REFERENCES

Brettell, Anna. (2007). "Channeling dissent: The institutionalization of environmental compliant resolution in China," in Peter Ho and Richard Louis Edmonds eds., *China's Embedded Activism.* Routledge.

Buckley, Lila & Jennifer Turner. (2005). "Environmental activist arrested in Hangzhou: Movement still hampered by legal and financial restrictions." China Watch Website, World Watch Institute.

Dai, Beijun. (2006). "Handling environmental mass incidents in Zhejiang Province: Practice and thinking."[*zhejiangsheng huanjing quntixing shijian de chuzhi yu sikao*]. Government Research Report. [Online]. Available: http://hbj.zj.gov.cn/corpus/2005/3.htm.

Economy, Elizabeth. "The great leap backward?" (2007). *Foreign Affairs*, Sept/Oct.

Economy, Elizabeth. *The River Runs Black: The Environmental Challenge to China's Future*, Cornell University Press, 2004.

"Eight villagers sentenced for the Dongyang incident." (2006, January 9). Radio Free Asia. [Online]. Available: http://www.rfa.org/mandarin/shenrubaodao/2006/01/09/dongyang/.

Ellis, Linden. (2007). "Greening the courts: China's legal advocates giving voice to pollution victims and the environment." China Environment Forum meeting summary, April 11. [Online]. Available: http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=228068.

"Environmental protection is a life and death issue for companies." (2007, November 9). *Economic Reference News.* [Online]. Available: http://jjckb.xinhuanet.com/yw/2007-11/09/content_73229.htm.

French, Howard. (2005, Aug 24). "Land of 74,000 protests (but little is ever fixed)," *The New York Times*.

Gill, Bates & Lu Xiaoqing. (2008). "Assessing China's response to the challenge of environmental health." *China Environment Series*, Issue 9, 3-15.

Homer-Dixon, Thomas. *Environment, Scarcity and Violence*, Princeton University Press, 1999.

Hu, Xinmin. (2005). "Uphold the scientific development principle, strengthen the protection of the environment." [*jianchi kexue fazhanguan, qieshi jiaqiang huanjing baohu*]. Government Document. [Online]. Available: http://hbj.zj.gov.cn/corpus/2005/21.htm.

Jahiel, Abigail R. (1997). "The contradictory impact of reform on environmental protection in China," *The China Quarterly*, No. 149, March, 81-103.

Jing, Jun. (2003). "Environmental protest in rural China." In Elizabeth Perry and Mark Selden Eds., *Chinese Society: Change, Conflict and Resistance*, Routledge, 204-222.

Lang, Youxing. (2005). "Consultative democracy and public participation in environmental governance: A case study of rural environmental protests in Zhejiang."[*shangyixing minzhu yu gongzhong canyu huanjing zhili: yi zhejiang nongmin kangyi huanjing wuran shijian wei li*] (paper presented at the Symposium on Public Policy and Governance in Transitional Societies, Guangzhou. [Online]. Available: http://www.chinaelections.org/NewsInfo.asp?NewsID=42918.

Lu, Xinyuan. (2005). "The progress, challenges and solutions of environmental law enforcement in China." [*woguo huanjing zhifa gongzuo jinzhan, tiaozhan yu duice*]. SEPA. [Online]. Available: http://www.sepa.gov.cn/info/jzxx/200509/t20050919_70118.htm.

Lu, Xinyuan. (2006, July 10). "Reform, creativity and problem solving: Environmental law enforcement must adapt to the historical transition." [*gaige chuangxin, pojie nanti, huanjing zhifa bixu shiying lishixing zhuanbian*], *China Environmental News*. [Online]. Available: http://www.sepa.gov.cn/hjjc/hjzf/djt/200607/t20060707_78247.htm.

Mertha, Andrew. (2008). *China's Water Warriors: Citizen Action and Policy Change*. Cornell University Press.

Najam, Adil. (2003). "The human dimensions of environmental insecurity: Some insights from South Asia," *Environmental Change and Security Project Report* (Woodrow Wilson Center), No. 9, 59-74.

OECD. (2003). *Governance in China*, Chapter 17, OECD.

Pei, Minxin. (2002). "China's governance crisis," *Foreign Affairs*, Sept/Oct.

Perry, Elizabeth & Mark Selden. (2003). Introduction to *Chinese Society, Change. Conflict and Resistance*. (Eds.).

Elizabeth Perry and Mark Selden, Routledge.
Phoenix Weekly. (2005, May 18). "Large scale police-people conflict in Dongyang." [Online] Available: http://www.peacehall.com/news/gb/china/2005/05/200505182308.shtml.
Pollution starts with planning: Probe into the Dongyang incident." (2005, May 10). *China Business News*. [Online] Available: http://finance.sina.com.cn/chanjing/b/20050510/03131572813.shtml.
"Seriously punishing those responsible for the Dongyang incident."(2005, December 30). *Zhejiang Daily*.
State Environmental Protection Administration. (2006). *China Environmental Statistics Yearbook* (*zhongguo huanjing tongji nianjian*), 241-243.
Tao, Junyi. (2006, December 12). "The handling of mass incidents and the capability of officals." Website of the Provincial Party Academy of Zhejiang. [Online]. Available: http://www.zjdx.gov.cn/1304/15145.htm.
Wang Aijun. (2006, July 16). "Pan Yue: Tinkering will not solve environmental problems," *Beijing News*. [Online]. Available: http://news.xinhuanet.com/politics/2006-07/16/content_4840328.htm.
Wang, Peng. (2008). "Environmental problems in developing of new socialist countryside." In Dongping Yang eds., *The China Environment Yearbook Vol.2: Challenges and Struggles*, Brill, 99-119.
Wang, Weiguang. (2006, August 31). "The proper handling of people's internal conflicts is key to the establishment of a harmonious society." [*zhengque chuli renmin neibu maodun shi goujian hexie shehui de guanjian*], Xinhua News Agency Report. [Online]. Available: http://news.xinhuanet.com/politics/2006-08/31/content_5029835.htm.
Wu Ruidong. (2008, July 8). "Cutting off the route of pollution relocation." *Xinhua Daily*. [Online]. Available: http://news.xhby.net/system/2008/07/08/010291695.shtml.
Zhang, Yulin. (2007). "State-Corporation alliance and environmental conflicts in rural China—Using three 'environmental mass incidents' in Zhejiang Province as analytical focus." [*zhengjing yitihua kaifa jizhi yu zhongguo nongcun de huanjing chongtu: yi zhejiangsheng de san qi quntixing shijian wei zhongxin*]. The Universities Service Centre for China Studies Paper Collection (Chinese University of Hong Kong). [Online]. Available: http://www.usc.cuhk.edu.hk/wk_wzdetails.asp?id=5920.
Zhang, Yulin & Jinlin Gu. (2003). "Who is the biggest victim to pollution: Discussing rural issues in the background of environmental degradation." [*sheishi huanjing wuran de zuida shouhaizhe: taolun huanjing wuran beijing xia de sannong wenti*]. The Universities Service Centre for China Studies Paper Collection (Chinese University of Hong Kong). [Online]. Available: http://www.usc.cuhk.edu.hk/wk_wzdetails.asp?id=2178.

NOTES

1. Interview with Anonymous U.S. China Analyst, August 21, 2008

2. Several respondents interviewed for this paper noted that the term "environmental dispute" has never been clearly defined.

3. [Online] Available: http://www.sepa.gov.cn/natu/stbh/js/200610/P020061026334063325958.doc (Text in Chinese)

4. Ibid.

5. Dongyang government announcement, [Online]. Available: www.dongyang.gov.cn/dongyang/zhenwudongtai/zhengwuneirong.jsp?InfoId=7867.

6. Interview with Anna Brettell, September 25, 2008

7. Ibid.

8. Samples of earlier reports can be found at: http://www.clapv.org/bbs/viewthread.php?action=printable&tid=99. (In Chinese).

9. Interview with Andrew Mertha, August 7, 2008.

10. Notably, very few Chinese NGO activists have been imprisoned, but the few who have been arrested or harassed by security officials do tend to be involved in anti-pollution activities.

11. Slogans and posters used by the villagers were quoted in Zhang (2007) and the *Phoenix Weekly* (2005, May 18).

12. Speech by Governor Xi Jinping, available at http://www.ywepb.gov.cn/Article_Show.asp?ArticleID=72.

13. Dongyang government announcement, May 23, 2005. [Online]. Available: www.dongyang.gov.cn/dongyang/zhenwudongtai/zhengwuneirong.jsp?InfoId=7867

14. According to the *Economic Reference News* report and Hu (2005), two of the most polluting companies, including Dongnong, voluntarily moved to other provinces to continue production

FEATURE BOX

Green Dragon Media Project

By Max Perelman

DEAR MR. MOU ZHANG,

Gongxi! Gongxi! China is on the minds of many around the world—not only because of the 2008 Summer Olympics and the 2010 World Expo in Shanghai, but businessmen also are excited to hear your country is now one of the world's largest economic markets.[1] Developers know that between now and 2015 roughly half of the world's new building construction will take place in China.[2] But environmentalists are worried to learn China has become the world's largest greenhouse gas emitter.[3] My experience represents all three of these groups. I have worked as an e-commerce consultant based in Asia but am now devoted to promoting sustainable construction in China and the United States.

I focus on buildings and cities because these will be humanity's environmental experiment determining the type of planet on which our children and grandchildren will live. The majority of the world is now living in cities[4] and within the next decade the majority of Chinese will too.[5] People are becoming an urban species; our cities are consuming 2 percent of the world's landmass but 74 percent of its resources.[6] More than 50 percent of China's greenhouse gas emissions are due to the construction and operation of buildings.[7] If cities are our environmental battleground, then Chinese cities are the frontline since China will be urbanizing 400 million rural people over the next 12 to 20 years.[8]

I believe climate change is our global generation's challenge and it is my responsibility to collaborate with you so that our generation does not follow the path of my American parents' generation. That "American" path, perpetrated by consumerist propaganda, will lead to four-hour daily commutes to work, worse than anything now experienced in Beijing, promoting even further dependence on foreign energy, food, and water.

In terms of purchasing power parity, China's GDP has well surpassed the United States and even has a smaller portion of people below the poverty line.[9] I know that the Chinese people are enjoying new luxuries and building new careers: You have a right to and you deserve it. But perhaps there is a way for you to fulfill Deng Xiaoping's challenge of becoming "gloriously rich" while simultaneously addressing the urban and rural environmental challenges we all face. The International Monetary Fund estimates the total cost of China's air and water pollution is 5.8 percent of your country's GDP, almost $200 billion.[10] What if I told you there was a way to minimize these costs while actually reducing many of the other infrastructural "growing pains" of development?

THE ECOBLOCK—MASS-REPLICABLE SUSTAINABILITY

Half of the world's construction is occurring in China and every year the country adds 12 million new urban housing units (as well as all the associated expensive infrastructure and services). The predominant model of development is the "gated" 10- to 30,000-unit SuperBlock. While these one-square kilometer blocks are highly efficient at providing a large number of housing units, SuperBlocks have extraordinarily negative consequences—including congested arterial roads, limited access to public transit, and a high dependency on a costly centralized infrastructure of power plants, sewage treatment facilities and water supply. To keep pace with urban and industrial growth, China is currently building the equivalent of two coal-fired power plants every week.[11] Gloom and doom reports in the international news media on China's air pollution and other environmental problems have notably overlooked what I believe is an exciting plan to

Eighty percent of the construction workers in Beijing, such as the man pictured above, are rural migrants. Photo Credit: Green Dragon Media Project

build a new model for sustainable urban neighborhoods that transforms China's current residential SuperBlock paradigm.

On my way to China in 2007 as part of the Green Dragon Media Project team, I met with Harrison Fraker at the University of California, Berkeley, College of Environmental Design. Professor Fraker wanted to tackle this development challenge while working within the Chinese cultural framework and one-square kilometer SuperBlock development scale. He has partnered with the international engineering firm, Arup, transforming the business-as-usual SuperBlock into a sustainable neighborhood model for China—the EcoBlock. The EcoBlock is a mass-replicable and economically viable alternative that provides 100 percent on-site renewable energy generation; recycles 100 percent wastewater on site; reduces 90-plus percent potable water demand; encourages journeys by foot, bicycle and public transit; and provides 40 to 60 percent of the site area as productive green space—urban agriculture and urban orchards.

According to Professor Fraker, each EcoBlock development represents 415 tons less solid waste, 23.8 million gallons less untreated sewage, and 1,404 tons less carbon dioxide emissions annually. Arup designers estimate that if the EcoBlock replaces just 25 percent of the SuperBlocks being built, China could save $9 billion in infrastructure costs by avoiding the construction of 13 drinking water plants, 11 wastewater treatment plants, 9 coal-fired power stations, and 8 landfills.

In the summer of 2008, the mayor of Qingdao gave official approval to move forward with the first EcoBlock and a developer and site have been selected. Detailed design began in September 2008 and the developer hopes to break ground within 18 months. Construction is anticipated to complete within three to five years. Led by Jean Rogers in the San Francisco office, Arup's primary role has been to provide a portion of the project's seed funding and develop the detailed analysis demonstrating the viability of the project to the Chinese government. The results of the feasibility study are very positive and establish the proof of concept for the EcoBlock, confirming the possibility of achieving self-sufficiency in energy and water systems, and demonstrate the technical, social and cultural feasibility of a sustainable neighborhood model.

THE BEAUTY OF STRAW—WHAT THE OTHER TWO PIGS DIDN'T KNOW

Last summer, I set out to learn more about projects like the Qingdao EcoBlock as well as the barriers and opportunities to expanding China's green building industry. One of the outcomes was a Green Dragon Media Project documentary film and multimedia information source focused on green buildings in China's urban centers. However, urban buildings are only part of the story, though perhaps the largest part since the majority of Chinese will live in cities within the next decade. Nevertheless, the plight of ordinary rural Chinese is a bit closer to my heart, and I have found that oftentimes a dollar spent in the countryside not only has a greater impact, but also is more emotionally satisfying.

As my green building pilgrimage took me outside the cities, I learned that a third of all homes in rural northeast China are drafty and cold, made from mud and straw. Including the more modern buildings, only slightly more than 1 percent of homes in this region are equipped with energy efficiency measures. Understandably, families are often locked in a vicious cycle of poverty and sickness as they struggle to heat their small 700-square-foot homes with four tons of ever-pricier coal each winter.[12] Despite the fact that roughly 30 percent of average rural income goes to coal purchases, families will often manage to find the $4,000 needed to build a "modern" red-fired brick home. This new home will have solid brick walls almost three feet thick that will not only represent an enormous amount of embodied energy, but surprisingly, will require the same four tons of coal to heat annually and be just as dangerous in an earthquake.

BOX 1. STOP PRESS: The Green Dragon Sequel is Coming!

RED HOT GREEN CHINA

WARNING: Content Could be Local and Spicy

Red Hot Green China is a new TV series for international broadcast that follows a young, savvy production team as they explore one of the most critical societal transformations in human history. Because of its sheer scale, China's environmental impacts are already affecting everyone on Earth. As they continue to build, their choices could either make or break humanity's pathway to sustainability. That is why the Red Hot Green Team are going to be our there, on the ground, finding the real stories and the real character that reveal China's potential for a bright green revolution. This is a travel show on a mission.

The TV series will be backed up by RedHotGreen China.com, an online visual media platform that will share feature stories of people and projects geographically-placed around China, a blog, an e-learning cinema and a video-based business who's who directory for China's emerging green leaders.

The production team is split across China and the United States and is currently producing the promotional video. Want to be a part of this? Early-bird corporate sponsorship benefits and investment opportunities are available. Please email carolinegreendragon@gmail.com for details and access to the full online concept description.

In the above photos are a few of the many faces of people in the Green Dragon Media Project's upcoming documentary. The film trailer can be viewed at: www.redhotgreenchina.com.

Just as with urban SuperBlocks, however, I learned of a group tackling this rural challenge from within the cultural and socioeconomic constraints of the region. The Adventist Development Relief Agency (ADRA) is leading a grassroots initiative to build environmentally friendly, energy efficient housing in Heilongjiang Province in China's rural northeast. This is the largest straw bale building initiative in the world. Since introducing straw bale construction to northern China in 1998, the program has worked with local communities, giving training to local construction teams and building over 600 (registered) energy efficient, earthquake-resistant, and culturally appropriate homes and schools using straw and other local building materials. In this extremely cold environment, villagers can take advantage of straw's amazing insulative qualities. Homeowners of straw houses will burn an average of three tons (75 percent) less coal per year to heat versus the mainstream red brick alternative.

Rice turns out to be an incredibly elegant and useful natural material. First, the rice grain can be eaten. Second, the rice husk can be burned as biofuel to produce heat and/or electricity. Next, the husk ash can be used to offset cement and reduce the total embodied energy of concrete, of which China is the world's largest producer.[13] After replacing a large portion of cement with the ash from its burnt husk—reducing the need for the energy-intensive product—the remaining shafts of straw, typically an agricultural waste product, can be baled into blocks of dense insulation for ADRA's homes!

ADRA has been careful to design homes that look like modern red brick structures. Villagers were hesitant at first but word has spread and people now prefer buildings made from straw over brick! This turns out to make good environmental sense as over its lifetime, the straw bale version of a typical rural Chinese home will produce over 300 tons less greenhouse gas. Unfortunately, with the high price of steel, straw-baling equipment is in short supply. ADRA and the provincial government have partnered to launch a new program providing training and straw balers to local construction companies. The project investment yields an impressive one ton of greenhouse gas mitigation per $1 spent. Ensuring 25 percent of the annual 150,000 homes that need to be replaced each year in Heilongjiang Province are made with straw bale could reduce greenhouse gas emissions by 11,250,000 tons, roughly the same amount attributed annually to 511,000 Americans.

BOUND AT THE HIP

Mr. Zhang, you are in Beijing and I am in California—although I share your excitement for China's growth, I also share your pollution. As your SuperBlock's central furnace burns coal to heat an apartment or a villager up north adds a coal briquette to her stove, portions of that coal smoke's fine particulates, sulfur dioxide, nitrogen oxides, and airborne mercury travel the long journey along air currents over the Pacific Ocean to end up in California and other parts of the United States. China is responsible for a quarter of U.S. airborne mercury, a quarter of the particulate matter above Los Angeles,[14] up to a quarter of California's nitrogen oxide,[15] and nearly a third of the state's smog-forming air pollution.[16] Even more troubling, China's coal combustion is predicted to quadruple California's current levels of nitrogen oxides and volatile organic compounds in the next fifteen years.[17]

Geography and winds funnel pollution from the California coast into inland air basins. Comprising two-thirds of the Central Valley landmass, the bowl-shape topography of the San Joaquin Valley Air Basin provides a particularly ideal conduit for trans-Pacific air pollution. This does not bode well for my country's food supply, for California's agriculture industry is the world's fifth largest source of food and agricultural produce and California's Central Valley supplies a quarter of food to the United States. While China's atmospheric pollution has doubled in the past ten years, Chinese desertification and coal combustion is forecast to quadruple atmospheric pollution by 2020 in China as well as in the Central Valley.[18]

Your environmental fate is tied to mine, Mr. Zhang. Coal is the source of 70 percent of China's energy[19] and will be so for the foreseeable future. You use it to produce steel and cement, to generate electricity and to heat buildings—all of these are aspects of the urban environment. The World Bank estimates that between now and 2015, roughly half of the world's new building construction will take place in China—so let's work together promoting green buildings in China.

Sincerely,
Max Perelman

Max Perelman is the research director and co-producer of the Green Dragon Media Project, a documentary film and website identifying barriers and opportunities to expanding the Chinese green building movement.

He can be reached at maxgreendragon@gmail.com. For more information, see the following links:

- *The Film: http://www.greendragonfilm.com/more_about.html*
- *The Qingdao EcoBlock: http://www.greendragonfilm.com/qingdao_ecoblock_project.html*
- *Rural Chinese Straw Building: http://www.greendragonfilm.com/strawbale/index.php*

NOTES

1. MacLeod, Calum. (2008, April 21). "China vaults past USA in number of Internet users." *USA Today*, p. 1A.

2. Langer, Kenneth & Watson, Robert. (2006, January 9). "Bringing LEED to China." *Sustainable Business*. [Online]. Available: http://www.sustainablebusiness.com/index.cfm/go/news.feature/id/1289.

3. "China overtakes U.S. in greenhouse gas emissions." (2007, June 20). *International Herald Tribune*. [Online]. Available: http://www.iht.com/articles/2007/06/20/business/emit.php.

4. NC State University. (2007, May 22). "Mayday 23: World population becomes more urban than rural." [Online]. Available: http://news.ncsu.edu/releases/2007/may/104.html.

5. United Nations Development Fund. (2007). *State of World Population* 2007: Unleashing the Potential of Urban Growth. Page 13. [Online]. Available: http://www.unfpa.org/swp/2007/english/introduction.html.

6. Global Foresight Network. (2006, October). *Future Cities*, page 9. [Online]. Available: www.globalforesight.net.

7. Skinner, Nathaniel. (2007, December 12). Interview with David Fridley, Staff Scientist at the Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory. Conducted after presentation at the Monterey Institute of International Studies.

8. Perelman, Max. (2007, July). Interviews with David Nieh of Shui On Land. [Online]. Available: http://www.greendragonfilm.com/how_industry_works.html.

9. Central Intelligence Agency. *CIA Factbook*. [Online]. Available: https://www.cia.gov/library/publications/the-world-factbook/. China's GDP (purchasing power parity) is $10.21 trillion while United States GDP (purchasing power parity) is $13.08 trillion. Regarding the percentage below the poverty line, it is 10% in China versus 12% in the United States.

10. The World Bank. (2007, March). *Cost of Pollution in China: Economic Estimates of Physical Damages.* Report presented at the International Conference on Sustainable Development, Beijing, China. [Online]. Available: http://go.worldbank.org/FFCJVBTP40.

11. Kim, Juli S. (2007, February 2). *A China Environmental Health Project Factsheet: Transboundary Air Pollution – Will China Choke on Its Success?* Washington, D.C. Woodrow Wilson International Center for Scholars. [Online]. Available: http://www.wilsoncenter.org/topics/docs/transboundary_feb2.pdf. The government plans "building nearly 100 new coal-fired power stations each year until 2012."

12. Perelman, Max. (2007, July). Interviews with Wu Yongxue, Government of Harbin, Heilongjiang.

13. Lawrence Berkeley National Laboratory, China Energy Group. (2008). [Online]. Available: http://china.lbl.gov/cement.

14. Hopkins, Brent. (2006, August 1). "L.A.'s big import: overseas pollution," *L.A. Daily News*.

15. Wells, Janet. (2006, February 2). "Live locally, act globally: The EPA's China Director, Lida Tan, found a way to help clean up her homeland from San Francisco," *The San Francisco Chronicle*.

16. Barboza, David & Bradsher, Keith. (2006, June 11). "Pollution from Chinese cities casts a global shadow," *The New York Times*. Article alludes to 2006 study by Natural Resources Defense Council.

17. Watts, Jonathan. (2005, October 31). "Satellite data reveals Beijing as air pollution capital of the world," *The Guardian*.

18. Pollock, Caitlin. (2007). "From China with Love: Transboundary Dust and the Fate of the California Central Valley." Monterey Institute of International Studies. Unpublished.

19. Kim, Juli S. (2007, February 2). "Transboundary air pollution—Will China choke on its success?" Washington, D.C. Woodrow Wilson International Center for Scholars. [Online]. Available: http://www.wilsoncenter.org/topics/docs/transboundary_feb2.pdf.

SPOTLIGHT

Ensuring Clean Water for Communities in the Earthquake's Epicenter: A Child's Right Post-Disaster Relief Work in Sichuan

By Eric Stowe

China's devastating earthquake on 12 May 2008 claimed more than 80,000 lives and left more than 5 million people homeless and more than 4,000 children orphaned. Within days of the earthquake, the potential for outbreaks of widespread communicable diseases were of major concern to the Chinese Ministry of Health, the World Health Organization, and to countless NGOs en route to assist. Fortunately, the possibilities for outbreaks were mitigated, in large part by the efforts of multiple NGOs undertaking the task of focusing on provisions of food, clean water, and sanitation. However, the Chinese government was a focal contributor and primary catalyst in this push as well.

In the wake of the disaster, and remaining largely underreported, the Chinese government performed an outstanding job of transplanting the displaced communities from the countless tent cities which sprung up after the earthquake to safer and more manageable displacement "villages"—each one housing between 500 to as many as 10,000 people, and each with multiple kitchens, toilets, electricity, and running water. The larger sites house security staff, as well as maintenance crews to keep the "villages" functioning and cleaning crews to keep the sites relatively hygienic. The swift action by the Chinese government in reconnecting nearly 5,000,000 people with basic services in less than three months time was impressive by every measure; it is somewhat disheartening that our own natural disaster in Louisiana has still not seen the level of attentiveness comparable to the Chinese government's in the three years post-Hurricane Katrina.

Several corporations and organizations saw provisions of clean water for the displaced communities as imperative for the long-term health of those populations. Although most displacement camps had running water, the biological contaminants from breaches in the municipal grid were quite high. General Electric, Siemens, and Everpure were but a few of the companies that donated clean water systems to the local government in Sichuan.

Our organization—A Child's Right (ACR)—has been working in China for several years with the goal of providing every orphanage in the country with purified water, through means of purification equipment, which we install, monitor, and maintain. After the earthquake, a sub-branch of the Ministry of Civil Affairs asked if we could help regarding water systems in the displacement villages. With tremendous speed we saw significant donations of equipment, money to fund the project, U.S. State Department assistance to get our equipment into the country, as well as Chinese governmental approvals for us to work directly in the epicenter.

ACR worked with the Chinese government both nationally and provincially in the most damaged areas to provide clean and safe drinking water to families and children impacted by the earthquake. Through our project, ACR installed 30 clean water systems in 10 schools for children displaced by the earthquake, 9 displacement camps, and 1 hospital. All sites were equipped with replacement parts and supplies to keep the systems fully operational for several years; this is important given rebuilding efforts will take quite some time, leaving many in the displacement camps for years before being relocated.

The majority of our work focused within miles of the earthquake's epicenter, and each installation provided water to more than 1,500 people on average. With this undertaking, we were able to provide clean and safe drinking water to more than 50,000 people who severely impacted by the earthquake—30,000 of which were children. We were informed this was the single largest water purification donation of its kind from any organization after the earthquake!

With direction from local government, hiring of local engineers and plumbers, assistance from our own China staff, and additional help from A.J. Antunes Filtration Technologies staff, ACR was

Children tasting the water after treatment for a site with more than 3,000 people. Photo Credit: Eric Stowe

able to install systems in sites with the greatest need for high-impact and sustainable water purification methods. As each site will be in operation for at least three to five years, our national staff and regional contracted employees will provide consistent maintenance and support for each system to ensure success and sustainability at every site.

In our years working in China we have experienced delays, as is common dealing with any government in navigating the bureaucratic chains. On this project, however, the national government, by way of the Ministry of Civil Affairs and the China Association of Social Work, the local government in Sichuan, as well as Civil Affairs Bureau, Water Resources Department, Construction Bureau, Office of Disaster Relief Management, and several local magistrates, assisted extensively and quickly with site designation and proper approvals to install our systems. These agencies also quickly coordinated our work amongst the displaced communities and schools, and continue working with us in monitoring the efficacy of the purification units post-installation.

It has been six months since our work was completed. In that time, the filled-to-capacity displacement camps and schools are being rebuilt, though lives are still far from normal in the region. Local water officials tested several of our systems and found each still provides high-quality water. It is a small offering at best for the communities affected by the earthquake. However, the charitable, philanthropic, and cross-agency partnerships that arose from this event will hopefully be fostered within China and continue to offer substantive and sustainable conduits for change and assistance in the future.

Eric Stowe is director of A Child's Right. He can be reached at: eric@a-childs-right.org. For more information on A Child's Right's work in China and other countries, please visit www.a-childs-right.org.

COMMENTARY

China's Mercury Problem: A Sleeping Giant?

By Celia Y. Chen

Baiyangdian Lake in Hebei Province is intensively utilized and altered by humans. This freshwater system, like many in China, suffers from contaminant inputs from industry, nutrient inputs from agriculture and aquaculture, and fish kills due to anoxia and lake drying. In 2001, we collaborated with Chinese scientists to investigate metal contaminants in the lake with particular interest in methylmercury, a potent neurotoxin to which humans throughout the world are increasingly exposed, mainly through consumption of fish and shellfish (Mergler, et al., 2007; Rice et al., 2000; Sunderland, 2007). Human exposure to mercury is of particular relevance to China given the country's major emissions of Hg from coal-fired plants and the dependence of its population on freshwater fish for protein.

In China, populations are exposed to mercury in areas where fish is a primary food source, through ingestion of contaminated rice, or occupational exposures to mercury via inhalation, usually in coal mines. Mercury in the environment is found in inorganic (Hg^{2+}) and organic (methylmercury) forms of which the latter is the most toxic and readily accumulated in humans and wildlife. Concentrations of mercury in fish are predominantly methylmercury and consumption of fish is the main vector to humans. Mercury concentrations in commonly consumed freshwater fish species in China exceed the maximum allowable limit in fish recommended by the World Health Organization (0.4 mg per kg wet weight) posing a threat to human health (Jin et al., 2006; Chen et al., 2008). These elevated mercury exposures are directly related to the high levels of mercury emissions and deposition in China largely from coal burning and mining that end up in the country's agricultural crops and aquatic food chains. Moreover, reservoir construction for hydroelectric power in China may also exacerbate the levels of mercury bioaccumulating in reservoir fish.

HUMAN HEALTH DANGERS FROM MERCURY

Human exposures to methylmercury have resulted in neurological and cardiovascular effects in adults and developmental effects in children (Grandjean et al., 2005; Mergler et al., 2007). *In utero* exposures are also linked to neurobehavioral problems in children (Grandjean et al., 1997). Thus, children and the unborn fetus (exposed via pregnant mothers) are considered to be the populations at greatest risk of mercury exposure and toxicity (Oken et al., 2005). There are documented cases of mercury exposure in China that have been linked to neurological and physiological effects. For example, a recent study in the city of Changchun in Jilin Province revealed that fish consumption is the primary route of exposure (43 percent of the absorbed dose), followed by inhalation of mercury from coal burning and ingestion of cereal and grains (Li, Wang & Luo, 2006). Fish consumption is also related to elevated blood and hair mercury levels in children living near the South China Sea (Ip et al., 2004). In the industrial port city of Tianjin, mercury is the major risk contributor for children of all the heavy metals measured—copper, zinc, lead, cadmium, mercury, and chromium—due to ingestion of vegetables and fish (Wang et al., 2005). In Guangzhou median blood mercury levels in children were ten times higher in 2001 and 2002 than those of children in the United States (Ye, Fu & Guidotti, 2007).

In certain regions of China, mercury contaminated rice is also an important exposure route (Feng et al., 2008; Li et al., 2008). Fish and rice are both impor-

> **"Estimates of mercury emissions identify Asia as the source of 54 percent of global emissions with China contributing 28 percent of the total."**

tant components of Chinese diets and thus potential vectors for mercury-human exposure. Although ceasing fish consumption in some exposed populations in China has resulted in a reduction in mercury hair and blood levels (Ip et al., 2004; Weihe et al., 2005), this is not necessarily an optimal strategy for reducing health risks. Fish consumption is an important source of protein for many populations around the world and often the main source of important omega-3 fatty acids, which some studies have linked to benefits in neurological development and diminished risks of cardiovascular disease (Oken et al., 2005; Budtz-Jorgensen et al., 2007).

Studies documenting human health outcomes of mercury are fewer in China, but indicate health effects in exposed populations:

- High levels of fish consumption and methylmercury exposure have been correlated with male infertility in Hong Kong (Dickman, Leung & Leong, 1998; Dickman & Leung, 1998).

- Artisanal mercury mineworkers in Wuchuan County (Guizhou Province) with methylmercury exposures via inhalation and rice consumption were found to exhibit clinical symptoms (eyelid tremors and gingivitis) of mercury poisoning (Li et al., 2008a & 2008b).

A LONG-TERM PROBLEM: PERSISTENCE AND BIOACCUMULATION IN THE ENVIRONMENT

Fluxes of mercury into the atmosphere from anthropogenic sources have increased substantially with industrialization, increasing the mercury concentrations in foods that humans consume (Mason, Fitzgerald & Morel, 1994). Throughout the world, mercury is now present in fish and shellfish at levels that can adversely affect humans and wildlife (Driscoll et al., 2007; Evers et al., 2007). The ultimate exposure of humans to methylmercury results from four steps in the environmental fate of mercury:

(1) Emission of inorganic mercury from coal combustion and metal smelting;
(2) Deposition of inorganic mercury on the landscape;
(3) Transformation of inorganic mercury to Methylmercury in aquatic systems; and,
(4) Bioaccumulation of methylmercury in fish and shellfish.

Anthropogenic sources (e.g., electric utilities, incinerators, and industrial facilities) emit inorganic mercury (Hg^0 and Hg^{2+}) into the atmosphere where it is transported and eventually deposited on the landscape (Wiener et al., 2006; Driscoll et al., 2007). Inorganic mercury is then transported via streams and rivers to lakes, reservoirs, and coastal systems where sediment microbes transform it into methylmercury. Methylmercury—the most toxic and bioavailable form of mercury—is readily bioaccumulated and biomagnified in aquatic food webs where it reaches concentrations of potential risk to humans and wildlife. Reservoir creation and management practices have been shown to contribute to higher levels of methylmercury bioaccumulation in fish. In fact, methylmercury bioaccumulation is greater in reservoir fish associated with hydroelectric power than in natural lakes (Tremblay, Cloutier & Lucotte, 1998; Schetagne & Verdon, 1999; Mailman et al., 2006). Thus, increased exposures of humans to methylmercury are attributable to mercury emission and transformation processes related to two of the most common modes of electricity production: coal combustion and hydroelectric power.

SOURCES OF MERCURY

Globally about two-thirds of the total global emissions of mercury stem from combustion of fossil fuels, most of which is coal combustion. Estimates of mercury emissions identify Asia as the source of 54 percent of global emissions with China contributing 28 percent of the total (Pacyna et al., 2006; Jaffe & Strode, 2008). Mercury emitting industries such as steel production, gold mining, and electrical and electronic manufacturing also have domi-

nated industrial development in Asia (Wong et al., 2006). China emitted 696 tons of mercury in 2003 increasing at an average annual rate of 2.9 percent from 1995 with 80 percent of those emissions coming from coal combustion and nonferrous metal smelting (zinc, lead, copper and gold; Wu et al., 2006). In Guizhou Province—a particularly well-studied mining region in China—mercury emissions increased approximately 3 times from 1986 to 2002 and are estimated to double again by 2015 (Tang et al., 2007). China's increase in emissions will undoubtedly increase the global atmospheric pool of mercury as well as the local deposition of mercury domestically with direct consequences for the Chinese population.

HIGH LEVELS OF MERCURY DEPOSITION

In China and other parts of the world, local sources of mercury deposition result in elevated levels in nearby soils and water bodies (Horvat et al., 2003; Wang et al., 2005; Zhang et al., 2006; and Evers et al., 2007). Studies in the northeast United States have shown that mercury deposition in any given region is from both long distant transport and local sources (Evers et al. 2007). In China, estimates of emissions and transport indicate that most of the inorganic mercury emitted by coal-fired plants, metal smelters, and other industries is deposited within China (Jaffe et al., 2008). This suggests that mercury deposition on the local landscape is a major repository of China's own industrial emissions. In fact, air mercury concentrations in Wuchuan, Guizhou Province, one of the important mercury production centers in China, are 100 to 10,000 times higher than background concentrations in Europe and North America (Horvat et al., 2003; Wang et al., 2007). In Beijing and Tianjin, mercury decreases with distance away from the city center into the suburbs suggesting that there is a local deposition of fly ash emitted from power plants (Wang et al., 2005; Zhang et al., 2006). Humans in these areas of high deposition are particularly vulnerable to mercury exposure via inhalation and ingestion of foods (e.g., fish and rice) in which methylmercury has bioaccumulated.

ENERGY PRODUCTION AND MERCURY IN CHINA

China is expected to quadruple its gross domestic product and double its energy use between 2001 and 2020 (Yonghul et al., 2006). This is being met by a surge in construction of energy production facilities, predominantly coal-fired power plants and hydroelectric dams. By 2015, an additional 562 coal-fired power plants will be constructed in China to total more than all the coal-fired power plants in the United States and Europe combined (Dickinson, 2007). China's coal use is expected to increase by 4 percent each year resulting in increased emissions of CO_2, SO_2, and mercury.

Large dams are being constructed throughout Asia as a way to meet growing energy demands while using renewable energy technologies. China's hydroelectric power capacity is growing rapidly with plans to produce 200-240 GW of hydroelectricity by 2020 (Jing, 2006). This near quadrupling of current hydropower will be roughly the equivalent of building one Three Gorges Dam (which inundated an area of 632 km^2) every two years (Yonghul et al., 2006). In fact, although half of the world's largest dams are in China, most of the country's hydroelectric potential has yet to be exploited (Sweet, 2001). These new dams will flood large areas of agricultural and forested land creating large areas of mercury methylation—transforming inorganic mercury to methylmercury the toxic form—in reservoir sediments and bioaccumulation of methylmercury by fish.

Impacts of Reservoirs

Hydroelectric reservoirs are known "hotspots" for elevated methylmercury bioaccumulation in fish. When soils that contain mercury deposits from industry are submerged due to flooding in the creation of reservoirs, there is an initial transformation and release of methylmercury into the water and a subsequent bioaccumulation of methylmercury in the aquatic food chains (Anderson et al., 1995; Schetagne et al., 1999; Evers et al., 2007). Studies in Canada and elsewhere have also shown that elevated mercury in reservoirs arises from fluctuations associated with management (e.g., raising and lowering water levels). Elevated mercury levels have been found to remain high for up to 21 years in fish (Anderson et al., 1995; Schetagne et al., 1999). Total mercury concentrations in aquatic organisms increase 1.5 to 4 times natural lake background levels in new reservoirs and methylmercury concentrations increase by 30 percent in the first 13 years after reservoir creation (Tremblay et al., 1998; Schetagne et al., 1999; Mailman et al., 2006).

In the northeast United States, many reservoirs have considerable methylmercury bioaccumulation in fish due in part to the degree of water level

In the intensively utilized Baijiangdian Lake in Hebei Province, some fish species caught by fishers contained mercury at levels exceeding U.S. EPA human health screening values. Photo Credit: Paul Pickhardt

fluctuation. Reservoirs with greater fluctuation contain fish with higher mercury concentrations (Rodgers, Dickman & Han, 1995; Evers et al., 2007). A study of 12 reservoirs in China revealed that reservoir carp had consistently higher mercury concentrations than carp in the adjacent rivers and that fish from reservoirs with larger catchments and flooded areas had higher mercury concentrations (Jin, Hui & Xu, 1999). This suggests that populations harvesting fish from the reservoirs in China will be at increased risk of mercury exposure.

FINAL THOUGHTS ON MERCURY RISKS IN CHINA

The combination of increased mercury emissions and deposition on the landscape in China with the increased land areas being converted to reservoirs will undoubtedly result in more methylmercury exposure to the Chinese population, primarily through consumption of fish. The extent of the increased human exposure will depend on how well these aquatic systems will be monitored for mercury and whether fish consumption advisories are established, publicized and understood by Chinese consumers. To date, though research on mercury emissions has been increasing in China, mercury bioaccumulation in fish and human exposures via consumption of fish have received far less attention. The mercury in water issue is perhaps overshadowed by the greater news media attention of toxic algal blooms and major pollution accidents into China's lakes and rivers. Sleeping giants rarely make headlines. However, mercury is likely to be far more widespread and its effects more insidious than other pollution problems in China.

In our study of Baiyangdian Lake, we found that there were some fish species caught by fisherman destined for market with mercury concentrations exceeding U.S. Environmental Protection Agency human health screening values (Chen et al., 2008). There is great potential for major influxes of methylmercury into fish due to the high mercury deposition in China and the extensive creation of hydroelectric dams and reservoirs. These energy production developments could result in a major human health issue, and should be brought to the attention of populations with the greatest potential for exposure. Steps

should be taken to monitor mercury in fish species commonly consumed particularly from lakes close to sources of mercury emissions (e.g., power plants and metal smelters) and in reservoirs. Such monitoring would provide some minimal information for fish consumption advisories that would begin to protect public health in this rapidly developing country.

Celia Chen is an aquatic ecologist who has conducted research on the fate and effects of toxic metals in aquatic ecosystems over the last 13 years. She has specialized in the study of mercury bioaccumulation and trophic transfer in lake and reservoir ecosystems. Her research has covered much of the Northeast United States and also Baiyangdian Lake in Hebei Province, China. This research has been supported by grants from the Superfund Basic Research Program of NIEHS (NIH Grant Number P42 ESO737) and the Strategic Environmental Research and Development Program of DOD. She can be reached at: celia.chen@dartmouth.edu.

REFERENCES

Anderson, M. R.; Scruton, D. A.; Williams, U. P.; & Payne, J. F. (1995). "Mercury in fish in the Smallwood Reservoir, Labrador, 21 years after impoundment." *Water Air and Soil Pollution, 80(1-4)*, 927-930.

Budtz-Jorgensen, E.; Keiding, N.; Grandjean, P.; & Weihe, P. (2007). "Confounder selection in environmental epidemiology: Assessment of health effects of prenatal mercury exposure." *Annals of Epidemiology, 17(1)*, 27-35.

Chen, C. Y.; Pickhardt, P. C.; Xu, M. Q.; & Folt, C. L. (2008). "Mercury and arsenic bioaccumulation and eutrophication in Baiyangdian Lake, China." *Water Air and Soil Pollution, 190(1-4)*, 115-127.

Cheung, K. C.; Leung, H. M.; & Wong, M. H. (2008). "Metal concentrations of common freshwater and marine fish from the Pearl River Delta, South China." *Archives of Environmental Contamination and Toxicology, 54(4)*, 705-715.

Dickinson, B. (2007). "The rise of China - Progress at what price?" *Chemical Engineering Progress, 103(6)*, 8-11.

Dickman, M. D.; Leung, C. K. M.; & Leong, M. K. H. (1998). "Hong Kong male subfertility links to mercury in human hair and fish." *Science of the Total Environment, 214(1-3)*, 165-174.

Dickman, M. D.; & Leung, K. M. C. (1998). "Mercury and organochlorine exposure from fish consumption in Hong Kong." *Chemosphere, 37(5)*, 991-1015.

Driscoll, C. T.; Han, Y. J.; Chen, C. Y.; Evers, D. C.; Lambert, K. F.; Holsen, T. M.; Kamman, N. C.; & Munson, R. K. (2007). "Mercury contamination in forest and freshwater ecosystems in the Northeastern United States." *Bioscience, 57(1)*, 17-28.

Evers, D. C.; Han, Y. J.; Driscoll, C. T.; Kamman, N. C.; Goodale, M. W.; Lambert, K. F.; Holsen, T. M.; Chen, C. Y.; Clair, T. A.; & Butler, T. (2007). "Biological mercury hotspots in the northeastern United States and southeastern Canada." *Bioscience, 57(1)*, 29-43.

Feng, X. B.; Li, P.; Qiu, G. L.; Wang, S.; Li, G. H.; Shang, L. H.; Meng, B.; Jiang, H. M.; Bai, W. Y.; Li, Z. G.; & Fu, X. W. (2008). "Human exposure to methylmercury through rice intake in mercury mining areas, Guizhou Province, China." *Environmental Science & Technology, 42(1)*, 326-332.

Grandjean, P.; Cordier, S.; Kjellström, T.; Weihe, P.; & Budtz-Jørgensen, E. (2005). "Health effects and risk assessments." In N. Pirrone & K. R. Mahaffey (Eds.), *Dynamics of Mercury Pollution on Regional and Global Scales: Atmospheric Processes and Human Exposures around the World* (pp. 499–523). Norwell, MA: Springer.

Grandjean, P.; Weihe, P.; White, R. F.; Debes, F.; Araki, S.; Yokoyama, K.; Murata, K.; Sorensen, N.; Dahl, R.; & Jorgensen, P. J. (1997). "Cognitive deficit in 7-year-old children with prenatal exposure to methylmercury." *Neurotoxicology and Teratology, 19(6)*, 417-428.

Horvat, M.; Nolde, N.; Fajon, V.; Jereb, V.; Logar, M.; Lojen, S.; Jacimovic, R.; Falnoga, I.; Qu, L. Y.; Faganeli, J.; & Drobne, D. (2003). "Total mercury, methylmercury and selenium in mercury polluted areas in the province Guizhou, China." *Science of the Total Environment, 304(1-3)*, 231-256.

Ip, P.; Wong, V.; Ho, M.; Lee, J.; & Wong, W. (2004). "Environmental mercury exposure in children: South China's experience." *Pediatrics International, 46(6)*, 715-721.

Jaffe, D.; & Strode, S. (2008). "Sources, fate and transport of atmospheric mercury from Asia." *Environmental Chemistry, 5(2)*, 121-126.

Jin, L. J.; Hui, Y.; & Xu, X. Q. (1999). "Predictive model for mercury accumulation in carp (Cyprinus carpio) of reservoirs in China." *Water Air and Soil Pollution, 115(1-4)*, 363-370.

Jin, L. N.; Liang, L. N.; Jiang, G. B.; & Xu, Y. (2006). "Methylmercury, total mercury and total selenium in four common freshwater fish species from Ya-Er Lake, China." *Environmental Geochemistry and Health, 28(5)*, 401-407.

Jing, D. (2006). "China's hydroelectric power capacity rising." Available: http://english.gov.cn/2006-01/31/content_281715.htm.

Li, P.; Feng, X.; Qiu, G.; Li, Z.; Fu, X.; Sakamoto, M.; Liu, X.; & Wang, D. (2008a). "Mercury exposures and symptoms in smelting workers of artisanal

mercury mines in Wuchuan, Guizhou, China." *Environmental Research, 107(1)*, 108-114.

Li, P.; Feng, X.; Qiu, G.; Shang, L.; & Wang, S. (2008b). "Mercury exposure in the population from Wuchuan mercury mining area, Guizhou, China." *Science of the Total Environment, 395(2-3)*, 72-79.

Li, Z. B.; Wang, Q. C.; & Luo, Y. M. (2006). "Exposure of the urban population to mercury in Changchun city, Northeast China." *Environmental Geochemistry and Health, 28(1-2)*, 61-66.

Mailman, M.; Stepnuk, L.; Cicek, N.; & Bodaly, R. A. (2006). "Strategies to lower methyl mercury concentrations in hydroelectric reservoirs and lakes: A review." *Science of the Total Environment, 368(1)*, 224-235.

Mason, R. P.; Fitzgerald, W. F.; & Morel, F. M. M. (1994). "The biogeochemical cycling of elemental mercury - Anthropogenic influences." *Geochimica Et Cosmochimica Acta, 58(15)*, 3191-3198.

Mergler, D.; Anderson, H. A.; Chan, L. H. M.; Mahaffey, K. R.; Murray, M.; Sakamoto, M.; & Stern, A. H. (2007). "Methylmercury Exposure and Health Effects in Humans: A Worldwide Concern." *Ambio 36(1)*.

Oken, E.; Wright, R. O.; Kleinman, K. P.; Bellinger, D.; Amarasiriwardena, C. J.; Hu, H.; Rich-Edwards, J. W.; & Gillman, M. W. (2005). "Maternal fish consumption, hair mercury, and infant cognition in a US cohort." *Environmental Health Perspectives, 113(10)*, 1376-1380.

Pacyna, E. G.; Pacyna, J. M.; Steenhuisen, F.; & Wilson, S. (2006). "Global anthropogenic mercury emission inventory for 2000." *Atmospheric Environment, 40(22)*, 4048-4063.

Rice, G.; Swartout, J.; Mahaffey, K.; & Schoeny, R. (2000). "Derivation of US EPA's oral Reference Dose (RfD) for methylmercury." *Drug and Chemical Toxicology, 23(1)*, 41-54.

Rodgers, D. W.; Dickman, M.; & Han, X. (1995). "Stories from old reservoirs - Sediment Hg and Hg methylation in Ontario hydroelectric developments." *Water Air and Soil Pollution, 80(1-4)*, 829.

Schetagne, R.; & Verdon, R. (1999). "Mercury in fish of natural lakes of northern Quebec (Canada)." In *Mercury in the Biogeochemical Cycle: Natural Environments and Hydroelectric Reservoirs of Northern Quebec* (pp. 115-130). New York: Springer.

Sunderland, E. M. (2007). "Mercury exposure from domestic and imported estuarine and marine fish in the US seafood market." *Environmental Health Perspectives, 115(2)*, 235-242.

Sweet, W. (2001). "China's Big Dams." *IEEE SPECTRUM*, 46-51.

Tang, S. L.; Feng, X. B.; Qiu, H. R.; Yin, G. X.; & Yang, Z. C. (2007). "Mercury speciation and emissions from coal combustion in Guiyang, southwest China." *Environmental Research, 105(2)*, 175-182.

Tremblay, A.; Cloutier, L.; & Lucotte, M. (1998). "Total mercury and methylmercury fluxes via emerging insects in recently flooded hydroelectric reservoirs and a natural lake." *Science of the Total Environment, 219(2-3)*, 209-221.

Wang, S. F.; Feng, X. B.; Qiu, G. G.; Shang, L. H.; Li, P.; & Wei, Z. Q. (2007). "Mercury concentrations and air/soil fluxes in Wuchuan mercury mining district, Guizhou Province, China." *Atmospheric Environment, 41(28)*, 5984-5993.

Wang, X. L.; Sato, T.; Xing, B. S.; & Tao, S. (2005). "Health risks of heavy metals to the general public in Tianjin, China via consumption of vegetables and fish." *Science of the Total Environment, 350(1-3)*, 28-37.

Weihe, P.; Grandjean, P.; & Jorgensen, P. J. (2005). "Application of hair-mercury analysis to determine the impact of a seafood advisory." *Environmental Research, 97(2)*, 201-208.

Wiener, J. G.; Knights, B. C.; Sandheinrich, M. B.; Jeremiason, J. D.; Brigham, M. E.; Engstrom, D. R.; Woodruff, L. G.; Cannon, W. F.; & Balogh, S. J. (2006). "Mercury in soils, lakes, and fish in Voyageurs National Park (Minnesota): Importance of atmospheric deposition and ecosystem factors." *Environmental Science & Technology, 40(20)*, 6261-6268.

Wong, C. S. C.; Duzgoren-Aydin, N. S.; Aydin, A.; & Wong, M. H. (2006). "Sources and trends of environmental mercury emissions in Asia." *Science of the Total Environment, 368(2-3)*, 649-662.

Wu, Y.; Wang, S. X.; Streets, D. G.; Hao, J. M.; Chan, M.; & Jiang, J. K. (2006). "Trends in anthropogenic mercury emissions in China from 1995 to 2003." *Environmental Science & Technology, 40(17)*, 5312-5318.

Ye, X. B.; Fu, H.; & Guidotti, T. (2007). "Environmental exposure and children's health in China." *Archives of Environmental & Occupational Health, 62(2)*, 61-73.

Yonghul, Y.; Baiping, Z.; Xiaoding, M.; & Peng, M. (2006). "Large-scale Hydroelectric Projects and Mountain Development on the Upper Yangtze River." *Mountain Research and Development 26(2)*, 109–114.

Zhang, X. M.; Luo, K. L.; Sun, X. Z.; Tan, J. A.; & Lu, Y. L. (2006). "Mercury in the topsoil and dust of Beijing City." *Science of the Total Environment, 368(2-3)*, 713-722.

SPOTLIGHT

Greening China's "Factory of the World:" Institute for Sustainable Communities in Guangdong

By Zhang Ye

China's Guangdong Province helped spur the nation's economic miracle and continues to remain a powerful engine of growth, generating 11 percent of the nation's gross domestic product. At the same time, the province faces frequent energy shortages and deteriorating environmental conditions. In response, the Chinese central government set ambitious environmental, health and safety targets, as well as standards for energy use and intensity. However, due to its large number of factories, Guangdong's compliance with these regulations lags behind those of other regions.

In order to help factories achieve and move beyond compliance, the Institute for Sustainable Communities (ISC) has developed an Environment, Health, and Safety (EHS) Academy that will expand the number of qualified EHS managers serving enterprises in Guangdong, a region that has become known as the "factory of the world."

Located at Lingnan University, College of Sun Yat-Sen University in Guangzhou, the academy marks the first time Chinese and U.S. experts have joined together to create a world-class, independent, Chinese-owned and Chinese-staffed EHS training center. Through affordable and convenient training, managers will learn to apply international best practices in EHS management, enabling their companies to increase compliance with Chinese standards, lower energy consumption, and reduce greenhouse gases and other harmful emissions.

ISC developed the academy concept over the course of two years through hundreds of meetings and consultations with Chinese government agencies, factory managers, and multinational corporations. At a 2006 seminar organized by ISC and the General Electric Company, corporations concluded that the most cost-effective way to improve EHS performance within their supply chains—and across Guangdong's manufacturing sector—was to expand the number of EHS managers, or "champions," with the practical knowledge, management expertise, and leadership skills needed to produce positive change in their factories.

The EHS Academy curriculum is based on training developed by leading multinational corporations and international and Chinese experts. A project steering committee made up of ISC's key corporate and Chinese partners provides oversight and guidance. A core group of master trainers began training EHS Academy trainers in early 2009, and ISC anticipates enrollment for the fall session will begin mid-year. The academy aims to certify several thousand managers in its first three years of operation.

The greening of Guangdong's supply chain through the creation of the EHS Academy serves as a strategic approach to promoting sustainable business practices—achieving healthier communities. The academy will serve as a permanent source of EHS leadership and expertise in south China. In this way, it represents a departure from the traditional approach of auditing suppliers. ISC's approach will build the capacity of Chinese practitioners to meet and exceed international practices—and to actively contribute to the growth of the EHS profession in China.

ISC plans to measure results by tracking a number of indicators, including material environmental compliance findings in EHS audits, as well as measures taken to meet international standards. ISC will also measure the reduction of energy consumption at the same level of output, and the reduction of greenhouse gases and other pollutants.

The EHS Academy is a public-private partnership funded by ISC's corporate partners—the GE Foundation, Citi Foundation, Honeywell, and SABIC Innovative Plastics—as well as by the U.S. Agency for International Development. More companies are expected to join the partnership. Resource partners include GE, Adidas,

Workers make tiles in a ceramic factory in Guangzhou, China. ISC is helping factories improve energy efficiency, reduce greenhouse gas emissions, and protect worker's health by launching an academy to train managers on environment, health and safety standards. Photo Credit: Matthew DeGroot

Business for Social Responsibility, U.S.-China Business Council, and the Natural Resources Defense Council. Chinese partner agencies include the Guangdong Economic and Trade Commission, the Guangdong Bureau of Work Safety, and the Guangdong Environmental Protection Bureau.

The EHS Academy is part of a larger ISC program to improve environmental health and resource efficiency in Guangdong. ISC also works with local and regional authorities to improve environmental governance, with educators to develop and implement courses on sustainable development that will provide hands-on learning to primary and middle school students, and with municipal districts and townships to demonstrate how communities can design and implement comprehensive energy efficiency programs.

For more information, please visit www.iscvt.org or contact Zhang Ye at: zhangye@iscchina.org.

COMMENTARY

Public Health and Air Pollution in Chinese Cities: Local Research With Global Relevance

By Sumi Mehta, Aaron J. Cohen, Davida Schiff, Daniel Greenbaum, Nick Moustakas, and Robert O'Keefe

As China continues to experience rapid increases in industrialization, urbanization, and vehicularization, there has been widespread awareness about the potential health impacts of air pollution. This was clearly evident as local officials in Beijing, responding to concerns raised around the world, took drastic measures to improve air quality during the 2008 Summer Olympic Games by limiting automobile traffic, suspending polluting enterprises across northern China, and reducing emissions from coal-fired power plants. These measures likely contributed to improved Beijing air quality in the short term, as Beijing's average daily air pollution index (API)—a summary indicator of air pollution—during the first 26 days of August was 36 percent lower than the average API during the same period from 2000 to 2007. In the long term, however, emission trends (e.g., energy, fuel, and vehicle use), population trends (degree of urbanization, urban population growth, and city size), health trends (age structure and background disease rates), and other important factors (broad changes in regulatory approaches and improvements in control technology) will continue to influence the extent to which exposure to air pollution affects the health of the Chinese population.

The World Health Organization estimates that urban air pollution contributes to approximately 800,000 deaths and 6.4 million lost life-years worldwide each year, with fully two-thirds of these losses occurring in rapidly urbanizing countries of Asia, including China (WHO, 2002). These estimates were made using the results of U.S. studies of long-term exposure to air pollution because such studies have not yet been conducted in the developing countries of Asia, where health, health care, exposure to pollution, and socioeconomic circumstances still differ markedly from the United States. This contributes considerable uncertainty to these and other recent estimates of health impacts of air pollution.

With the effects on air quality of recent, rapid development visibly apparent in the haze and thick clouds of pollution that often shroud many of Asia's cities and industrial areas, government decision-makers, businesses and citizens are increasingly raising concerns about the health impacts of urban air pollution. The Public Health and Air Pollution in Asia (PAPA) Program was initiated by the Health Effects Institute to inform regional decisions about improving Asian air quality to promote health. (See Box 1). The PAPA program collects and reviews research on the health effects of air pollution in Asia, supports new research, and helps the region's scientific communities build their capacity to conduct research and communicate their results effectively to key policymakers in government, industry, international lending agencies, and other stakeholders. We focus here on the China-specific aspects of our program, including the 214 Chinese studies identified in a systematic review of the peer-reviewed scientific literature on the health effects of air pollution in Asia, and HEI-funded research on the health effects of air pollution in representative Chinese cities.

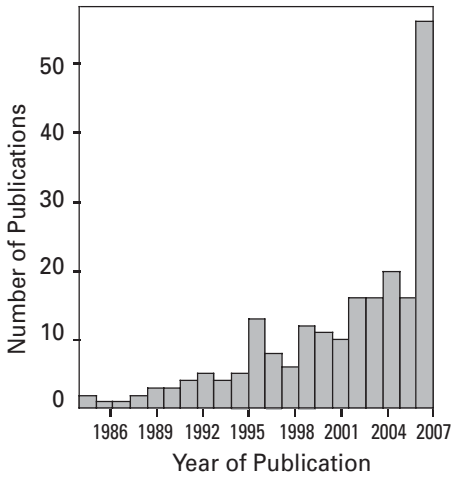
From its inception, PAPA was structured with a clear understanding that science in isolation does not effectively drive policy. We have developed effective strategies for communicating key information on the health effects of air pollution in Asian cities to policymakers and other stakeholders. This has included integrating local air pollution

Table 1: Summary of Reports in China, 1980–2007 (By Study Design)

STUDY DESIGN	NUMBER OF REPORTS
Case–control	7
Case–crossover	12
Cross-sectional	76
Cohort	18
Ecologic	12
Health impact	28
Panel	9
Time-series	52

Note: Data for 2007 includes only reports identified through September 2007

Figure 1: Reports on Health Effects of Air Pollution in China 1980–2007 (By year of publication)



Note: Data for 2007 includes only reports identified through September 2007

and health officials into the PAPA research teams in each Chinese city from the earliest stages and regular briefings of leaders from the Ministry of Environmental Protection (MEP), local environmental pollution boards, environmental nongovernmental organizations, and industry. Over the past four years, the PAPA results have also been a regular part of the annual Regional Air Quality Management (RAQM) meetings for local and national environmental officials in China that are organized in Beijing by China's Ministry of Environmental Protection (MEP), the U.S. EPA, and European governments. These meetings address the health effects, sources of, and control measures for major pollutants in China including particulate matter, sulfur dioxide, and nitrogen oxides from industrial sources. By integrating local evidence within the global literature on the health effects of air pollution, these meetings focus on issues of particular relevance to China.

THE HEALTH EFFECTS OF AIR POLLUTION IN CHINA: REVIEWING THE EVIDENCE

The number of published studies on the health effects of air pollution in China has been growing nearly exponentially over the past quarter century. A total of 214 studies in China (110 in Mainland China, 25 in Hong Kong, and 79 in Taiwan) have now been identified. (See Figure 1). These account for approximately half of the studies identified in Asia overall. In addition, the consistent increase in air pollution studies in China over the past decade parallels the continued increase in similar publications within the region. This could reflect an increased awareness of environmental health risk factors in China, as well as the increased availability of data and technical capacity necessary for conducting quality health effects research. Around 35 percent of these studies are cross-sectional studies, which are typically used to study the effects of long-term exposure to air pollution on the prevalence of chronic respiratory symptoms and disease or on chronic impairment of pulmonary function. Twenty-two percent of these studies are time-series studies, which estimate the effects of short-term exposure to air pollution. Thirteen percent of the studies are health-impact assessments, which estimate the potential benefits, in terms of public health, of actions taken to improve air quality. (See Table 1). In terms of health outcomes, 43 percent of these air pollution studies focused on some aspect of respiratory disease, while 25 percent focused on mortality. (See Table 2).

Table 2: Summary of Environmental Health Reports in China, 1980–2007 (By Outcome Addressed)

OUTCOME ADDRESSED	NUMBER OF REPORTS
Biomarker	16
Birth outcomes	8
Economic assessment	18
Hospital admissions, visits, discharges	20
Lung Cancer	10
Mortality	54
Respiratory disease, symptoms, lung function, asthma	92
Other	25

Note: Data for 2007 includes only reports identified through September 2007

- **Studies in Mainland China:** Most of the reports in Mainland China described studies conducted in metropolitan areas, such as Beijing or Shanghai, or in industrial cities, such as Chongqing, Guangzhou, Lanzhou, Shenyang, or Wuhan. Some estimated the effects of exposure on the basis of residential proximity to industrial facilities or mobile sources.

- **Studies in Hong Kong:** Most of the Hong Kong reports examined the relationship between ambient pollution and respiratory symptoms and disease as well as mortality and hospital admissions. A few health-impact assessments estimated the effects of restrictions on sulfur in fuel oil and industrial air pollution.

- **Studies in Taiwan:** Half of the studies in Taiwan were conducted in the south, where petrochemical plants and heavy industrial complexes are located. More than half estimated the health effects of exposure to both particulate matter and gaseous pollutants, while the rest estimated health effects on the basis of residential proximity to petrochemical and industrial facilities and to traffic.

FACILITATING LOCAL RESEARCH WITH LOCAL RELEVANCE

PAPA-funded studies in representative cities bridge the gap between studies conducted locally and elsewhere, and thus inform policy. These include:

Coordinated studies in Hong Kong, Shanghai, and Wuhan on the health effects of short-term exposure to air pollution:
This is the first coordinated multi-city analyses of air pollution and daily mortality in China. Coordinated multi-city studies in Europe and North America currently provide the most definitive epidemiologic evidence of the effects of short-term exposure, and as a result play a central role in health impact assessment and environmental policy. Such studies also have provided a setting in which important analytic issues, such as how to choose among competing statistical models, can be addressed using large data sets, and can provide a context in which the local scientific capacity to conduct air pollution research can be further developed.

The PAPA studies in these three cities, which began in 2004 and concluded in 2008, are designed and conducted by local investigators in concert with local air pollution and public health officials and international experts, and examine relationships between daily changes in air pollution and mortality in cities with varying climates and air pollution levels. The studies address scientific issues of global relevance including the effects of exposure at high concentrations and at high temperatures, and the potential influence of influenza epidemics on the relationship between air pollution and health. The first systematic presentation of these results was published in the September 2008 issue of *Environmental Health Perspectives* (Kan, 2008; Qian, 2008; Wong, 2008).

For a summary of city-specific pollutant concentrations, and how they relate to WHO 2005 Air Quality Guidelines (World Health Organization, 2006), see Table 3. Note that Shanghai and Wuhan, in particular, have daily average PM_{10} concentrations 2 to 3 times the WHO guideline levels, with a 2.5 to 5 percent increase in short-term mortality expected at the 100 and 150 $\mu g/m^3$ levels respectively. While Hong Kong's pollution levels appear closer to the guidelines, the standard deviations indicate that here too the guideline levels are routinely exceeded.

BOX 1. The Health Effects Institute

The Health Effects Institute (HEI) is an independent nonprofit research institute established in 1980 to provide scientists, public and private decision-makers, and the public with high-quality, impartial, and relevant scientific information on the health effects of air pollution. Over the years, HEI has funded a comprehensive body of new research, scientific reviews, and reanalysis that were designed to be directly relevant to decisions made in the United States and in key international regulatory forums. HEI has sponsored research in the Americas, Asia, and Europe.

PUBLIC HEALTH AND AIR POLLUTION IN ASIA—THE PAPA PROGRAM

In 2002, HEI launched the Public Health and Air Pollution in Asia (PAPA) program in partnership with the Clean Air Initiative for Asian Cities (CAI–Asia) to inform regional decisions about improving Asian air quality to promote health. The PAPA Program collects and reviews research on the health effects of air pollution in Asia, supports new research, and helps the region's scientific communities build their capacity to conduct research and communicate their results effectively to key policymakers in government, industry, international lending agencies, and other stakeholders.

LITERATURE REVIEWS

The first external PAPA product program was an initial Review of the Health Impacts of Air Pollution in the Developing Countries of Asia (http://pubs.healtheffects.org/view.php?id=3) to define the existing landscape, including an initial meta-analysis of time series studies in Asia and comparison to similar studies conducted in the West. A second review, to be published in 2009, will incorporate recent research, including emerging evidence from PAPA-funded research, as well as a meta-analysis of Asian studies on the chronic health effects of air pollution.

Public Health and Air Pollution in Asia—Science Access on the Net (PAPA-SAN) is a web-based (http://www.healtheffects.org/Asia/papasan-home.htm) compendium of peer-reviewed publications of the health effects of air pollution in Asia created to help researchers studying the effects of air pollution in Asia and to provide policymakers, international lending organizations, and other stakeholders with information to help them make better-informed decisions. PAPA-SAN includes 421 peer-reviewed reports identified through September 2007 and published since 1980 on research conducted in 11 Asian countries.

NEW RESEARCH IN ASIAN CITIES

Time-Series Studies: The PAPA Program has funded seven time-series studies of the health effects of short-term exposure to air pollution in China (Hong Kong, Shanghai, and Wuhan), Thailand (Bangkok), and India (Ludhiana, Chennai [formerly Madras], and Delhi). All interdisciplinary investigator teams, selected through a competitive process, consist of experienced local researchers with strong links to local health and regulatory organizations.

Potential Asian Cohort Studies: PAPA funded a pilot study to examine the feasibility of using an existing cohort of elderly in Guangzhou to assess the impact of long-term exposure to air pollution in the development of respiratory and cardiovascular disease. Pilot data documented the high annual levels of air pollution in Guangzhou, but unfortunately did not clearly demonstrate that large enough differences existed in exposure among the population to make a study of this cohort informative. We continue to explore the potential to fund an Asian cohort study.

Poverty, Air Pollution, And Health: With joint funding from the Asian Development Bank, PAPA is supporting new studies of air pollu-

tion, health, and poverty in Ho Chi Minh City, Vietnam, including a hospital-based study of acute lower respiratory infections in children and a household-based exposure assessment study. These studies attempt to address whether the poor are more exposed to and/or impacted by air pollution compared to the non-poor.

ENSURING HIGH QUALITY RESULTS

International Scientific Oversight Committee (ISOC): ISOC oversees all PAPA activities to ensure scientific quality and relevance. Members are leading international experts in medicine, environmental health sciences, exposure assessment, epidemiology, and other related disciplines, including Dr. Jiming Hao of Tsinghua University Institute of Environmental Science and Engineering and Dr. Bingheng Chen of Fudan University School of Public Health.

Quality Assurance: PAPA's QA auditing program provides assurance to policymakers that data completeness and reliability were accurately reported by investigators. An external QA process evaluates the quality and consistency of city-specific environmental and health data and the extent to which studies are conducted according to pre-approved protocols and standard operating and quality control procedures.

Applied Technical Assistance: The PAPA Program is committed to building the capacity of Asian scientists and improving the quality of results. This includes intra-regional networking and assistance as well as inter-regional guidance and collaboration.

Communicating Results: The PAPA program continues to maintain its commitment to bring independent science about the health effects of air pollution in Asian cities to policymakers and other stakeholders, including local and national governments, civil society, academe, private sectors, and development agencies. PAPA investigators, HEI staff, and ISOC members play a visible role (including presentation of work in progress, poster presentations, and participation in symposia and/or workshops) in local, regional, and international forums.

"In 2002, HEI launched the Public Health and Air Pollution in Asia (PAPA) program in partnership with the Clean Air Initiative for Asian Cities (CAI–Asia) to inform regional decisions about improving Asian air quality to promote health."

Table 3: Summary of Daily Average Pollution in PAPA Time-Series Studies

	AVERAGE 24 HOUR (STANDARD DEVIATION) POLLUTANT CONCENTRATION IN μ/M3				
	STUDY PERIOD	PM_{10}	SO_2	NO_2	O_3
Hong Kong	Jan 1996 – Dec 2002	51.6 (25.3)	17.8 (12.1)	58.7 (20.0)	36.9 (23.0)
Shanghai	Jan 2001 – Dec 2004	102 (64.8)	44.7 (24.2)	66.6 (24.9)	63.3 (36.7)
Wuhan	Jul 2000 – Jun 2004	141.8 (63.7)	39.2 (25.3)	51.8 (18.8)	85.7 (47.0)
WHO Air Quality Guidelines, 2005		50 (24 hour average) 20 (annual average)	20 (24 hour average)	40 (annual average) 200 (1 hour daily max)	100 (8 hour daily max)

World Health Organization, 2006

Air pollution and health during the Beijing Olympics (2007–2010):
For Dr. Junfeng Zhang and his collaborators, the significance of the upcoming Olympics would not be best measured in gold medals or world records, but in biological indicators demonstrating the potential health benefits of improved air quality. As the government aimed to reduce fine particulate matter (PM2.5), by approximately 70 percent from pre-Olympic levels, Zhang's PAPA-supported study will assess whether there are measurable changes in lung and systemic inflammation, blood coagulation, autonomic dysfunction, and oxidative stress in healthy local residents. Moreover, the study will assess whether these biomarkers return to pre-Olympic levels after air pollution controls are relaxed. Exposure to PM2.5, ultrafine particles, and key PM constituents will be measured.

Health gains from reducing sulfur content in fuel:
Dr. Chit-Ming Wong's PAPA-funded study, which began in 2006, is assessing the impact of the 1990 Hong Kong restriction of sulfur content in fuel on life expectancy. Earlier studies observed decreased respiratory symptoms in children, decreased mortality from cardiovascular and respiratory disease in adults, and increased life-expectancy as near-term consequences of reductions in SO_2 due to the changes in fuel quality (Peters J et al., 1996; Hedley A, et al., 2002). The current study will evaluate whether any long-term health benefits are due to reduced SO_2 exposure, or to associated changes in the particle composition of fuels. The study also aims to reconcile evidence on short- and long-term effects of air pollution exposure on mortality and life expectancy.

STRENGTHENING THE NETWORK OF ASIAN ENVIRONMENTAL HEALTH SCIENTISTS

PAPA emphasizes applied capacity building through research. For our studies in China, capacity-building work has included:

- Coordinating studies to foster collaboration in study design, study implementation, and consistency of results;
- Building strong links with local health agencies, regulatory officials, and other stakeholders to ensure relevance to local policy decisions and credibility of results; and,
- Funding investigators to present their work at international scientific meetings and regional policy forums.

Due to the high caliber of training and research in Chinese centers of environmental health re-

> **A challenge to addressing the substantial air pollution problems in China is providing quality, credible, and local science to help policymakers decide on the best approaches with the most benefits to public health."**

search, several of our Chinese collaborators have provided technical assistance and training to PAPA-funded investigators in India, Indonesia, Vietnam, and Malaysia.

CONCLUSION

A challenge to addressing the substantial air pollution problems in China is providing quality, credible, and local science to help policymakers decide on the best approaches with the most benefits to public health. The PAPA Program, by marshalling all of the region's literature; conducting new, high quality studies with intensive capacity building; and communicating the resulting science in diverse stakeholder forums, is advancing the state of knowledge in China, building a stronger bridge between Chinese scientists and international expertise, and providing the foundation for better air quality decisions.

ACKNOWLEDGEMENTS

The PAPA Program is supported with funds from the U.S. Agency for International Development, the William and Flora Hewlett Foundation, the Asian Development Bank, industry, and others. For more information on the Health Effects Institute's PAPA Program email PAPA@healtheffects.org. Sumi Mehta, Senior Scientist (smehta@healtheffects.org); AJ Cohen, Principal Scientist (acohen@healtheffects.org), D Greenbaum, President (dgreenbaum@healtheffects.org); N Moustakas, Policy Associate (nmoustakas@healtheffects.org); and R O'Keefe, Vice President (rokeefe@healtheffects.org) are all members of the HEI's PAPA team. Formerly a research assistant at HEI, D Schiff (dschiff@bu.edu) is now a medical student at Boston University.

REFERENCES

Hedley A.J.; Wong C.M.; Thach T.Q.; Ma S.; Lam T.H.; & Anderson H.R. (2002). "Cardiorespiratory and all-cause mortality after restrictions on sulphur content of fuel in Hong Kong: An intervention study." *Lancet*, 360, 1646–1652.

Kan, H.D.; London, S.J.; Chen, G; Zhang, Y; Song, G; Zhao, N; Jiang, L; & Chen, B. (2008). "Season, sex, age, and education as modifiers of the effects of outdoor air pollution on daily mortality in Shanghai China: the Public health and Air Pollution in Asia (PAPA) Study." *Environmental Health Perspectives*, 116, 1183-1188.

Peters J.; Hedley A.J.; Wong C.M.; Lam T.H.; Ong S.G.; Liu J.; & Spiegelhalter D.J. (1996). "Effects of an ambient air pollution intervention and environmental tobacco smoke on children's respiratory health in Hong Kong." *International Journal of Epidemiology*, 25, 821–828.

Qian, Z.; He, Q.; Lin, H.M.; Kong, L.; Bentley, C.M.; Liu, W.; & Zhou, D. (2008). "High temperatures enhanced acute mortality effects of ambient particle pollution in the 'oven' city of Wuhan, China." *Environmental Health Perspectives*, 116, 1172-1178.

Wong, C.M.; Ou, C.Q.; Chan, K.P.; Chau, Y.K.; Thach, Q.Q.; Yang, L; Chung, R.Y.; Thomas, G.N.; Peiris, J.S.M.; Wong, T.W.; Hedley, A.J.; & Lam, T.H. (2008). "The effects of air pollution on mortality in socially deprived urban areas in Hong Kong, China." *Environmental Health Perspectives*, 116, 1195-1202.

World Health Organization. (2002). *The World Health Report 2002: Reducing Risks, Promoting Healthy Life.* Geneva, Switzerland: World Health Organization.

World Health Organization. (2006). "Air quality guidelines. Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulfur dioxide." Copenhagen, Denmark: World Health Organization

FEATURE BOX

Coal City: China Environmental Health Project Work in Huainan

By Wei-Ping Pan and Ma Tianjie

Huainan city, an industrial town in Anhui Province, is often referred to as the "coal-powered Three Gorges" because of its status as the energy base of eastern China. Coal—which provides 70 percent of China's energy—releases many pollutants into the air including sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and mercury, resulting in a profound impact on human health and the environment. There are between 400,000 and 750,000 premature deaths attributed to air pollution every year in China. Huainan's three (soon to be four) coal-fired power plants generate considerable amounts of energy and pollution. Huainan produced 11 million tons of coal in 2004 and is projected to reach 30 million tons by 2030. Due to its crucial place in China's energy and environmental landscape, Huainan was selected as the location for the coal monitoring activities of the China Environmental Health Project (CEHP)—a U.S. Agency for International Development (USAID)-supported joint project between Western Kentucky University (WKU) and the Anhui University of Science and Technology (AUST). The China Environment Forum works together with WKU and AUST on information dissemination and outreach activities.

OBJECTIVES OF CEHP COAL PROJECT

The main purpose of CEHP in Huainan is to build the capacity for coal monitoring in the city and to closely examine the effects of heavy coal use and poor air quality on health. Components of this initiative include improving the monitoring system of SO_2, NO_2, and PM_{10} (particulate matter with diameters measuring less than 10 micrometers); training and educating Chinese researchers and students in the latest techniques; and reducing coal-related health problems. Because Chinese standards have not been established for some of the pollutants (such as mercury), CEHP work in Huainan employs U.S. Environmental Protection Agency (EPA) standards and sampling equipment to ensure the quality of measurement and analysis.

CEHP FINDINGS AND ACCOMPLISHMENTS

CEHP teams collected air quality samples from three communities near the three functioning coal-fired power plants in Huainan. They revealed an alarming fact that in the absence of a flue gas desulfurization (FGD) scrubber, 90 percent of the mercury in coal would be released into the air. These findings are significant, considering that Huainan's coal contains two to three times more mercury than the coal found in other parts of China and the United States. Emissions containing PM_{10} are at a dangerously high level in Huainan due to the unusually high fly ash content in Anhui's coal. Particulate matter in general not only affects air quality visibly—as is seen in the black snow that falls in Huainan—but also causes asthma, lung cancer, and cardiovascular diseases. Even in rain, the levels of particulate matter in Huainan's air never fall below the U.S. standards for safety. Overall, SO_2 emissions have been decreasing since scrubbers—now mandatory for all power plants in the country—were installed at all three power plants; however, with the addition of a new power plant and the growth of other industries, SO_2 and other emissions will undoubtedly increase in the city.

AUST and WKU researchers gathered information on the effects of heavy pollution on ap-

Western Kentucky University Professor Wei-Ping Pan and two professors from AUST medical school giving lectures on the effects of air pollution on health to elementary school children and faculty in a mining area near Huainan City, Anhui. Photo Credit: AUST

proximately 3,000 elementary and middle school children (ages 11 to 15) and in residential areas in Huainan, comparing it to data gathered in Taiyuan, one of China's 10 most polluted cities. While pollution-induced health problems are increasingly serious in Huainan, the results fared better than Taiyuan in terms of disease burden, which included chronic bronchitis, asthma, constant colds, and other respiratory illnesses.

In September 2008, AUST and WKU held a conference in Huainan to discuss the challenges and successes in compliance and enforcement programs in China; the air pollution monitoring system in Huainan City; as well as the experiences in enforcing U.S. emissions monitoring, reporting, verification, and programs (the latter topic was presented by Jeremy Schreifels (EPA). Also presented were results of studies from the CEHP/USAID air program for the past two years:

- Emissions from three Huainan coal-fired power plants;
- Mercury distribution in the particulate matter emitted from Huainan city;
- The lifecycle of trace metal from coal-fired power plants; and,
- The relationship between particulate matter and meteorological factors.

The impact of climate change on the United States (Jerry Shang, former Department of Energy) and carbon dioxide (CO_2) capture technologies (Yan Cao, Western Kentucky University) were also topics addressed during the workshop.

FUTURE WORK OF CEHP'S COAL PROJECT

Climate change is a growing concern internationally and a growing challenge for China, now regarded as the world's top greenhouse gas emitter. A primary emission of coal use, CO_2, is

believed to contribute 63 percent of global climate change. Thus, CO_2 capture remains an important area of CEHP research. In 2009, AUST will continue to enhance their partnership with WKU to target these issues with enhanced scientific processes, adding new sophisticated equipment—such as carbon gas-phase monitoring systems—and expanding their monitoring to two new power plants in Huainan. Future work will also be informed by the emerging goals of the recently established Asia-Pacific Partnership on Clean Development and Climate (APP-CDC). As the data accumulates, the team will then collect it in a comprehensive database and disseminate it, with analysis, to decision-makers.

Carbon to Crops Initiative

Another application of the data is to use captured carbon as a fertilizer in order to store the carbon long-term. CO_2 produced from combustion sources, such as fossil-fuel fired power plants, can be captured from the flue gas. When combined with aqueous ammonia, the captured CO_2 forms ammonium bicarbonate—an economically and environmentally acceptable nitrogen fertilizer. Since ammonium bicarbonate is water soluble, this fertilizer acts as a "CO_2 carrier" to "transport" CO_2 from the atmosphere to crops. About 10 percent is directly absorbed by growing plants. The majority (76 percent) of the remaining carbon percolates into the soil as water-soluble bicarbonates—eventually sinking into aquifers—forming environmentally safe carbonate salts of calcium and magnesium. Generally speaking, alkaline soil better captures and stores carbon.

POLICY IMPLICATIONS OF COAL CITY

Heavy reliance on coal for energy poses serious challenges for Chinese policymakers. China has stringent regulations for new power plants, but some of the older plants are heavy polluters and shutting down or retrofitting these inefficient plants is costly. Comprehensive monitoring of emissions from old plants and convincing analysis of the deleterious health impacts they are causing can help policymakers better comprehend the total costs of coal emissions. In addition to preventing dirty coal emissions, China needs to stress better energy efficiency, especially in buildings, as it is a cost-effective way to reduce demand for coal-powered energy. Speaking at a May 2008 China Environment Forum meeting, Derek Vollmer of the National Academies noted that because so many cities are developing rapidly, it is also imperative that Chinese cities "build smart instead of build out." Pollution control will not only save lives but also impact the local economy by reducing the days of work lost and the volume of crops damaged from acid rain, which is especially significant given that much of China's scarce cropland is located at the peripheries of heavily polluted cities.

For more information on the CEHP coal project see http://www.wku.edu/cehp/ or Wei-Ping Pan at Western Kentucky University: wei-ping.pan@wku.edu.

Ma Tianjie was a summer 2008 research intern at the China Environment Forum. Currently he is in his second year at American University pursuing a Masters at the School of International Service. He can be reached at tm2198a@american.edu.

COMMENTARY

Neither Black Nor White: Mangrove Conservation With Chinese Characteristics

By Liu Yi (Translated by Jing Chen and Ma Tianjie)

Fenglinwan, a bay near Xiamen City, Fujian Province, used to be home to the largest area of mangroves in the region. However, beginning in the 1960s, a large campaign to reclaim land from the sea almost erased all the mangroves. Following the reclamation in the bay, just a few mangroves remained in the village of Dongan. In the late 1980s, a farmer in neighboring Jimei village noticed that there were many crabs in the areas where mangroves still grew, and he correctly surmised that there was a healthy relationship between the mangroves and the crabs. At that time, crab was a local delicacy with market prices ranging from 15 to 20 Yuan per kilogram. The villager decided to grow mangroves in another part of Fenglinwan and between 1989 and 1996 he successfully planted 50 mu (1 mu = .1647 acres) of mangroves, with seedlings collected from the original mangroves that remained in Dongan Village. With his gradually improving planting skills, the area of mangroves grew quickly, together with his income. As mangroves became his main source of income, he started to patrol the mangroves regularly to prevent others from damaging them. When other villagers saw the profitability of the mangroves, they joined him in cultivating and protecting this unique coastal ecosystem. Today there are about twenty families from Jimei Village who are in the mangrove-crab business, with the total mangrove area reaching nearly 120 mu. A 1992 National Forestry Bureau policy that granted families exclusive user rights of the mangroves, giving them full access to the profits from crabs and other aquatic products.

SEEKING SOLUTIONS FOR DISAPPEARING MANGROVES

Southwest China could be dubbed the mangrove hotspot of northeast Asia, with about 22,300 hectares of mangroves along the coasts of Hainan, Guangdong, Guangxi, Fujian, Zhejiang, Hong Kong, and Macao. China's mangroves are home to 2,305 identified species of animals and plants, including 43 percent of total mangrove species in the world. One-third of China's mangrove species are on the International Union for Conservation of Nature's red list and mangrove areas have shrunk by 55 percent over the last 50 years. Three major historical events have led to the destruction of the mangroves in China: (1) land reclamation projects in the 1960s; (2) reclamation of tidal flats and deforestation for aquaculture in the 1970s and 80s; and (3) urbanization boom from the 1990s to the present.

The Chinese government and a handful of local nongovernmental groups are beginning to take action to protect and expand mangrove habitats. Mangroves, which are trees and scrubs that thrive in salty waters, protect shorelines from wind and sea surges, purify water and serve as vital habitat for birds and seafood.

The China Mangrove Conservation Network (CMCN)—a former student environmental group that has become a professional conservation organization—believes success of any mangrove protection effort hinges on whether it addresses the core needs of all stakeholders depending on this unique coastal ecosystem. For seven years CMCN has been conducting campaigns that have been promoting research, encouraging mangrove rehabilitation and providing public education, community development and training to restore and sustainably use mangroves. CMCN runs 20 ongoing projects on four key topics: (1) sustainable development

Volunteers helping to plant seedlings as part of the mangroves restoration project in Jimei Xiamen, Fujian Province in 2008. It is hard work to plant the mangroves in the mud, and sometimes you need to PLANT yourself first so you can plant the seedlings. Photo Credit: Liu Yi

BOX 1. History of China Mangrove Conservation Network

China Mangrove Conservation Network (CMCN) was originally a mangrove program under Green Wild, a student organization established in 2000 at Xiamen University. In 2001, Green Wild established a mangrove team to protect mangroves in Xiamen and nearby areas. In 2003, this team was renamed the Mangrove Program, and expanded the protection area to all of Fujian Province. In 2005, the program reoriented itself and adopted the name China Mangrove Conservation Network, which described its new function as a cooperative mechanism linking mangrove protection forces within the country.

CMCN has nearly 40 cooperative nongovernmental entities (including NGOs, communities, schools, nature reserves, and research institutions); 3,000 volunteers; and 150,000 network members. During the last 7 years, CMCN and its cooperative organizations have hosted thousands of activities, planted 200,000 mangrove seedlings, launched nearly 300 sustainable development education sessions, established 20 demonstration education schools that promote sustainable development of mangroves, and printed a series of educational materials.

CMCN has received wide recognition for its work and won two Ford Conservation & Environment Grants in 2004 and 2006, as well as an award from the Whitley Fund for Nature from Britain in 2008.

education, (2) capacity building for communities, (3) mangrove rehabilitation research, and (4) ecological recovery. The various programs have involved dozens of nongovernmental groups and replanted more than 200,000 mangroves. (See Box 1).

EXPANDING THE ROLE OF PUBLIC PARTICIPATION IN RESEARCH AND CONSERVATION

Scientific research is an effective tool for finding the root causes of environmental problems and their solutions. Research can help communities restore mangroves by increasing the survival rate of planted trees, improving biodiversity, and managing mangroves sustainably. Central in the research is to create an understanding of how people and the mangroves can become a balanced ecological community. Such information can greatly enhance the conservation work of nongovernmental organizations (NGOs) like CMCN.

CMCN has taken advantage of its connection with universities and research institutions to become a professional NGO that carries out effective campaigns and possesses a strong research capacity. A major challenge to this kind of work within NGOs is the public perception (including many of our volunteers) that research is a job for experts. In a role that is perhaps unique among Chinese NGOs, CMCN promotes the concept of "scientific research for all" by designing research projects in which the general public can participate, enabling them to fulfill their own scientific interests in the process.

Over the past seven years, CMCN research and project activities have reached almost all the regions in mainland China where mangroves grow. We have studied the ecology of mangroves including the flora and fauna in mangrove ecosystems, the pests, the water quality, and the soil. We also study the techniques of mangrove planting and nursery. Some of our long-term research projects include: the biodiversity and seasonal change of mollusks in 13 typical mangrove forests in China, the observation of bird communities in mangroves, and the monitoring of mangrove rehabilitation efforts. From May 2003 to April 2004, CMCN organized hundreds of volunteers to assist in a yearlong observation of rehabilitation activities on the Dayu Island of Xiamen. The results provided useful information to the efforts of mangrove recovery, the selection of different types of mangroves, and promising techniques for transplanting and seedling care for mangroves.

The results of the Dayu Island study revealed that the survival rate of transplanted mature mangroves is low (20 percent). Transplanting also costs more than ten times that of planting young seedlings. This study directly confronts the practice of many urban development projects in China that try to transplant mature mangroves. The study did caution, however, that while young seedlings have relatively higher survival rates, their death rates increase significantly in the winter if not properly maintained. Besides the insights this study provided to urban planners, this project also demonstrated that the general public can participate in meaningful scientific research work.

EFFECTIVE EDUCATION PROJECTS THAT EMPHASIZE ACTUAL NEEDS

Public awareness of the vital ecological function played by mangroves and the need for conservation is still very low in China. Sustainable development education is a direct and effective way to raise the awareness of stakeholders who could be involved in the protection of mangroves.

Meeting Actual Needs

CMCN's educational projects always follow the principle of meeting the actual needs of the various stakeholders. For example, past experiences show that the environmental education models adopted in urban areas are not suitable for many rural communities, especially remote mountainous regions, such as Baise in Guangxi Province where there is not even access to electricity. For such groups there is little point in education about ozone depletion or plastic bag pollution when they are completely disconnected from the consumer market.

In 2004, when CMCN was doing education work on mangrove conservation in Hainan Province, the local elementary schools informed us that they were willing to compile educational materials for their students, but they lacked the expertise and resources. The school needed age-appropriate materials, for over CMCN's longtime environmental education experience we have learned that people in different regions and age groups have very different needs in terms of the type and content of environmental education. For example, children between the ages 6 and 9 do not like the conventional textbook approach, but prefer fairytale style textbooks and participatory experiences.

Cover of the Son of the Sea textbook that CMCN produced to promote awareness of mangrove conservation in elementary schools. Photo Credit: CMCN

Therefore, CMCN produced a mangrove conservation textbook especially designed for young children called "Son of the Sea." (See Figure 1). The 12 chapters in this fairytale book each cover a separate theme and are filled with colorful illustrations, games, experiments and questions that facilitate learning through "playing." At no cost we have produced and provided the schools 5,000 copies of the textbook and 200 copies of the teacher's manual. CMCN also has trained teachers and volunteers to guarantee the frequency and quality of the weekly course.

Sustaining Effect

Conventional environmental education is often just outreach in public places using educational boards and leaflets, or ad hoc lectures and teach-ins that have no sustainable effect. Such approaches usually only raise people's curiosity instead of spreading a green message they can actively sustain.

To make environmental education more sustainable and effective, CMCN has tried many approaches including: establishing mangrove education centers and foundations, initiating online educational platforms, training volunteer eco-tour guides, and producing educational textbooks.

Drawing on five years of experimentation with education work, in 2006 CMCN repackaged its various environmental educational initiatives under a broader initiative—the Sustainable Mangrove Developmental Education Project (SMDEP). SMDEP not only includes environmental education, but also covers relevant social and economic issues. One of the main features is empowering participating stakeholders to spread the green message during activities.

In terms of environmental education, SMDEP targets all stakeholders. Besides conducting yearlong activities in 20 trial schools and 5 demonstration schools, which included training 100 teachers and volunteers, CNCM designed different education approaches for different target groups so that the "sustaining effect" principle will be followed. For example, in elementary schools time slots are generally divided into "class time," "between-class time," and "after-class time." CMCN's environmental education solution fully covers the three time slots. In class, CMCN trained teachers and volunteers to teach the environmental textbook once a week at trial schools. Between class time slots, CMCN promotes environmental activities such as plant adoption, environmental poster design, environmental broadcasting and photography through small grants and education centers. After class, CMCN helps the students conduct research-based studies that are relevant to conservation. The yearlong project has demonstrated that this approach achieves the goal of being sustainable and effective.

Lasting Results

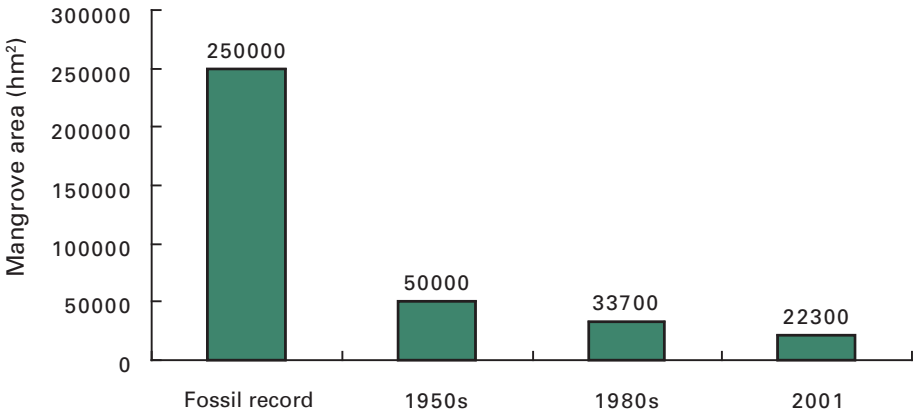
Of one thousand students that used the "Son of the Sea" textbook, the majority of students, teachers and schools gave very positive feedback on the trial. At the end of 2006, CMCN's Sustainable Mangrove Developmental Education Project was

Figure 1: Species Biodiversity of Mangroves in China

CATEGORY	SPECIES NUMBER
Higher Plants	70
Fish	249
Algae	494
Birds	370
Benthic (Shoreline) Fauna	650
Insects	440
Amphibians and Reptiles	18
Mammals	14
Total	**2305**

Source: Wang & Wang (2007). *The Mangroves of China.* Science Press of China.

Figure 1: Changes In the Area of Mangroves in China



granted the "Asia Good Practice ESD Practice Project Award" by the United Nations Ten Year Sustainable Education Program. The yearlong environmental education trials in the 20+ schools generated a large amount of writings and drawings from participating students, which generated news media reports and attention from government departments, research institutes and other NGOs.

COMMUNITY DEVELOPMENT: A "WIN-WIN-WIN" SOLUTION

Community development is the most direct way to solve the mangrove issue and achieve a winning solution for the economy, society and environment. Almost all environmental problems are combinations of larger problems in the community, which usually can be summarized as economic development at the expense of the environment. In order to solve these problems, we must start with community development to promote sustainable, alternative development models.

Living by the Mountain: Intensive Aquaculture versus Mangroves

One Chinese proverb states that "if you live by the mountain, you rely on the mountain to live." Before the 1960s, Chinese fishers living around the mangroves survived on wild catches, which put relatively limited pressures on the mangroves. However, as the human population grew and development became more resource intensive, exploitation of mangroves also intensified in China. Many unsustainable development models, such as clear-cutting mangroves for aquaculture, started to appear. Intensive aquaculture not only destroys the foundation of the original wetland and the mangroves, the highly-concentrated wastewater it generates is often discharged directly into the mangrove areas nearby, seriously polluting the water.

As the soil that mangroves live on is often acidic, and therefore unsuitable for aquaculture, many aquaculture farms witness continuously declining output every year. In many places in China and Southeast Asia, aquaculture farms are abandoned after just a few years. Farmers would then fell more mangroves to start new aquaculture farms. Between growing seasons, the fishermen often dig out the soil of the wetland and "sterilize" it by basking it in the sun and mixing it with lime and pesticides. This practice aims to protect aquaculture from diseases and pests and extend the life of the fish farm by raising the pH of the water, but such "cleaning" processes severely degrade the soil and affect surrounding ecosystems.

Intensive aquaculture in mangroves itself is highly risky: In years without natural disasters, the farmers might gain tens of thousands of dollars, but when faced with disease outbreaks or hurricanes, their losses can also reach tens of thousands. Farmers thus aim to maximize profits quickly and serve their immediate interests, for "If I cannot feed myself, how do I care for the environment?" Therefore, simple environmental education and outreach will not work in fishing communities. The real solution in such a situation is to give farmers what they need—more money—while at the same time protecting the mangroves for their own interests.

Land reclamation that began in the 1960s destroyed most of the mangroves in Fenglin Bay near Xiamen City (Fujian Province). Beginning in the late 1980s, some families from Jimei Village along the bay began restoring the mangroves to help their cultivation of crabs. This grassroots restoration is a model for community development and mangrove protection. Photo Credit: Liu Yi

Searching for Solutions

CMCN has realized the importance of community development since 2003. Over the past few years CMCN staff and volunteers have started a nationwide search for cases of sustainable community development, evaluated them, and promoted the most promising ones. We have found several such cases including the Jimei Fenglinwan Mangrove case that opened this article and the Guangxi Duck Egg case. (See Box 2). Currently, CMCN is trying to promote the Guangxi Duck Egg model in other places, such as in the Jiulong River basin in Longhai, Fujian Province where CMCN has been operating a "Beautiful Backyard Action." In the 1980s, there used to be many mangroves in the Nan Branch River of Jiulongjiang River in Longhai. But because of high-speed boats and economic development in the basin, almost all of the mangroves disappeared. So CMCN initiated the "Beautiful Backyard Action, which consists of three activities over a five-year period to promote the local community development. The first step has been to undertake efforts to reforest the mangroves; next CMCN has worked to increase the public awareness on mangroves conservation and public participation. The third and final stage will be to help the local villagers along the Nan Branch River to develop with the sea-duck egg project or other sustainable community development projects. Our model of community development uses the economic interests of local fishermen as a starting point.

ECOLOGICAL RECOVERY: AFFORESTATION, MONITORING AND MAINTENANCE

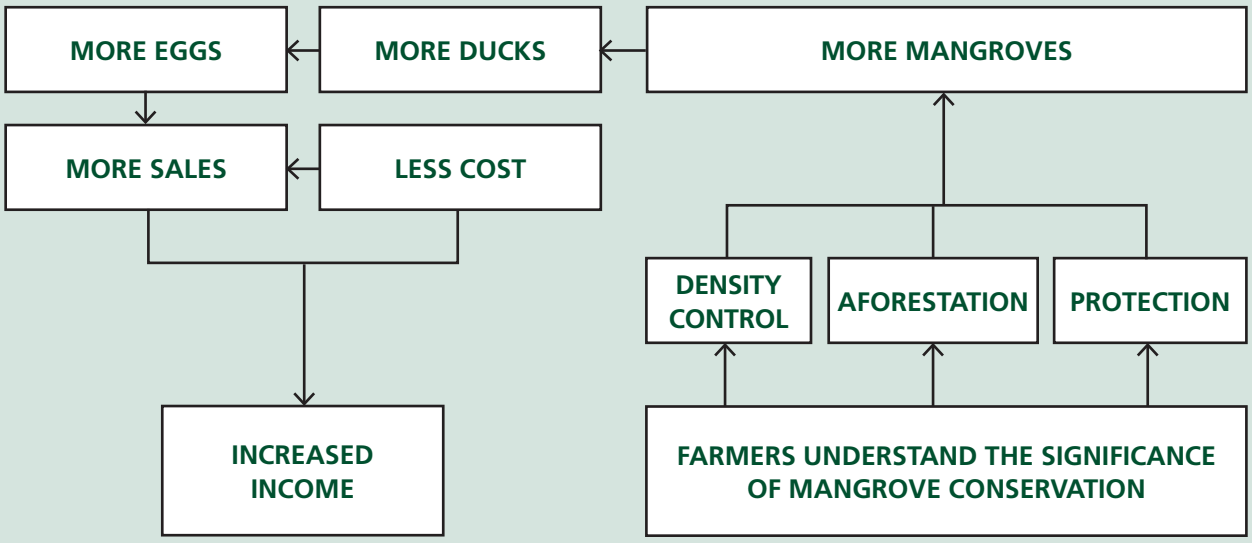
The problems facing mangroves are not simply low public awareness. A bigger problem is that there are increasingly fewer suitable locations for mangroves to flourish. If relying on natural recovery, mangroves in China could not recover to their 1950 level in 200 years. Therefore, afforestation efforts based on science are imperative.

The Chinese government has recognized the mangrove crisis and has started taking action. The State Forestry Administration (SFA) promulgated the National Wetland Protection Action Plan and the National Wetland Protection Blueprint in 2000 and 2004, respectively. Besides conserving the existing 22,300 hectares of mangroves, the SFA also plans to increase them by 65,900 hectares through rehabilitation before 2030. Since the end of the

BOX 2. **Duck Egg Model**

GUANGXI DUCK EGG CASE: "RED-HEART EGG" PROMPTS MANGROVE CONSERVATION

Red-heart salty egg is a famous local delicacy of Fangchenggang in Guangxi Province and mangroves play a crucial role in the production of these eggs. The local fishermen put ducks in the mangrove area. As the mangrove ecosystem provides the ducks with a rich supply of small fish, shrimps and seashells, the fishermen do not even need to buy feed, which significantly reduces costs. In addition, the mangroves have a water cleansing function, which makes the ducks and their eggs organic food that are considered to be tasty and having a high nutritional content. Even though the eggs are three times more expensive than regular eggs, the sales are guaranteed. In Fangchenggang, local fishermen understand that the mangroves have their own carrying capacity, which should not be overexploited. Only a suitable number of ducks can ensure the quality of their eggs. In order to profit more from the eggs, the fishermen both protect the mangroves and have made efforts to expand the size of local mangroves. The flow chart below captures the positive interactions that occur when farmers begin their work with the understanding that healthy mangroves will help their duck egg sales.



1990s, some large mangrove reserves, such as the Zhanjiang National Mangrove Nature Reserve and Hainan Dongzhaigang National Mangrove Nature Reserve, have taken on large-scale rehabilitation actions. Some municipal governments also have prioritized the protection of mangroves under their jurisdiction. For example, in 2007, the Xiamen government set aside 100 million Yuan to recover 2,000 *mu* of mangroves.

For the past 7 years, CMCN has been promoting public efforts of mangrove rehabilitation through research, compiling scientific literature reviews and expert interviews. The resources were then freely provided to our partner institutions with some funding and training. We also assisted different groups in obtaining seedlings and organizing volunteers to participate in tree planting. So far, CMCN and its partners have planted 200,000 mangroves in 5 southeastern provinces, with a survival rate higher than 90 percent.

Tree planting is just the first step of rehabilitation: Monitoring and care afterwards is crucial to survival, which is why CMCN has initiated long-term monitoring and care on Dayu Island and Jimei.

THE FUTURE OF CMCN AND CHINA'S MANGROVES

After decades of exploitation, it is now time that the mangroves be protected and restored. Fortunately, China has established 23 Mangrove Nature Reserves (including 6 national-level reserves), which cover about 75 percent of China's mangroves. Relevant government departments have begun to pay more attention to the issue, and social groups are starting to exert more influence.

The future work of CMCN will be challenging, but we plan to continue campaigns that raise public awareness of mangrove conservation and conduct projects that both protect and rehabilitate mangrove ecosystems while simultaneously promoting community development. We hope to strengthen our network by constructing an interactive online network of nongovernmental mangrove protection groups. Together with these groups we will conduct more basic research on mangroves that will help inform the development of regulations to promote mangrove conservation and push to establish a national mangrove destruction alert system. CMCN will also be seeking partners to explore the relationship between mangroves and climate change.

Liu Yi has been the lead campaigner for the China Mangrove Conservation Network for seven years. In May 2008 Liu Yi became the youngest ever recipient of a Whitley Award, which was presented to him by the UK's Whitley Fund for Nature for his work to restore and expand the mangrove forests on the eastern coast of China. He can be reached at: china_mangrove@126.com.

The two translators of this commentary—Jing Chen and Ma Tianjie—were both summer 2008 research interns at the China Environment Forum. Jing Chen is a graduate student at the University of Maryland and can be reached at jichen@gvpt.umd.edu. Ma Tianjie is in his second year at American University pursuing a Masters at the School of International Service. He can be reached at: tm2198a@american.edu.

SPOTLIGHT

The Forest Stewardship Council: Because Forests and People Matter

By Marion Karmann

CHINA'S FORESTS

China's temperate and tropical forests are some of the most biologically diverse in the world, and in mountainous areas, they regulate water flow to lowland agricultural fields. Widespread deforestation of natural forests in the past caused acute consequences. In 1998, for example, thousands of lives were lost as disastrous floods decimated entire towns and villages. China has drawn consequences: over the past 30 years, China increased its forest coverage from 12 percent of total land area to 18 percent—a phenomenal achievement never matched by any other country—through a concerted plantation program over vast areas of the country and a government ban on commercial logging of natural forests in 17 provinces. However, while intended to conserve forest landscapes, the ban has not only fuelled the sharp increase of illegally and irresponsibly harvested wood and pulp imports from Southeast Asia and Siberia, but also has created hardship for local families whose livelihoods depend on logging.[1] At the same time, the success of China's forest plantation program is the main reason why the global rate of deforestation slowed down in the first five years of this century.[2] China's ambition is to increase forest coverage to 23 percent by 2020. The resulting effect would narrow the gap between domestic timber supply and demand, reduce pressure on fragile ecosystems, and help to absorb more carbon dioxide, the main agent of climate change.[3]

CHINA'S WOOD INDUSTRY

China's market for industrial timber, pulp, and paper is the second largest in the world—outranked only by the United States—and its position in the global marketplace is likely to become more pronounced in the next decade. Nearly half of all tropical trees harvested worldwide are utilized by the Chinese goods-producing sector. This is due in part to increasing domestic demand, but also to growing international demand for China's low-cost finished wood products, such as furniture. China may soon overtake the United States as the primary destination for illegal timber exports from some South American countries—particularly as raw material for China's flooring and furniture exports[4] to the North American and European markets.[5]

As for the domestic sphere, over half of China's wood fibers still come from Chinese forests, despite the timber ban. Local communities practice subsistence gathering of wood fuel and fruits and medicinal plants, further straining resources. China is now looking at how it can resume logging in state forests in a sustainable way—maintaining wildlife habitat and controlling flooding and erosion. As the government reviews its forest strategy, the development of responsible management certification and a national forest stewardship standard are key steps in the progress towards responsible forest management in China.

THE FOREST STEWARDSHIP COUNCIL

The Forest Stewardship Council (FSC) is an international nonprofit membership-based organization aiming to develop such certifications and standards in China. FSC sets international framework standards for responsible forest management and establishes multi-stakeholder working groups (FSC National Initiatives) to develop indicators appropriate for national and regional forest management through consultative processes. FSC accredits independent third-party organizations who can certify forest management and forest product producers, known as the Chain of Custody, according to these FSC standards. Throughout the past 13 years, over 90 million hectares in more than 70 countries have been certified according to FSC standards, while several thousand products are produced using

FSC-certified wood and carrying the FSC trademark. In China, FSC is working on two initiatives: timber certifications and non-timber forest products (NTFPs).

CERTIFICATION OF TIMBER PRODUCTS

China's FSC National Initiative was launched in March 2006, with the support of China's State Forest Administration, the Chinese Academy of Forestry, the WWF-China and many others. Accredited by FSC in June 2007, it joins the 45 other accredited FSC National Initiatives around the world in their mission to promote responsible forest management. The FSC National Initiative in China is leading the development of a set of Chinese national standards that can be recognized internationally by FSC.

Given China's role in the world's timber markets, the development of an FSC-accredited National Initiative in China presents truly global opportunities for creating incentives for better forest management, both in China and in some of the world's most threatened forests, while at the same time providing significantly more responsibly produced wood products for the North American and European markets.

While the National Initiative is still elaborating the FSC China national forest management standard, FSC certification in China based on generic standards is growing quickly, particularly in Chain of Custody. In January 2008, over 370 Chinese timber processing companies received FSC Chain of Custody certificates, and the numbers are increasing at an astonishing rate. At the same time, China had seven Forest Management Units covering more than 550,000 hectares certified according to FSC standards. However, in 2005, China's forest coverage was 175,000,000 hectares, which means the FSC certified areas accounted for only 0.3 percent of total forested area—leaving much opportunity for the project to expand. A number of other large forest holdings and community forest projects with a strong focus on NTFPs are also currently working towards certification.

NON-TIMBER FOREST PRODUCT CERTIFICATION: FOOD AND MEDICINE FROM THE FORESTS

Apart from providing timber, forests also play a vital role in global food security, providing nutrition, fodder, fuel, and medicine, as well as a source of paid employment for rural communities. Only by managing these resources sustainably will communities be able to utilize them in the years to come.

The majority of Yunnan's upland population remains poor and heavily dependent on the natural environment for its livelihood. Photo Credit: Forestry Stewardship Council

Southwest China—characterized by diverse mountainous terrain and climate, a large population of ethnic minorities, rich biodiversity, and increasing pressure on natural resources—is renowned for the wealth of NTFPs including pine seeds, mushrooms, walnuts, and an array of medicinal plants. The majority of the upland population remains poor and heavily dependent on the natural environment for its livelihood, as it has been for hundreds of years. The products from natural and planted forests play an important role in the household economy, especially in remote areas where other business opportunities are lacking. With the enforcement of a strict logging ban in 2000 on all natural forests, and the gradual conversion of land above 25 degrees of slope from grain into tree crops under the Sloping Land Conversion Program, many upland communities lost a significant source of income. Some households have substituted this loss by intensifying the collection of NTFPs from natural and planted forests, overharvesting selected products and thus posing a threat to biodiversity. Yet, most collectors/producers only earn a small income from NTFPs, because they lack basic market knowledge and rely on traders to buy their products.

Despite local prominence, the economic and conservation potential of NTFP production and harvesting has yet to be realized on a larger scale

Forestry Stewardship Council has partnered with WWF-China and the Center for Mountain Ecosystems Studies to pilot projects on NTFP certification with communities in upland Yunnan. Photo Credit: Forestry Stewardship Council

in southwest China. Many Chinese farmers are not aware of the market potential of NTFP or how to cultivate them. For NTFPs which are not easily domesticated, such as Matsutake mushrooms and truffles, management regimes often need to be established to ensure sustainable harvesting. In both cases, marketing tools and knowledge (including branding and certification) are not available to upland communities, and the linkages between NTFPs and conservation often go unnoticed.

A potential solution that could benefit and bridge economic and environmental goals is product certification under organic, fair trade and/or sustainable forest management schemes. NTFPs that can be dried, further processed, and stored—such as nuts, medicinal plants, and mushrooms—may be particularly suitable since distance to markets poses a serious logistical challenge. At present, the relatively wealthier consumers of certified products are only found in China's big eastern cities or abroad.

NTFP Pilot Project

FSC, together with the Center for Mountain Ecosystems Studies (CMES) and WWF-China, are currently seeking support for a pilot project on NTFP certification with forest-dependent upland communities in Yunnan and Sichuan provinces. The aim of the project is to generate income for poor households while preserving biodiversity and averting environmental degradation and pollution. Specifically, the project intends to develop a successful and replicable model of marketing NTFP as certified organic food (with established markets) and small-scale responsible forest management through FSC certification. Based on preliminary research findings and initial community consultations, this project will pursue a joint FSC and organic certification, targeting China's East Coast and overseas markets. The project will run 12 months to ensure the establishment of a first certification, leading to further funding from the private and public sectors and ensuring participants are able to market their own goods. After three years, the project is expected to be self-sufficient and expanding. The core of the project is developing capacity among Chinese community members, government agencies, and project staff to certify and market NTFPs. Community members will be given a strong voice in the consultation processes related to the FSC certification.

FSC's activities in China have been kindly supported by the Wallace Global Fund, the DOEN Foundation, the FSC Global Fund, and WWF. For further information about the FSC, visit their website at www.fsc.org. For further information about the CMES/FSC/WWF project "certification of non-timber forest products," contact Mr. Alistair Monument, technical director FSC China at china@fsc.org. Marion Karmann is on the development team at FSC International Center in Germany. She can be reached at m.karmann@fsc.org.

NOTES

1. Global Timber. (2007). "China—Illegal imports and exports." [Online]. Available: http://www.globaltimber.org.uk/ChinaIllegalImpExp.htm.

2. Sekitoleko, Victoria. (2007, June 12). Article by the FAO Representative in China, DPR Korea and Mongolia for the World Day to Combat Desertification and Drought. [Online]. Available: www.desertification.gov.cn/gongyue/2007_FAO_Article_final%20eng.doc.

3. World Bank. (2007). A poverty project that is restoring China's forests." [Online]. Available: http://go.worldbank.org/OFAH4KL2C0.

4. GlobalTimber.org. (2007). "The EU's FLEGT Initiative." [Online]. Available : http://www.globaltimber.org.uk/FLEGT.htm.

5. WWF. (2006). "Failing the forest: Europe's illegal timber trade." [Online]. Available: https://www.wwf.or.jp/activity/forest/lib/illegalloggingeu_1.pdf.

COMMENTARY

Building Rural Models to Last: The Global Environmental Institute's Biogas Work in Western China

By Emmy Komada

During a recent trip to Wujinmai village in Sichuan for a routine visit to a biogas project household, Global Environment Institute (GEI) project managers inadvertently experienced the effects of indoor fuel burning firsthand. Upon entering the modest home, it was immediately apparent that the family had returned to using wood for fuel. "The kitchen was filled with black smoke so thick that I could barely see, let alone breathe normally," said project coordinator Mingjie Chen, "I couldn't believe [this woman] had lived like this for so many years." When asked why she was burning wood to cook, the woman replied that a small screw on the biogas stove had broken, making it impossible to use. She had been relying on her husband to repair their system, and his temporary absence left her no option but to use wood as she had not attended maintenance sessions to train her how to fix the system. Local project partners helped her replace the screw that very day and have since begun planning a training session aimed at the community's women, who are among those most negatively affected by wood burning.

This woman's family in Sichuan is but one of over one hundred Chinese households that have benefited from similar GEI biogas projects focused on sustainable solutions to rural health and development issues. Since 2004, the Beijing-based GEI has been helping communities and policymakers in China undertake research and project-based models that integrate economic viability into environmental problem solving. With offices in Beijing, Sichuan, Tibet, and Sri Lanka, GEI's development initiatives are uniquely placed to work with a diverse set of partners to develop multifaceted solutions that consider the demands of the market alongside those of environmental protection.

It is through the organization's sustainable rural development program that GEI has most directly impacted both rural poverty and health, and has helped alleviate the need for rural people to exploit their environment to support their livelihoods. At the center of GEI's rural development model is biogas technology, which not only provides a source of clean, renewable energy, but also decreases community dependence upon local resources for fuel, thereby significantly improving the health of rural people by eliminating the practice of indoor biomass burning. As the wealth gap between urban and rural areas grows wider, adequate access to health and education services have suffered, moving China's leaders to prioritize rural poverty and the social issues that accompany it. Identifying effective means of helping rural people integrate into the growing market economy is not an easy task, however, and addressing the issue using ecologically sustainable solutions creates an even more complex goal—but these two challenges are central to GEI's biogas work southwest China.

BIOGAS—THE GEI APPROACH

By approaching rural development from an energy use perspective, GEI has been able to tackle a number of related issues, including deforestation and climate change, health concerns, and poverty. The World Health Organization (WHO) estimates that burning biomass causes the indoor air pollution responsible for over 1.5 million deaths per year, over 400,000 of which occur in China alone, with women and young children by far the most affected groups. In monitoring rates of Chronic Obstructive Pulmonary Disease (COPD), bronchitis, and lung cancer over an eight-year period, WHO also noted a rise in all three diseases in China's

GEI staff and farmers at the Tibet site monitor growth of organic produce. Photo Credit: Global Environment Institute

rural areas while rates declined in urban regions. With respiratory diseases still one of the leading causes of death throughout China, the rural rise in these cases is a crucial concern.

The environmental impact of using biomass as fuel in rural China is also enormous. In 2006 the UNDP estimated that timber harvested near rural communities accounts for much of the nearly two million tons of biomass burned every day worldwide. The greenhouse gas emissions created through the process of burning wood is compounded by the effects of deforestation, especially in areas with rich biodiversity, such as western China. Biogas from animal dung prevents deforestation and also reduces the risk of disease from untreated animal waste. In places where animal dung is directly burned as a fuel source, however, collection is often ad hoc, leaving the uncollected dung to leach into groundwater sources and contaminate water that communities and ecosystems depend upon. Over the past twenty years, water tainted with animal wastes and poor sanitation has been linked not only to reduced crop yields, but more alarmingly, to heightened rates of water-borne diseases. Powering rural development with clean, renewable energy such as biogas is thus an approach that addresses both the vast environmental and human health detriments of indoor burning.

While dually practical and environmentally sound, developing biogas-based rural initiatives is not always easy. In China, scores of government-subsidized rural biogas initiatives have failed in the past, in part because they have generally been inappropriately large in scale and thus inefficient and difficult to maintain. In addition, past projects tended to overlook the necessity of local involvement in long-term, sustainable integration of new energy systems. Adding to these circumstances was poor technology and insufficient maintenance, which meant that only a fraction of the systems built between 1973 and 1980 were still in operation by the early 1990s. China has long recognized the potential of biogas as an energy source, having implemented widespread biogas projects in eastern provinces as early as 1973. These industrial-sized projects also utilized animal waste as their primary energy source, often operating on or near the premises of large-scale pig farms to minimize transportation needs. When GEI began implementing its biogas projects, therefore, this technology was not radically new. GEI's approach to using the technology, however, was.

Noting the primary causes that had hindered successful biogas project development in the past, GEI took measures to ensure that its own initiatives last beyond the timeframe of GEI's project activity by innovating the financing of the biogas systems, and by engaging local people in both project planning and operation. At the rural program's first project site in Yunnan's Lijiang County, GEI worked with local government officials to introduce a financing system for the biogas tanks that included significant investment by participating farmers. By organizing farmers into cooperatives with collective resources, GEI was able to establish a guarantee fund through which farmers borrowed and repaid loans for the cost and maintenance of the systems. This approach established personal investment in the new energy source. By using a farmer cooperative-supported scheme, GEI's Yunnan site was host to the first instance of China's rural farmers successfully acquiring loans from their local bank, which has enjoyed high returns in the two years since the fund's establishment.

All GEI sites use single household-scale up-floating biogas systems with a straightforward construction that eases farmers' access to maintenance requirements. The scale of the systems is small enough to ensure easy installment and flexibility to the needs of each project site. Farmers use biogas to provide everyday energy needs and to fuel various GEI-led community development initiatives, which have included organic agriculture and animal husbandry. In turn, these initiatives help increase villager incomes and build links to the outside market. In Tibet, where biogas initiatives introduced by other programs had faltered because of the systems' tendency to freeze during winter, GEI has placed the biogas systems inside farmers' greenhouses, where higher temperatures reduce the danger of freezing and malfunction. Such considerations have helped ensure project longevity at different sites with radically diverse sets of climates.

A HEALTHY IMPACT

In each of the areas where GEI's program operates local villagers were originally relying almost entirely upon biomass, usually firewood harvested from local forests, for fuel. Though natural gas was also available, inadequate access and high costs prevented most villagers from using the fuel on a regular basis. Because most biomass cooking devices in these areas are partially—if not entirely—unventilated, the impact of indoor burning is particularly harsh, and with a three-person household burning an average of five tons of wood per year, the ecological impact was similarly significant.

A Sri Lanka project participant tests a biogas stove.
Photo Credit: Global Environment Institute

In Tibet, farmers participating in GEI's projects relied primarily on yak dung to provide fuel for cooking and heating. Because yak dung is difficult to light directly, villagers were using wood and paper to stoke their fires, further adding to both local resource depletion and to increases in harmful suspended particles inside their households. This process also involved expending extensive human energy collecting fuel, as wooded areas in Tibet are scarce. With the arrival of biogas as an alternative, health issues linked to indoor burning were significantly alleviated and sanitation concerns improved as an animal waste-based energy system increasingly motivated community-wide organized yak dung collection.

All four of GEI's rural development sites employ biogas tanks that both provide fuel for everyday household activities and produce compost as a byproduct. Farmers use this rich organic fertilizer to increase productivity without having to rely on harmful chemical pesticides to protect their crops. Cleaner water sources have also contributed to thriving agricultural activity. At each GEI site, participating farmers are often their community's only source of organic produce, and selling their surplus crops has consistently increased family incomes across the board. In 2007, GEI's first biogas and organic agriculture project in Lijiang, Yunnan

> **"In 2006 the UNDP estimated that timber harvested near rural communities [in China] accounts for much of the nearly two million tons of biomass burned every day worldwide."**

Province became an independently registered organic food company. Called the Lijiang Snow Mountain Organics Company Ltd., the operation kept many of the project's initial participants involved in as shareholders and employees, and now supplies fresh organic produce for Yunnan as well as for markets as far away as Hong Kong and Beijing. In places where inhaling indoor particulate matter amounted to the equivalent of smoking nearly two packs of cigarettes a day, residents can now breathe easy.

STRENGTHENING COMMUNITIES

In addition to improving health both directly by reducing indoor air pollution and indirectly through reduced animal waste and organic agriculture, GEI projects also build community ties. Because protecting rural environments depends upon the capability of local people to make a living without exploiting the land, the success of GEI's projects is intertwined with community development initiatives. Aimed at providing a source of income that is both sustainable and environmentally sound, GEI's development initiatives have paired biogas with organic agriculture cultivation, honeybee husbandry, and rabbit rearing. These three activities have helped increase local villagers' incomes by providing a means of actively participating in a set of niche markets with a steadily growing demand.

While often beginning with only a few households, these activities have evolved with the growth of their respective projects. The Lijiang Snow Mountain Organics, which became a locally managed, private company set up by GEI project participant farmers, is an example where health benefits and community development intertwine. This significant step is an example of the ways that GEI's projects offer rural people alternative means of benefiting from a growing national economy without having to leave their villages and sacrifice traditional lifestyles.

Overall, project coordinators have reported unanticipated support and success. After just one year of operation in Sichuan, projects have already met initial target numbers for reduced firewood dependency, lessening the community's environmental impact both by decreasing wood burning emissions and slowing deforestation. In Sri Lanka, where GEI's presence marks the first instance of the Sri Lankan government's collaboration with an international NGO, six months of operation in the energy-poor country have earned the support of farmers and local government alike.

CONCLUSIONS

While GEI's rural program operates at the community level, its engagement of multiple social sectors highlights the new direction that environmental problem solving is taking. Environmental protection can no longer exist in a vacuum, separate from economic considerations, and developing societies are at the forefront of experimentation for this new approach. Effective policies now require dialogue across multiple sectors of society, and increasingly, among nations with vastly different cultures and levels of development. With this idea in mind, the Global Environmental Institute is confronting environmental challenges both at the local level and, through its recently inaugurated Environmental Governance Program, between governments on an international scale. By finding solutions that fit within the diverse demands of our world today, GEI is confidently helping achieve development that is socially, economically, and ecologically sustainable.

Emmy Komada was a translator and communications officer at GEI's office in Beijing from August 2007 until August 2008. She now works in the city as a freelance writer and can be reached at: ekomada@gmail.com.

SPOTLIGHT

Greener Wishes for Grasslands in Inner Mongolia: Green Longjiang

By Zhang Yadong

Hailar means black in Mongolian. The river got its name from the dark green grass growing on both sides of its banks. From a distance, the Hailar River looks like a black belt lying under the blue sky. Our destination, Chenbaerhu Banner, near Hailar City, is also known as the "Grassland of Paradise," due to its particularly beautiful grasslands.

CHENBAERHU'S UNBREAKABLE CHAIN

On 9 July 2008, Xu Qiang, a volunteer from Green Longjiang (*Lüse Longjiang*) and I followed Cong Lulu, the project manager, to an elementary school in Chenbaerhu Banner to carry out some environmental education activities with the children. From Harbin we took the train, arriving in Hailar the following night and then took a taxi to Chenbaerhu Banner. On the way, the driver asked us the purpose of our visit. The driver was impressed by our work and the fact that we had come so far to teach children about grassland preservation, and told us our efforts had contributed to the extraordinary beauty of this year's green grassy fields. Hearing the comments from the taxi driver, we were very eager to see the beautiful green grassy fields. After driving for 20 minutes out of Hailar, we were amazed by the green fields stretching to the horizon in all directions, dotted with groups of cattle and sheep partially hidden in the massive green. We felt so honored that we are able to devote ourselves to protect this beauty.

After we arrived at Chenbaerhu Banner, we rushed to prepare the content for the afternoon class on environmental education. At that moment, we realized students of Mongolian language elementary schools might not be able to understand our Mandarin. Cong Lulu was quite concerned about this as she was responsible for delivering a speech on the relations between climate change and grassland ecosystems. After meeting with the principal of the elementary school our concerns disappeared. He took care of the language barrier problem and arranged for students with good Mandarin skills in the top four classes, as well as some school teachers, to attend the activities.

The activities started at 3:00 in the afternoon with Cong Lulu delivering her speech to two classes of students, while Xu Qiang and I were busy with outdoor activities. At first, we were worried we would have trouble handling 70 students all at once, but things went smoothly. The first warm-up activity was called "untangling a chain." We had a group of six students to link hands and then we twisted them up. Then we asked them to untangle themselves while still holding hands, which they found easy to do. However, we then added more people into the group and amidst lots of giggling the students found it increasingly difficult to untangle the lengthening chain. Through this activity, students learned the

> **"We believe that education transforms human behavior and we hope by our work to make environmental education more accessible to children to enable them to influence their families with their knowledge of grasslands."**

The outdoor activity "untangling a chain." Students learned the importance of biodiverity in order to perceive a grassland ecosystem. Photo Credit: Green Longjiang

importance of conserving biodiversity in an ecosystem, for the chain (ecosystem) is harder to break when more people (species in an ecosystem) are in the group and linked together. We hope students will remember what they learned in these activities and put more care into their valuable grasslands.

After the activities, we asked each student to write a letter to one person who had not attended the class to tell them what they learned and what they plan to do in the future to preserve the grasslands. It was so rewarding to watch these smiling students sit down and write letters to their friends and families in beautiful Mongolian script. Cong Lulu was pleased by the students' intelligence and enthusiasm in the lectures as well. When the activities came to an end, we felt exhausted, but satisfied. We were delighted that the environmental education project inspired these young students to care more about the grasslands, sowing the seeds of hope for future grassland protection.

GREEN LONGJIANG

In late 2006, Green Longjiang began its grassland conservation work with investigation and conservation work focused on migratory bird species at the E'erguna Water Basin between China and Russia. In 2007, we expanded our grassland protection work in this area, with support from the BP Foundation, to cover the surrounding area of the E'erguna Water Basin and established a tri-state bird species monitoring network in China, Mongolia and Russia under the (CMR) International Conservation. Under this agreement, Green Longjiang was responsible for a large part of the public outreach, environmental education, social research, and training of young local volunteers.

The project operating in Inner Mongolia will last for one more year, and we plan to include much more educational content. We believe that education transforms human behavior and we hope by our work to make environmental education more accessible to children to enable them to influence their families with their knowledge of grasslands. Only then we will be able to see more youth working to protect the grasslands for the future.

To learn more about Green Longjiang, please visit www.greenlj.ngo.cn. Zhang Yadong is director of Green Longjiang. He can be contacted at zhangyadonghaobang@126.com.

COMMENTARY

Green Student Forum: Beijing's Secret Garden of Growing Environmental Health Advocates

By Daniel Pulver

Shen Cheng's father is an engineer for a cement factory in his hometown of Huaibei in China's central Anhui Province. In an interview with me in a crowded, dingy restaurant in Beijing's university district, Shen Cheng warmly recalled, "There was a small hill near my home when I was growing up. We would catch insects, pick the flowers and climb the trees there. It was our 'secret garden.'" But that was a long time ago. "Now, the trees are covered in white powder and look sick. I hear stories of kids with inflamed lungs from breathing the dust in the air from the factory's dynamiting rock to make cement." Rather than follow in his father's footsteps, Shen Cheng left the coalmines and cement dust of Huaibei to attend Beijing's Forestry School and joined Green Student Forum (GSF) in 2003.

Zhang Qian grew up in the small industrial town of Baotou on the steppes of Inner Mongolia in an area undergoing rapid desertification. She recalled sandstorms so fierce she was forced to stay inside for days. On a walk through her campus's tree-lined paths in Beijing she shook her head as she remembered, "The sky was bright yellow and it hurt to breathe the air. Many people in the town got sick from the sand." Zhang Qian is in her first year at the Urban Horticulture department of Beijing's Forestry School and recently became a volunteer for GSF.

EMERGENCE OF THE GREEN STUDENT FORUM

These opening stories are ubiquitous in China, a nation that is undergoing rapid development often at the cost of environmental and human health. A 2005 survey by the World Health Organization (WHO) found that 71 percent of China's seven major waterways failed to meet water quality standards and up to 74 percent of the Chinese population live in an area where the air pollution exceeds WHO standards.[1] Unfortunately, these statistics show few signs of immediate improvement.

Most of the participants in GSF bring with them similar personal stories of the toll pollution can have on the health of family, friends and community. Accompanying many of these stories is a sense of helplessness. In China, growing up with pollution is a normal occurrence. "As a child, you don't question it. You see people get sick and you're upset and you want to do something about it, but you don't think there's anything you can do," explained Shen.

Yet in the meetings of GSF, these students and others like them have found a burgeoning community of young conservation activists working to change the way people interact with their environment. They also have found a way to get the information and experience they need to begin to get China's environmental health record back on track.

GSF was founded in 1996 by prominent reporter Wen Bo and now imprisoned social activist Hu Jia, along with students of the Beijing Forestry University.[2] It was created as a forum for students interested in environmental protection to share activism ideas and experiences and GSF has evolved into a gateway for students into the world of environmental activism. The organization has grown into a network linking nearly 270 student environmental groups on university campuses throughout China with programs aimed at capacity building and raising local environmental awareness.

The Beijing branch, which serves as the head office, plays many different roles in the student community. While existing as an NGO in its own right, planning activities and training student volunteers

nationwide, GSF also acts as a communication hub for the multiple student environmental organizations located in many of Beijing's prestigious universities.

In the small office tucked away in a residential neighborhood, GSF students from Beijing's Forestry, Communication, Technology, Mining and Resources and other universities congregate for planning sessions and to exchange ideas for upcoming activities. Programs range from energy and water conservation, recycling initiatives, and community outreach to communication with international NGOs regarding Chinese development projects.

Although it has no full-time staff and runs solely on volunteer power, GSF is able to operate on a modest budget from funds provided by international nonprofit donors such as Pacific Environment and Global Greengrants Fund as well as by drawing support from partners such as Greenpeace China and Friends of Nature. The GSF Beijing office is managed by a chief director and three board members, all of whom were active members during their time studying in Beijing and who have gone on to work for other NGOs while lending their spare time to running the office and planning activities.

ACCOMPLISHMENTS AND INITIATIVES

Perhaps GSF's most successful collaborative achievement is its monthly walks along Beijing's compromised river system. Led by a professor of Beijing history, these walks follow the banks of Beijing's famous rivers, taking in the history and the culture of the waterways, as well as measuring the changes to habitat and water quality. "Only by understanding the river's history and culture can we understand the river's present situation and protect its environment," one student volunteer commented, strolling down its concrete banks. Participants measure the water's pH levels, observe the state of the fish population, and trace the course of the river through the city's cement channels and frequent sewer pipe outlets, marking spots where plastic bags and other pedestrian trash accumulates. This pollution gets carried downstream to the provinces of Liaoning and Hebei where it joins with runoff from steel and paper factories dotting the banks of the rivers, turning the waterways into little more than open sewers by the time they reach the sea.

On one spring river walk, the group passed a team of city trash collectors maneuvering the waterways in a small boat, dredging out the larger

Workers skim trash from the canals of Beijing with fishing nets.
Photo Credit: Daniel Pulver

pieces of trash with a flimsy fishing net. "I don't think a lot of people realize how serious the problem is," a volunteer commented as an elderly man swims laps through the same water that just a mile back was mingling with the effluent from sewer drains. Minutes later the group passes a sign forbidding swimming and fishing in the river due to high levels of pollution.

GSF has expanded the river walk program to other audiences in an effort to educate the general public about environmental issues. Volunteers have presented pro-environmental skits and colorful picture books to elementary school classes and encouraged teachers to adopt environmental protection as an early educational topic. Students also have reached out to the city's elderly participating in early morning group exercises in public parks and handing out leaflets outlining energy-saving techniques and explaining the link between reducing energy use and breathing cleaner air. Enthusiastic GSF volunteers even sang conservation-themed songs with the singing club that gathered in the early morning mist in one park. Last year the GSF's outreach efforts were rewarded with substantial media coverage and a plaque for positive work in the community.

PROVIDING FOR THE FUTURE

While providing students with an opportunity to participate in environmental activism, GSF presents a much greater service to its student volunteers by offering them training and experience work-

ing in their first professional NGO setting. For most student volunteers, Green Student Forum is their first experience with environmental nonprofits. GSF's board of directors, all of whom have graduated and are working in other environmental NGOs, give training lectures to volunteers. Subjects include financial management, budget calculations, organization of materials and activities, basic office skills, media relations, English language, time management, publicity, and fundraising. GSF also organizes lectures in Beijing on various environmental topics given by visiting professors and graduate students. This training puts GSF student volunteers in a unique position to succeed in the field of nonprofit work in China's NGO sector after graduation, lending students the skills, knowledge, and passion necessary to work towards change in a challenging and sometimes hostile environment. Shen Cheng, who leads the training initiative, lists tight government control, lack of human and financial resources and a still nascent international network as obstacles facing many Chinese NGOs. But he remains positive as he reiterates that the goal of China's green NGOs is "to solve the problem, not increase the conflict."

Chinese environmental nonprofits have seen a dramatic increase in their numbers and activity level since the 1994 government regulation granting independent status to NGOs and most have naturally congregated in Beijing. Students who come to the city and get involved in student conservation often stay on to work in the burgeoning environmental protection and health field. Green Student Forum's staff exemplifies the influence that student activism groups can have on the future of their participants. Shen Cheng, a board member of GSF and prior dedicated student volunteer, went on to work at Roots and Shoots in China and then moved to his current position at International Fund for Animals Welfare where he is its sole representative in China. On the side he still plans GSF training workshops for students.

Su Jianhua, another GSF board member, works for the Beijing-based NGO SynTao which monitors corporate social responsibility in China. She is currently collecting information on companies' dedication to environmental health and protection. Su got her start in the field of environmental health when she joined GSF's Green Reporter Training Program in 2001. She described GSF as an "organization with a lot of important things going on as well as [a] great platform to improve myself."

There are also students who are motivated to use their newfound knowledge and experience to address issues that affected their hometowns. Zhang Qian, who remembers the dust storms of her childhood in Inner Mongolia, wants to use her degree in urban horticulture and her experience in GSF to alleviate the same symptoms here in Beijing. She is learning how trees are effective at blocking wind and reducing airborne particulates and also serve to cool down ambient temperatures in the scorching Beijing summers. She explained "trees clean the air and make it easier for people to breathe, especially children and older people. It's also important that people realize the impact their actions, whether planting trees or saving water, have on the environment, and also on their own health."

GSF empowers China's student community to channel their frustrations with the current environmental health situation into positive action. For volunteers like Zhang and Shen, GSF's greatest accomplishment is giving students the necessary network, skills and experience to turn their dreams of a greener, healthier secret garden into a reality.

Dan Pulver has researched various aspects of China's environment for Pacific Environment and BlueWater Network. He graduated from Carleton College with a degree in Chinese Literature and a minor in Environmental Studies in 2006. He can be contacted at pulverdaniel@gmail.com.

NOTES

1. World Health Organization. (2005). *Environmental Health Country Profile- China.* [Online]. Available: www.wpro.who.int/NR/rdonlyres/1BAA5515-9571-4383-BA1D-169BDD4A8C38/0/China_EHCP_EHDS_9jun05.pdf

2. Hu Jia, who first became active in the Chinese environmental movement, went on to advocate for AIDS awareness and human rights in China and was arrested in April 2008 for 'inciting subversion.'

3. Coonan, Clifford. (2008, April 4). "Hu Jia, China's Enemy Within." *The Independent.*

SPOTLIGHT

Exploring China's River Heritage with China Rivers Project

By Kristen McDonald

"Many Chinese do not understand how beautiful this place is. The people here live so harmoniously with the river. That is the spirit of this place."

—Great Bend trip participant

Mao Zedong once proclaimed, "Doing is itself knowing." This concept is at the heart of the China Rivers Project, an organization promoting appreciation for China's rivers through whitewater boating trips. China Rivers Project, founded in 2007 as part of the U.S.-based Earth Island Institute, focuses on China's threatened western river canyons, including the upper Yellow and Yangtze rivers, the Mekong River, and the Nu River. China Rivers Project trips serve as a platform for journalists, researchers, conservationists, government officials, and business leaders from China and elsewhere, to learn from each other in creating a constituency to protect China's threatened river heritage. In addition to conducting rafting trips, China Rivers Project seeks to promote consensu ds among conservation groups in China around how to protect China's last remaining river heritage.

SAYING "ZAIJIAN" TO THE GREAT BEND OF THE YANGTZE

A core strategy of China Rivers Project is exploring and documenting outstanding rivers in China that will soon be transformed by dams. In April 2008, China Rivers Project organized an eight-day trip on the Great Bend of the Yangtze River, where several hydropower dams are in various stages of planning and construction. This section of the Yangtze abounds with contrasts: spectacular 10,000-foot-deep gorges and ancient stone-hewn Naxi villages are interspersed between mile-long dam construction sites.

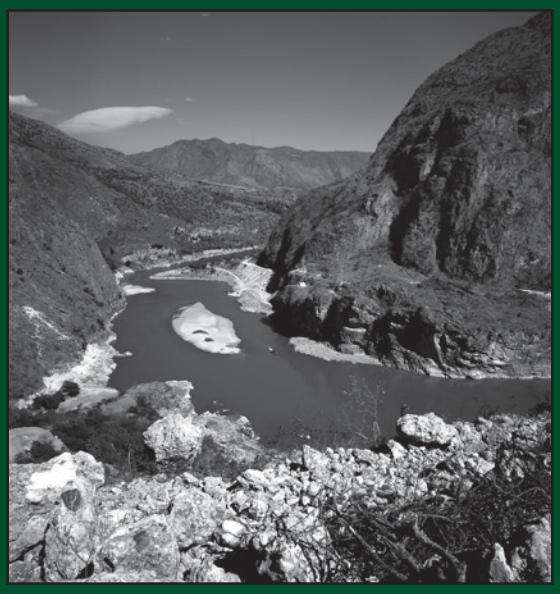
The 28 participants on our "farewell" trip of the Great Bend shared with each other river history, previously undiscovered geology, and glimpses into ancient Naxi culture. Some rowed the Yangtze's world-class rapids for the first time. As one budding oarsman, a journalist from Beijing enthused, "It is very moving to see how we can get down the river with our own power."

CCTV's travel channel came along on the expedition, with plans to broadcast a special on the Great Bend to millions of television viewers in China. China Rivers Project hopes such stories will help change perceptions of why rivers are valuable to China. Some of China's planned dams may be necessary, but river trips are a time to explore other river values—values that are lost when dams are built.

STARTING OUR JOURNEY

China Rivers Project co-founder Travis Winn participated in his first boating trip in 1998 in a remote canyon in China when he was 16 years old. Soon after, he made the decision to help whitewater enthusiasts he had met in China learn to boat. "You have to come back to China and teach us how to do this," Travis' new friends insisted. He started learning Mandarin and began to lead river trips in Sichuan, Yunnan, and Tibet in 2003.

I met Travis in 2005, while living in the Nu River valley and researching the local politics of dam building. In my free time I would marvel at the turquoise blue pools and exciting rapids formed by constrictions in Nu River's narrow canyon walls. When I learned Travis was also interested in the Nu River, I volunteered to see if I could get a boating permit. With its stunning scenery, ethnic diversity, and steep rapids, we knew the Nu had a bright future as a rafting hotspot.



A small hydropower station is being constructed on a tributary of the apex of the Great Bend of the Yangtze River, shown here. Photo Credit: Li Hong

But like many of China's best boating destinations, local governments have plans to tap the Nu River (not to mention many of its tributaries) to produce hydropower for export to other provinces. The neighboring Lancang River, where Travis and I organized our second trip together in 2006, has already lost much of its recreational value for boaters. The reservoir created by the 300-meter Xiaowan Dam will soon cover historic sites and displace isolated villages along the remote gorge section we used to boat. We realized while leading these trips that river exploration in China could become a powerful outreach tool for river conservationists, such as Yu Xiaogang of China Green Watershed. Yu—famous for bringing the plight of the Nu River to Beijing and successfully delaying construction of a series of dams—joined us on the Mekong River's "farewell" journey in 2006 and later joined China River Project's advisory committee.

GROWING A CONSTITUENCY FOR RIVER CONSERVATION IN CHINA

China Rivers Project faces an uphill battle. Not only is China's hydropower industry mighty, but the demand for whitewater recreation has only barely started to grow. After several Chinese rafters drowned in 1989 in a race to complete a "first descent" of the Yangtze, many Chinese viewed rafting as dangerous and suitable only for experts. Since then, most people who boat on the Yangtze and other world class whitewater in China come from outside the country and pay top dollar for trips led by foreign outfitters.

However, China's growing urban middle class population is increasingly eager to reconnect with natural landscapes, lost culture, and China's history, all of which can be found in the remote canyons of western China. Now, a few domestic outfitters offer day trips, and rafting equipment can be purchased in China. China Rivers Project seeks to encourage responsible boating industry practices and to tap into this new wave of outdoor enthusiasm to get journalists and government decision-makers on the rivers.

China Rivers Project is in part inspired by the U.S. example, where a nearly 50-year-old river conservation movement has resulted in close to 200 rivers and river sections being permanently protected from dams and other development. This outcome is in part thanks to boaters, who often develop deep connections with the rivers they explore. But in the United States and other countries, the river conservation movement also includes citizens concerned with the impact of water pollution on the health of their children, fishing communities facing rough economic times, and Native Americans whose ancestors have longstanding utilitarian and spiritual ties to rivers.

China has its own unique river heritage, one that is in many ways more alive than our own in the West. On the upper Yangtze, for example, the river is home to mythical golden spirit yaks that rise from the water, and ancient rock carvings that whisper prayers into the rushing waves. Further downstream, the Yangtze is surrounded by terraced hillsides, built by hand starting thousands of years ago, and fishing communities who still use handmade nets and lines. The concept of "river culture" is well known in China and describes traditions of barge commerce on the middle Yangtze. And still further downstream, the Yangtze's fertile valley forms the most productive rice-growing region in all of China.

China Rivers Project's next trip will start in early 2009, when we will return to the Great Bend of the Yangtze to see what has changed since our last trip in April 2008. We hope to see you on the river!

Kristen McDonald, Ph.D., is native to Oregon, a raft guide and the director of China Rivers Project. More information can be found at www.chinariversproject.org, or by emailing kristen@chinariversproject.org.

COMMENTARY

Mining in China: A Primary Ecological and Human Health Concern

By Saleem H. Ali

People naturally don't like the dark. Who would want to be a miner digging galleries?
—Chronicler from Han dynasty, Wang Chung Lun Hong, A.D. 82[1]

The pessimists will be proved wrong. Chinese mining multinationals will be a permanent feature of the future and they will, I have no doubt, increasingly strive for excellence in their performance.
—Sir Mark Moody-Stuart, Chairman Anglo-American Mining Group, 2006[2]

Considerable international attention has been accorded to China's environmental record with the publication of popular books such as Elizabeth Economy's The River Runs Black, which often incriminate the mining sector for creating ecological damage. The impact of the mining sector is considerable at both the level of human health as well as environmental pollution. While exports from China are often marked by manufactured goods, the country's rapid economic growth has largely been spurred by its natural resource base that has been harnessed at an unprecedented level over the last fifty years. Domestic minerals fuelled much of China's early industrialization and were a major component of Chairman Mao's early plans for development of the country. Judith Shapiro (2001), in her landmark volume Mao's War Against Nature, described how Mao had been willing to even donate royalties from his own writing to ensure that the mineral resources of Panzhihua (located 350 kilometers north of Yunnan's capital Kunming) were developed to the fullest extent.

Raw materials have been pivotal in most cycles of large-scale industrialization through either export revenues or for their necessity in infrastructure development. For China, primary industries, particularly mining have been essential, for infrastructure development. The natural resource endowments of the country are enormous and with the rapid growth of technologies and investment opportunities by domestic and foreign companies, mining has grown phenomenally in China over the past decade. In 2006, mineral mining accounted for 4.8 percent China's gross domestic product (GDP) and mineral trade accounted for 21.6 percent of the country's total trade (USGS, 2007).[3] Coal mining is also a huge industry in China with production increasing about 66 percent between 2001 and 2006.[4] Due to concerns about climate change there has been considerable research already on this sector and the country is reforming this sector. However, given the low cost of coal and its relative abundance, it is more likely that China will invest in ways to mitigate coal mining impacts with "clean coal" technology investment rather than reducing coal production.[5]

THE MAJOR PLAYER: IRON

Iron ore has always been the backbone of infrastructure development because of its importance in steel manufacturing. China is the world's leading producer of pig iron[6] and crude steel (34 percent of global total), with an output that is more than the combined total production of Japan, the United States, and Russia (which ranked second, third and fourth, respectively).[7] Steel production is highly energy intensive and thus results in the need

for even greater mining of coal—a highly polluting industry—which accounts for nearly 70 percent of China's energy demand.

In addition to increasing the demand for coal, the iron ore bonanza has had unexpected manifestations such as the rise of "magnet fishing" in the streams of Anhui Province. Community members are flocking to streams with magnets extended on fishing poles to find lumps of iron ore washed down from waste rock at nearby mines, hoping that the rising price of iron will allow them to sell the lumps and earn more than fishing—in great part due to the fact that fish stocks decrease in rivers where mine tailings are dumped.[8]

Figure 1 shows the rapid rise in China's iron ore production from domestic mining. Within five years, China's share of global iron ore production has more than doubled, but is now expected to slow down as stocks are depleted and the government attempts to temper the impact of such rapid growth on the environment and communities. However, the growth of minerals production is not confined to iron ore. The range of nonrenewable materials that are being extracted in China is staggering in some areas.

Exports

The connection between pollution and exports is also highlighted by Chinese government officials. For example, in 2007 Hu Chunli, director of the government's Industrial Development Research Institute, noted:

> As much as 20 percent of China's energy consumption goes into producing products for export. The Chinese government is determined to curb the excessive export of high energy-consumption and environment polluting products such as steel products. Policies may include further increasing export taxes, export licenses and restrictions on steel product projects.[9]

Small-Scale Mines

Small-scale mines employ an estimated six million people and account for large shares of mining in many sectors. An estimate by a Canadian researcher in 2005 concluded that more than 75 percent of China's bauxite, 65 percent of manganese, 51 percent of phosphate, and 43 percent of coal mining is mined at the small scale (Gunson, 2005). Additionally, the iron ore content of the ores on average has been declining, which means mines must operate—and pollute—longer to earn profits. Large-scale mines account for about 20 percent of total iron ore production, while medium- to small-scale mines produce the bulk of the ore. According to data collected by the United Nations Conference on Trade and Development there are 48 major mines, while there are close to 8,000 total iron mines in the country, most of which produce ore of less than 30 percent iron content (UNCTAD, 2007, p. 33-35).

ENVIRONMENTAL HEALTH AND SAFETY

Occupational Health

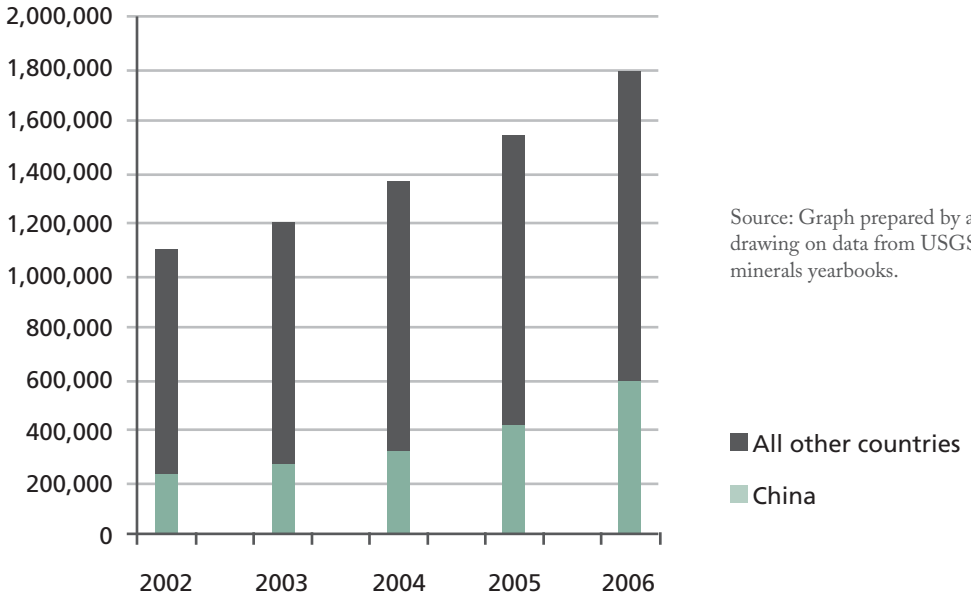
Global attention on Chinese mining has been largely focused on occupational hazards in the coal mining industry, which has an unenviable safety record. Indeed the health and safety performance for Chinese coal mining is orders of magnitude worse than global standards. For example, a study by the U.S. National Energy Technology Laboratory in 2006 concluded that for every one fatality per unit of coal produced in the United States, the comparable rate in China is between 200 and 250.[10] Changes in the mining laws; a projected investment of $60 billion from 2007 to 2011 on safety improvement mechanisms; and the closure of around 23,000 small coal mine with poor safety records are expected to make substantive improvements in this arena (Basu, 2008). The United Nations Development Programme also has

Table 1: China's 2007 Production of Nonferrous Metals

NONFERROUS METALS	MILLIONS TONS	PERCENTAGE CHANGE OVER 2006
Zinc	3.4	18.9% Increase
Copper	3.14	Same
Lead	2.44	5.7% Increase
Electrolytic Aluminum	11.16	34.6% Increase
Alumina	17.77	48.7% Increase
Lead	2.44	5.7% Increase

Source: Source: China Mining Association, 2008
Note: In 2007, production of the top 10 nonferrous metals in China was 21.31 Million Tons, representing an approximately 20 percent increase over the previous year (China Mining Association, 2008).

Figure 1: China's Iron Ore Production as a Share of Global Production (Thousands of Metric Tons)



Source: Graph prepared by author drawing on data from USGS minerals yearbooks.

started a $14.42 million project for improved coal mining safety education and training in the five Chinese provinces of Anhui, Guizhou, Henan, Liaoning, and Shanxi.[11] According to official accident data released in 2008, the accident rate has already gone down by 20 percent through these measures, though Chinese mining unions have often disputed accident reporting accuracy.[12]

Pollution

While some progress is apparent on the health and safety front, the environmental impact of mining still remains unresolved. One particular area of concern with regard to environmental pollution is the growth of small- and large-scale gold mining. Though during the height of the communist era, gold mining was banned as a diversionary extravagance, extraction of gold can be traced back in Chinese history to the Song Dynasty. Since 2007, China is now the world's largest gold producer (surpassing South Africa which held the top spot since 1905), to meet its demand for the prized metal, which jumped 23 percent, making it also the world's second-largest consumer after India. Using mercury for the amalgamation process to extract gold from rock is widespread in China at mines big and small and represents a major concern for bioaccumulation in freshwater fish that are a primary source of protein for many communities. While mercury is generally well-recovered in large-scale mining processes that use amalgamation, with an emission factor of ~0.79-g per gram of gold production, far less of the toxic metal is recovered in the small-scale mining process, resulting in an emission factor of ~15-g per gram of gold production (Streets, 2005).

Those mines that do not use mercury use cyanide for processing the gold, which has its own share of environmental and health concerns. There have been several accidents involving cyanide spills at Chinese gold mines in recent years. In September 2007, a house built on top of a cyanide pool in a gold mining area of Henan Province collapsed and 9 people died by falling into a two-meter deep pool of cyanide solution.[13] A hydrogen cyanide gas leak from a gold mining plant in Beijing's suburban district of Huairou killed three people and left another 15 hospitalized in 2004. Three years earlier, 11 tons of liquid sodium cyanide leaked into a tributary of the Luohe River in Henan Province.[14] The potential for tort litigation in this area may lead to some changes in regulatory enforcement of cyanide safety, but so far no major legal settlements have been documented.

Safe Closures

With thousands of mines all over the country in these boom years, Chinese environmental officials should pay more attention to closure and remedia-

Table 2: China's Exports and Imports of Nonferrous Metals (2007)

NON-FERROUS METAL	EXPORTS (PERCENT CHANGE)	IMPORTS (PERCENT CHANGE)
Copper	119,000 Tons (-50.9%)	12.26 Million Tons (+93%)
Copper Concentrate		3.46 Million Tons (+26.8%)
Aluminum	490,000 Tons (-50.9%)	203,000 Tons (-50.7%)
Alumina		3.94 Million Tons (+24.9%)
Lead Concentrate		945,000 Tons (+14.5%)
Zinc Concentrate		1.55 Million Tons (+178.1%)

Source: Source: China Mining Association, 2008
Notes: In 2007 the total export quantity of Cu, copper products, Al, aluminum products, Zn, Sn, Sb, and Mn) was 3.18 million tons, representing a 11.5% year on year decrease.

tion issues. Since mining is inherently obsolescent, closure and ecological restoration of mining projects is a necessary part of the planning process for new ventures. Without such planning, companies can walk away from a legacy of pollution with impunity. Consider the example of mercury mining in China, which officially ceased in 2001 after 600 years of operations all over the country, particularly in Guizhou, Shanxi, Henan and Sichuan. More than 100 Mt of calcines and other waste rocks have been produced as a result of the mercury mining in Wanshan District (Guizhou Province) alone, which was the "mercury capital" of the country. As a result of the mining, the soil concentration of mercury in the surrounding area is 24.3 to 348 mg/kg, which is 16 to 232 times the maximum mercury concentration allowed for soils in China. Mercury concentrations in adjoining waterways were also found to be highly elevated over six years after the mining stopped, ranging from 3.2 to 680mg/L. Given the biopersistence of mercury, the concentration of methylmercury in grains from this region is also as high as 0.14 mg/kg (Jiang et al., 2006). While health agencies usually allow for up to 0.5 mg/kg of mercury in meat products such as fish, a lower amount in carbohydrates such as grains can be far more potent because of a higher volume of carbohydrate consumption in human diets.

THE CHALLENGE

A major challenge to combating environmental pollution from mining is data. Data on pollution from mining is hard to obtain because impact categories are highly diffuse and dependent on the kind of mineral being extracted. Second, researchers gather most of the data on pollution in open access areas rather than at point sources. In such measurements there are often competing sources of pollution, which make ambient measurements hard to trace to a particular source. Most of the studies in this regard have been done in Yunnan, which has a high mining footprint and is also a biodiversity hotspot and hence of considerable research interest.

There has been an increase in the overall land acreage being used for agriculture, which has led to serious concerns that farm runoff will make it more difficult to analyze mine pollution. A recent study of agricultural expansion in Yunnan estimated that from 1960 to 2003 the push towards increased crop yield led to a 99-fold increase in fertilizer usage and doubling of pesticide usage. Interactions between these agricultural chemicals and pollutants from mines in waterways and lakes makes impact categorization more difficult (Li et al., 2007). Careful monitoring of effluent from pollution sources and waterways will be essential in years to come to identify the sources of major impact and to direct enforcement action or policy reform accordingly.

Although China's growth is being built on the assumption of continued mining, it is clear that past mining practices cannot be sustained in the future. The government has identified 60.7 billion tons of iron ore reserves, and is expected to identify more than 100 billion tons with better exploration techniques. The Ministry of Land and Resources, is now using international models to explore new deposits which could also increase estimates of China's identified reserves of copper ore by 20 million tons and bauxite by 200 million tons by the end of 2010 (USGS, 2007). All the new projects that will commence in coming years for these reserves will hopefully be planned with greater care if the country is to avoid an ecological crisis of immense proportions.

PROSPECTS FOR GREENING CHINA'S MINING INDUSTRY

The Chinese government has recognized the human and environmental threats that mining poses to the country and has begun to target those threats from several fronts. First, the government appears to be cognizant of the energy inefficiencies within the steel manufacturing system and has been taking measures to reduce the energy consumption of the sector as well as energy intensity (the total energy consumption per unit of GDP). According to the government's own calculations, the overall consumption of energy by China's major steel producers fell by 8.8 percent in 2007 and energy intensity fell by 2.78 percent for the first half of 2007 (which is still below the government's target of 4 percent). Aluminum production, which is also highly energy inefficient in China, is rapidly on the rise due to the expansion of smelting capacity and bauxite mining (there are currently over 300 bauxite mines in the country).[15]

It is difficult to gauge whether these recent improvements in energy efficiency have led to significant reductions in pollution, for data on air and water pollution have only recently become more accessible, but the quality of this data is uneven (*Editor's Note: See lead feature article in this volume*). The Chinese government has prioritized energy efficiency to increase energy security and decrease the pollution associated by coal burning.

Second, there appears to be a marked shift from polluting domestic mining production to imports. Box 1 highlights some of the data in this regard for 2007, which shows that some decline in mineral mining is occurring as the country shifts towards imports. The shift to importing metals is partly demand driven but also cost and environmental considerations. Many of the most profitable mines are now in Africa and environmental regulatory compliance is minimal, often reducing production costs. China's investment in Zambia has been particularly striking with an $800 million investment in the copper mining sector announced by President Hu Jintao in 2007.[16]

Moving Forward

The first step to improve environmental performance in the Chinese mining industry will entail exerting regulatory authority over all mining areas. Over the last three years, the Ministry of Land and Resources has identified over 65,000 unlicensed mines, 4,500 unauthorized excavations, about 1,000 unauthorized prospecting sites, and over 1,300 illegal transfer issues of mining rights. The ministry has shut down over 8,000 illegal mines over this time period, but many quickly reopen (Basu, 2008).

A coherent policy will also be needed to institutionalize the small-scale mining sector in China. With the help of the British government and the World Bank, there has been some movement to mainstream this sector through the establishment of a Chinese branch of an international program called "Communities and Small-Scale Mining." Led by researchers at the Chinese Academy of Sciences, this program aims to focus on this sector to improve its potential for providing livelihoods as well as increasing its environmental and social performance.[17]

Making the connection between the environmental and human costs of mining and direct economic impacts on other competing sectors may also improve the performance of the mining sector at multiple levels. The resources of the southeastern mountainous regions of the country have been particularly important in this regard and continue to play a pivotal role in China's economic development. However, this is also the most environmentally sensitive and ethnically diverse part of the country. Tourism has thus flourished in this area as well and there has been growing concern about the negative impact pollution from extractive industries might have tourism. While mining and tourism sectors can coexist, continuing deterioration of environmental indicators may start to have a negative impact on the tourist economy as well (Huang, 2008).

The mining sector has played a pivotal role in propelling China to Olympian heights of development by most measures. However, the environmental impact of this rush now needs greater scrutiny from the government as well as from the international community to ensure that the ecosystems are not irreparably damaged by extraction and can be restored to a state of biotic and social functionality.

Min Zheng provided valuable research assistance for this article.

Dr. Saleem H. Ali is associate professor of environmental planning at the University of Vermont's Rubenstein School of Natural Resources and the author of Mining, the Environment and Indigenous Development Conflicts. *He is also a member of the environmental and*

social stakeholder advisory group for DeBeers Corporation. He can be reached at: saleem@alum.mit.edu.

REFERENCES

Andrews-Speed, P., Guo Ma, Bingjia Shao and Chenglin Liao. (2005). "Economic responses to the closure of small-scale coal mines in Chongqing, China", *Resources Policy* 30 (1), 39-54.

Basu, Indrajit. (May 29, 2008). "China boosts domestic mining." *UPI Asia Online*. [Online]. Available: http://upiasiaonline.com/Economics/2008/05/29/china_boosts_domestic_mining/6152/.

Gunson, A.J. (2005). *Mercury and Artisanal and Small-scale Gold Miners in China.* Vancouver BC: Masters Thesis, University of British Columbia, Department of Mining Engineering.

Huang, Ganlin. (2008). *Mining and Tourism: Comparing Spatial Patterns, Socioeconomic contributions and environmental impacts in China.* Burlington, Vermont: University of Vermont, Rubenstein School of Natural Resources, doctoral dissertation.

Jiang, Gui-Bin, Jian-Bo Shi and Xin-Bin Feng. (2006). "Mercury pollution in China." Environmental Science and Technology, Vol. 40, No. 2, pp. 3672-3678.

Li, RQ, M Dong, Y Zhao, LL Zhang, QG Cui, and WM He. (2007). "Assessment of water quality and identification of pollution sources of plateau lakes in Yunnan (China)." *Journal of Environmental Quality* 36, no. 1 (February): 291-297.

Ottens, Berthold. (2005). "Mining in China – A 3000-year tradition." *Mineralogical Record* (January/February)

Shapiro, Judith. (2001). *Mao's War on Nature.* Cambridge UK: Cambridge University Press.

Sinton, Jonathan E. (2001). "Accuracy and reliability of China's energy statistics." *China Economic Review* 12, no. 4: 373-383.

United States Geological Survey. (2007). *China: Minerals Outlook.* [Online]. Available: http://minerals.usgs.gov/minerals/pubs/country/.

United Nations Conference on Trade and Development. (2007). *The Iron Ore Market—2006-2008*. Geneva, Switzerland, United Nations Conference on Trade and Development, May, p. 103.

NOTES

1. Text quoted by Ottens, 2005.

2. Speech before the China Mining Congress, November 15, 2006.

3. Most aggregate statistics have to rely on data from the Chinese government which has come under some scrutiny by researchers such as Sinton, 2001. However, we have little alternatives in terms of other sources and where possible field work has been used to verify the likely veracity of aggregate data.

4. China Heat Net. (October 2006). "How big is China's coal production?" (In Chinese). [Online]. Available: http://www.chihe18/1161092171216116.htm.

5. The Wilson Center commissioned a research paper in this regard in 2007, accessible online at: http://www.wilsoncenter.org/topics/docs/coalmining_april2.pdf

6. The term "pig iron" refers to the first intermediary product extracted from raw ore through heating in a blast furnace with a form of carbon called "coke." In early production, the molding of the ingots along a central runner resembled suckling piglets and gave the product its unlikely name.

7. Most of this iron accounting for this production is believed to be mined in China but figures on actual mine output from Chinese mines versus scrap usage and iron imports are not delineated. China is also the world's largest scrap (over 5 million metric tons annually) worth nearly $5 billion in 2006 (USGS, 2007).

8. Reuters News Service: Angling for Iron Ore in China's Streams, October 23, 2007.

9. Quoted in an article for Interfax China Metals: October 19, 2007 at: http://www.minesandcommunities.org/article.php?a=8253.

10. This estimate was based on annual data from 2005 and average statistics across numerous years would be a preferable comparison. Michael Moser, "Coal Mine Safety in the U.S. and China." Presentation at Resources for the Future, Washington DC, February 1, 2006.

11. The project details are available at UNDP's China website: http://www.undp.org.cn/

12. News story on fatality loss from Forbes magazine, January 13, 2008. [Online]. Available: http://www.forbes.com/afxnewslimited/feeds/afx/2008/01/13/afx4524639.html.

13. Reuters News service, September 28, 2007.

14. Cyanide incidences are tracked by the Mineral Policy Institute in Australia: http://www.mpi.org.au/campaigns/cyanide/cyanide_spills/.

15. Mineral Zone http://www.mineralszone.com/minerals/bauxite.html.

16. "China launches mining program in Zambia." (2007, February 4). *The Washington Post*. http://www.washingtonpost.com/wp-dyn/content/article/2007/02/04/AR2007020400536.html

17. See the web site of the program in Chinese: http://www.casmchina.org.

FEATURE BOX

From Rural Electrification to Biofuels: NREL's China Program

By David Kline, Monisha Shah, and Bill Wallace

The U.S. Department of Energy's National Renewable Energy Laboratory (NREL) is the premier U.S. laboratory engaged in renewable energy and energy efficiency research and development. NREL also pursues a program of technical support, R&D collaboration, and other cooperative activities with international partners. NREL's China program began in 1995 with the signing of a Protocol of Cooperation between the U.S. Department of Energy (DOE) and China's Ministry of Science and Technology. The majority of NREL's China work is sponsored by DOE. The U.S. Environmental Protection Agency (EPA) and the UN Environmental Programme's Solar and Wind Resource Assessment (SWERA) program also have supported NREL work in China.

NREL's China program illustrates the value of a longstanding and consistent bilateral program in terms of strong relationships between government departments, institutions, and individuals in the two countries.

EARLY RENEWABLE ENERGY WORK IN CHINA

In its early years, NREL's cooperation with China covered a wide spectrum of technologies including renewable and hybrid rural power systems, grid-scale wind power, biomass electric power, and geothermal heat pumps. NREL also provided technical support to the development of the Township Electrification Program—a major priority of the Chinese government to promote development in poor rural areas. NREL also has conducted biomass, wind, and solar resource assessments for some regions of China and worked to facilitate partnerships for energy business development.

In the 1990s, NREL developed a number of pilot experiments with hybrid renewable energy systems in China, as power solutions for remote areas. (See photo). Those projects were part of a DOE/NREL Village Power program that installed and evaluated off-grid systems in a number of countries.

The Wind Technology Partnership (WTP) and EPA provided technical assistance on wind policy and program analysis and developed advanced analytic methods for the economic assessment and planning of wind power prospect areas.

EPA's Integrated Environmental Strategies (IES) program also sponsored NREL work in China. IES aims to build capacity in developing countries in the quantitative analysis of co-benefits: improved local air quality and other environmental, economic, and health benefits that result from strategies to reduce both local and greenhouse gas emissions. The IES-China program began in Shanghai where the final results informed the air quality portion of Shanghai's 10th Five-Year Plan. [*Editor's Note: See "Breathing Better" commentary in CES 9 for details*].

NREL was also involved in the second phase of the IES-China program that focused on China's efforts to make the 2008 summer games in Beijing the world's first "Green Olympics." The IES-Beijing project built capacity to conduct a National Co-Benefits Assessment for China. In addition, the Beijing phase of the IES-China program included a study to examine possible ways to institutionalize co-benefits through various policies, laws, and institutional frameworks. The third phase of IES-China will be a national study focusing on identifying the most cost-effective measures in reducing local and global emissions for specific sectors.

NREL has been working with Chinese counterparts to promote rural electrification, such as this wind and solar initiative in Inner Mongolia. Photo Credit: NREL

CURRENT NREL ACTIVITIES

NREL's China activities currently include three primary areas: biofuels, grid-scale wind, and rural electrification.

Biofuels

In December, 2007, DOE and the U.S. Department of Agriculture (USDA) signed a Memorandum of Understanding with China's National Development and Reform Commission (NDRC) calling for R&D and technical cooperation on biofuels. NREL coordinates the U.S. technical work, which is also supported by Oak Ridge, Argonne, and Pacific Northwest National Laboratories. The biofuels cooperation includes the following areas:

- **Biomass resource assessment:** exchange of methods, software tools, strategies and technical support for the development of a resource assessment strategy for China.

- **Biochemical conversion processes:** collaboration between NREL and Tsinghua University to characterize Chinese feedstocks and evaluate proposed biochemical conversion techniques and strategies.

- **Thermochemical conversion processes** (led by Pacific Northwest National Laboratory)**:** collaborative R&D on thermochemical strategies for biofuels production.

- **Biomass sustainability and life-cycle analysis:** an examination of the environmental impacts of biofuel cycles and strategies for sustainable production.

- **Rural and agricultural development strategies** (led by USDA)**:** analysis of agricultural and development strategies for raising rural economic well-being.

Wind Power

NREL is continuing its collaboration with HydroChina, the key wind analysis and planning group in China. NREL and HydroChina have developed advanced economic assessment and planning techniques for large-scale wind farms. NDRC plans for HydroChina to use the resulting methods in the implementation of China's 30-gigawatt wind power target—a target which may be increased severalfold. In fact, NREL and its partners will support an effort led by Lawrence Berkeley National Laboratory to develop a 100-gigawatt wind power scenario for China.

Rural Electrification

NREL has supported China's ambitious rural electrification efforts since 1995, in partnership with the Institute of Electrical Engineering (IEE) of the Chinese Academy of Sciences. Most recently, NREL and IEE developed software that provides system design and sustainable finance guidelines for hybrid renewable rural electric systems. The basis of this work supports China's Township Electrification Program, which is aimed at providing electricity to the smallest and most remote settlements in China; the program was used in a World Bank pilot program in Xinjiang Autonomous Region from 2007-2008.

Other Activities under the US-China Strategic Economic Dialogue

NREL supports other areas of cooperation under the Strategic Economic Dialogue, including the Eco-Cities partnerships, which helps cities in China

> **"NREL…[has] a strategic opportunity to help China capitalize on several times more grid-connected wind power than called for in current official targets."**

and the United States to come together to learn about sustainability issues of common concern. For example, the Eco-Cities initiative has partnered Greensburg, Kansas—which is pursuing a "green recovery" from a devastating tornado—with Mianzhu in Sichuan Province—a city which is rebuilding after the May 2008 earthquake. Denver and Chongqing are also beginning an Eco-Cities partnership, focused on trials of electric-drive vehicles.

KEY RESULTS

NREL has had the opportunity to contribute to China's renewable energy programs for a decade and a half, seeing those programs become some of the most comprehensive and ambitious in the developing world. The trust gained during that time has provided valuable opportunities to both sides. For example, NREL has had the opportunity to comment on China's Renewable Energy Law during the drafting stages. NREL and its partners also have a strategic opportunity to help China capitalize on several times more grid-connected wind power than called for in current official targets.

The effectiveness of the capacity-building partnerships is illustrated by the engagement of the former IES team at Tsinghua University in high-level, international efforts such as the U.S.-China Strategic Economic Dialogue. At the same time, NREL researchers have also gained valuable experience and insights from their Chinese colleagues through data on the operation of off-grid power systems and frank discussions of the lessons learned from China's rural electrification, and other program efforts. The currently emerging research partnerships in biofuels should provide significant benefits to biofuel programs in the United States, China, and other countries.

For further information, please contact David Kline, david_kline@nrel.gov; Bill Wallace, william_wallace@nrel.gov; or Monisha Shah, monisha_shah@nrel.gov.

SPOTLIGHT

Filling a Gap in Environment and Health Work in Southwest China: The Yunnan Health and Development Research Association

By Zhang Kaining and Jackson Tung

BUILDING A NETWORK TO ADDRESS ENVIRONMENTAL HEALTH

The world is like a living "person." We have various specialists who understand parts of this "person" such as the heart, brain, and bone; however, we need a field that focuses on how to integrate the various specialists to improve the overall health of this "person." To apply this analogy to growing environmental health problems in China specifically, we need to integrate environmental science specialists and health science specialists and combine them with social, political, and economic scientists to effectively bring positive change. China—particularly the biodiverse rich, but economically poor southwest—is in great need of such multidisciplinary networks to better analyze and address the country's complex and dangerous environmental health problems.

The Chinese nongovernmental organization (NGO) Yunnan Health and Development Research Association (YHDRA) focuses on the integration effort of the various specialists in environment and health. YHDRA is not positioned to be the specialist in any one discipline, but rather to serve as a "glue" to help various specialists work together efficiently and effectively to achieve environment and health objectives for the people and natural environment in Yunnan Province. This initiative of YHDRA was launched in 2007 with funding from the Rockefeller Brothers Fund.

SHIFT FROM REPRODUCTIVE HEALTH TO ENVIRONMENT AND HEALTH

YHDRA's previous incarnation—the Yunnan Reproductive Health Research Association (YRHRA)—was founded in 1994 to address reproductive health issues focusing on under developed communities (including many ethnic minorities). YRHRA learned early on that single disciplines, such as clinical science, could only achieve limited results in improving reproductive health. YRHRA integrated communications programs with the understanding of ethnic minority's organization structure and achieved break through results in reproductive health.

In 2007, YRHRA changed its name to YHDRA to expand its scope from reproductive health to all health issues. Environment and health became a major focus, with financial support from Rockefeller Brother's Fund. YHDRA continued its multidisciplinary approach to accomplish results.

MULTIDISCIPLINARY TEAMS AND PROJECTS

At present, YHDRA has four multidisciplinary teams to study and address environmental health issues in four communities in Yunnan. In addition to conducting their own field research in specific areas the four multidisciplinary teams organize workshops and discussions between the teams to

"China—particularly the biodiverse rich, but economically poor southwest—is in great need of such multidisciplinary networks to better analyze and address the country's complex and dangerous environmental health problems."

promote idea exchanges and guide future actions. Inter-team activities strengthened the capacity of the multidisciplinary teams.

(a) Zongshuying Team was established in January 2007 to focus on environment and health issues. This team has 15 core members covering the disciplines of anthropology, ecology, economics, environment engineering, journalism, law, medicine, politics, and sociology.

(b) Mengla Team is the second YHDRA team established in April 2007 in the Mengla area (near the Laos border along the Kunming to Bangkok highway). This team of 10, who cover the fields of anthropology, economics, epidemiology, development, population, and resources, focus on issues such as rubber tree plantations and asbestos use.

(c) Waka Team is a unique team that examines Migrants such as ethnic Zang villagers as they migrate from high altitude areas to the valleys in Yunnan. The seven team members whose expertise covers agriculture, ecology, economics ethnography, forestry, health promotion, and nutrition began work in August 2007.

(d) Heijing Team focuses on environmental damage and repair associated with economic transition from a decaying industrial (salt production) town to a tourist attraction. The work began in August 2007 and includes eight researchers in the areas of anthropology, ecology, environment resources, public health, and sociology.

Besides the research team, YHDRA has carried out two online initiatives (done in partnership with the Social Science Research Council); one publication activity; and four on-the-ground integrated environmental health projects. The two websites and publication work include:

- **Environment and Health Information Website (http://www.chinaeh.org/)**

- **Environment and Health Literature Hub (http://ceh.resourcehub.ssrc.org/)**

This hub is a bilingual, searchable online database that serves as a resource on environment and health in China. It includes profiles of people and institutions working on these issues in China and around the world, and links to relevant articles, books and reports.

In 1990s, YHDRA (Formally known as YRHRA) closely worked with rural women in reproductive health. Photo Credit: YDRA

• Environment and Health Publications
Regular publications include the *Environment & Health Newsletters* and Translations. The newsletters contain extracts of reviewed literature, team activity highlights, and preliminary findings and analysis of the integrated projects. The translations contain selected English language articles that address key issues on environment and health.

In YHDRA's integrated projects environment and health relevant factors such as the rural poverty and development, pollution caused by industrialization, migration, health care services, and ethnic minority cultures were identified, discussed, and preliminarily analyzed. Different environment and health hypotheses were examined in real life situations and these cases offer potentially important information to policymakers. The projects are listed below.

(1) Dianchi Wetland Project
This project focuses on the changes of the wetland ecosystem around the polluted Dianchi Lake in Kunming. Topics studied include community response and the government regulations.

(2) Asbestos Roof Project
This project looks into the use of asbestos roofs in rural communities and their health risks. Project tasks include analyzing the current situation of asbestos use in roofing, exploring reasons behind its popularity and discussing efforts for asbestos replacement based on knowledge and needed attitude changes among villagers.

The use of asbestos as a roofing material is increasingly common in rural areas of Yunnan Province, posing health threats to both residents and the workers who produce the roofing materials. Photo Credit: YHDRA

(4) Rubber Tree Project
This completed project studied the expanding rubber tree plantations in southern Yunnan and their negative impact on water supply of the local communities.

(5) Eco-migration Project
This completed project focused on an ethnic Zang village in the warm valley area of the upper Long River. This entire village was moved from a cold mountainous area in Sichuan Province to Yunnan. The project looked into the environment and health challenges faced by the villagers as the village's location changed.

WE ARE THE GLUE

After nearly two years of implementing environmental health initiatives at YHDRA, establishing multidisciplinary teams and conducting integrated projects became this NGO's unique niche. Integrating different disciplines to accomplish the goals of environment and health improvements is YHDRA's forte. We do not strive to be the best in any one discipline; we work hard to be the "glue" that ties all the necessary disciplines together to protect the human face behind environmental challenges in China.

For more information on YHDRA please see: http://www.yhdra.org/. Jackson Tung is chief scientist at YHDRA. He can be reached at tungjackson@gmail.com. Zhang Kaining is the Environment and Health Project officer of YHDRA. He can be reached at knzhang49@139.com.

COMMENTARY

Green Eggs and Ham: Struggles in Swallowing Ecotourism

By Monica Liau

In the children's book Green Eggs and Ham *by Doctor Seuss the two main characters have a long and rhyming argument about the possibility of trying new things.*

Professor Li is the head of tourism development and research at Yunnan Normal University in Kunming, China. A man of influence, Li speaks regularly at tourism conventions and consults on high profile development areas in nature reserves like Gaoligongshan and Xishuangbanna. He also brushes aside the catchphrase "sustainability" when it comes to tourism and scoffs at the term ecotourism. Time and time again he has lectured me that the kind of economic development China needs and the sustainable environmental practices advocated by international NGOs and donor organizations clash considerably. At times, as he argues against applying a foreign tourism model to Yunnan, spittle begins to form at the edges of his mouth.

Li argues that since Yunnan is one of China's poorest and least developed provinces, sustainable "green tourism," as defined by the World Tourism Organization (WTO), is a luxury that Yunnan can not afford. Furthermore, most domestic tourists have no interest in, and often do not care to pay more for the privilege of having a "low-impact, responsible tourism experience." In short, with no demand for "eco-tourism," there is no market advantage for poverty-stricken residents in Yunnan who are hoping for a new quick form of household revenue. At the end of the day, he tells me, nobody in China really wants sustainable tourism development. Nobody wants it "green."

Xiao Tang, who works for The Nature Conservancy office in Kunming, points out that while most tourist destinations in Yunnan—especially the nature reserves—do want to be able to *advertise* "Green Tourism," it remains a label devoid of action. Yunnanese want "green profit," Xiao says, but they don't want to pay the "green costs." In this, they are no different from average poor tourist entrepreneurs elsewhere in China. The branding is as easy as printing a sign, but the practice itself is too complicated, too risky, too expensive, and too slow for most localities to undertake without technical assistance, managed funding, and local motivation.

Setting the states rhetorical commitment to "sustainable development" aside, there is a schism in Chinese society regarding the conflict of balancing environmental and economic needs. The debate is a fight between those who trumpet the desperate need for sustainable development and those who desperately want to throw off the binds of poverty that hold millions of Chinese in its grasp. As long as Professor Li's zero-sum premise forms the debate, it remains an argument without answer.

ECOTOURISM VS. TOURISM

People speaking about ecotourism tend to use certain terms interchangeably: sustainable tourism, "green" tourism, backpacking, adventure tourism. These terms bleed together, and are as confusing to the researcher as they are for the reader. For the simplicity of this article, I am using the term "ecotourism" in accordance to the World Tourism Organization 2002 International Forum definition. This means ecotourism is "all forms of tourism in which the main motivation of tourists is the

Illegal logging in Nature Reserve, Southern Yunnan Province. Photo Credit: Monica Liau

observation and appreciation of nature, which contributes to its conservation, and which minimizes negative impacts on the natural and socio-cultural environment where it takes place." (See Box 1).

The standard Western definition of "ecotourism" is a small group of tourists who experience a natural area with minimal environmental impact, minimal creature comforts, and economic benefit to local communities. In Chinese, on the other hand,. ecotourism is usually translated as "Shengtailuyou" (生态旅游), which simply means tourism that explores a natural environment. This involves both the small "backpacking" experience, but also includes more popular mass bus tours.

THE CURRENT STATE OF TOURISM IN YUNNAN

Tourism, green or otherwise, is particularly important to Yunnan's economic development strategy. Yunnan is China's most geographically and ecologically diverse province; its main wealth is its abundance of natural resources. Biologically speaking, Yunnan is a treasure house. In addition to holding 18,000 of China's 30,000 species of plants, Yunnan houses 85 percent of the country's endangered flora and fauna, many of which live within its 198 nature reserves.[1]

Most residents' income is based on the exploitation of these resources through dams, mining, timber, agriculture…and tourism. Every year, millions of tourists, both domestic and foreign, come to Yunnan. In 2007, Yunnan's tourism revenues increased by 20.4 percent from the previous year.

According to the official 2007 government census, domestic tourism for the whole country increased by 15.4 percent since 2006 (9.5 percent in real terms.) The future of tourism in China, and therefore Yunnan Province, is going to be geared chiefly towards domestic tourists, who will continue to be the main marketing target for tourism. This influx of tourism—particularly domestic tourism—and tourist money proffers an attractive economic incentive to poor Yunnanese. However, increased volume of visitors also raises serious questions about the ecological impacts that some of China's most sensitive nature reserves and scenic areas have to absorb as tourism is developed in those areas. With a growing population of 43.33 million,[2] some habitat loss is inevitable; nevertheless, Yunnan has as much to lose by unsustainable tourism in the long-term as it does to gain in the short-term.

Tourism's Impact on Yunnan

Creating sites for tourists is a large endeavor, and takes a lot of resources and construction in order to create a place of at least minimal comfort and convenience. Aside from the immense amounts of petroleum tourists need to burn in order to get to this remote province, there are serious environmental impacts that tourism development causes in nature reserves. Dramatic strips of deforestation appear in the course of building housing and roads. The ubiquitous trinket shops use energy and, when unmanaged, prey on local natural resources. Demand for food from new restaurants and residents encourage poaching and fish dynamiting. The need to flush increased waste unquestionably impacts water quality, especially when facilities lack their own water treatment centers[3]. In many nature reserves, the poorly managed expansion of infrastructure, tourism facilities, and tourists threatens the future beauty and health (and therefore marketability) of the very places tourists are paying to see.

Catering to standard mass tourism requires large infrastructure networks and hotels, and if not carefully managed these can deliver serious impact. For instance, Lugu Lake, located at the far northeastern tip of Yunnan Province, is a high altitude lake set deep in the mountains. Famous throughout

China, Lugu Lake has recently become a popular new tourist destination. The increased tourist traffic encouraged widened roads, new hotel construction projects and other negative environmental and ecological impacts. Now, the once pristine lake suffers from seasonal algal blooms. This problem is caused by an influx of erosion run-off, a product of deforestation and poorly managed construction projects. It is also due to a wastewater infrastructure unable to handle the increased load of solid waste spurred by tourism. Livestock and human manures are not adequately filtered before running into the lake, and tour guides now suggest that people refrain from swimming in the lake, or drinking from it without adequate filtering. There has also been a marked increase in garbage wastes, especially plastic bags which choke the shores.

POSITIVE ASPECTS OF TOURISM

Yunnan has one of the lowest environmental health indices in China, according to the *2007 China Statistical Yearbook*. It's easy to look at the negative impacts that tourism has on environmental health, but Zhang Kaining who heads the Yunnan Health and Development Research Association (YHDRA) also insists that tourism can have a very important positive health impact on communities touched by its development. [*Editor's Note: See Spotlight Box on YHDRA in this issue of CES*]. For instance, Mr. Zhang has worked extensively in several "tourism hotspots" in Yunnan such as Dali, located four hours west of Kunming. "When I started working [in Dali] in 1969 there was a high infant and mother mortality rate among the women forced to travel from their mountain towns to have their babies," he says. "There were no roads, one town phone and no easy ways of travel. Now, tourism money has developed transportation infrastructure and also allowed the government to invest in clinics of better quality, it's much easier [for the women]." Mr. Zhang goes on to insist that "an increased tourism economy is almost always followed by a dramatic decrease in infant and mother mortality rates. Tourism definitely enables the mountainous areas [to] get better transportation and communication, therefore is important in terms of saving lives of pregnant women or [elderly] people."

Tourism also dramatically improves education rates by increasing the value and relative affordability of education. According to Mr. Zhang, while many ethnic groups give preference to boys, "many guides for tourism are girls, so families begin to see their value–if you give a girl opportunities to attend school, she can earn a lot of money and be respected by the entire community. I heard villagers tell me 'oh look at all the girls, they are so successful, I want my daughter or granddaughter to be better educated.'"

> **"In many nature reserves, the poorly managed expansion of infrastructure, tourism facilities, and tourists threatens the future beauty and health (and therefore marketability) of the very places tourists are paying to see."**

According to Jackson Tung, chief scientist of the YHDRA, some communities also actually improve the physical environment of their town through tourism. Heijing, originally a salt mining town, went into economic decline due to extensive deforestation, a result of firewood needed to maintain the salt industry. Local people, to stimulate the flagging economy, decided to develop the town and its infrastructure to encourage tourism. Because the mountains and hills were bare, the town planted trees to mitigate erosion, and improved the waste-management infrastructure. "Because of the focus on tourism, the town ended up being a lot more environmentally conscious of things like trash and sanitation," says Dr. Tung. "People in Heijing are environmentally conscious, but they are financially motivated."

THE CRUCIAL FACTOR IN DEVELOPING SUSTAINABLE TOURISM IN YUNNAN

As far as tourism is concerned, there is a fissure between agendas of environmental NGOs and Chinese government organizations charged with environmental safeguards, and the agendas of organizations charged with stimulating economic development. Therefore, the tourism development

BOX 1. Defining Ecotourism

While definitions of ecotourism are plentiful, the WTO provides one that is fairly straightforward with three aspects on enhancing sustainability of tourism sites. These are:

- **Economic sustainability:** generating prosperity at different levels of society and addressing the cost effectiveness of all economic activity. Crucially, it is about the viability of enterprises and activities and their ability to be maintained in the long term.
- **Social sustainability**: respecting human rights and equal opportunities for all in society. It requires an equitable distribution of benefits, with a focus on alleviating poverty. There is an emphasis on local communities, maintaining and strengthening their life support systems, recognizing and respecting different cultures and avoiding any form of exploitation.
- **Environmental sustainability:** conserving and managing resources, especially those that are not renewable or are precious in terms of life support. It requires action to minimize pollution of air, land and water, and to conserve biological diversity and natural heritage.

planning process is fragmented. NGOs, government institutions, and private enterprises all work to develop tourism according to different agendas, in different parts of Yunnan.

An important factor often overlooked in developing effective tourism models is the value of private sector investment in areas that are looking to be opened to tourism. "In order for a strategy in ecotourism to work to optimize community benefits," says Amelia Chung, who has worked extensively on ecotourism projects with both the Nature Conservancy and the Global Environment Institute (GEI) "it is crucial that a private sector is involved." This is difficult as many NGOs don't want to involve the private sector. However, Amelia says the best role for NGOs is to serve as a temporary intermediary between local communities and the private sector. "NGOs must have an exit strategy," she says.

Tian Feng, an expert on ecotourism who is conducting a survey on ecotourism for Conservational International (CI) in Western China goes even further, insisting that "tourism is a business, business is money, and money is driven by the market and economic principles. NGO's like to use ecotourism as a conservation tool, but the reason so many [ecotourism] test sites are defective is because people forget basic economic principles."

MAKING ECOTOURISM MORE PALATABLE

Andrew Scanlon, who works in one of China's most famous Nature Reserves, Jiuzhaigou in Western Sichuan, says the definition of "ecotourism" needs to be reconsidered. "Western ecotourism standards do not necessarily apply to China," he says, "and backpacking may actually be worse for reserves than developing a small fraction of the reserve for high tourism use and leaving the heart of the reserve unopened and undeveloped."

Smart Travel and Greener Jobs

Sustainable tourism development strategies in China should not attempt to completely reduce the volume of tourist traffic through higher pricing. China is too big and has too many people moving around for this model to work, and the local economies depend on volume. However, this does not mean there is no way to emphasize smart, low impact development while also helping to invigorate and reinvent the local economy. Yunnan needs to deploy a development model that produces high levels of labor-intensive green employment. Local residents who rely on selling trinkets and curios that use local or unsustainable materials, driving large polluting buses, and building roads can instead work to support sustainability. These could include jobs such as walking tour guides, path maintenance crews, and driving (if necessary) smaller vehicles that burn clean fuel.

In addition to encouraging greener transportation in and around the scenic areas, Yunnan tourism will also benefit from a more diverse and low impact transportation network outside the parks themselves: cleaner airplanes, light rail, and green buses that deliver tourists from site to site. Since travel to Yunnan produces pollution in other provinces as well, any reduction in the consumption of aviation fuel would produce national and international benefits.

Guiding the Market

Such a program requires a strong government agenda to provide initial funds and training, and to create incentives to coordinate private business investment with NGO investment in order to create a stronger movement that could in turn (along with strong media campaigns) help encourage market demand in the minds of the average domestic tourist.

According to Tian Feng, this demand is already developing. While the tourism industry's ideas are slow to change, he says, his survey has found that more and more young Chinese people don't want to join mass tourism groups. "They want to find something more special," he says. "So there is a potential market, but people don't have many options." Feng Ruixi, program manager of the conservation education department at the Panda Research Base in Chengdu, concurs that attitudes among young Chinese people are already changing. She says that people in cities are becoming more and more interested in experiencing nature, and are starting to understand and appreciate its importance. At the Panda Research Center, she and her team work with young students, traveling to their classrooms to teach them about the role of wild animals, and proper behavior that should be followed in Nature Reserves. "Instilling the next generation with an appreciation and understanding of nature is important," she says. "Bridging the gap between city dwellers and their environment will help with the future of ecotourism"

A persistent media campaign, therefore, would be a key factor in helping stimulate demand and slowly reorient the tastes and habits of the domestic tourists towards more sustainable experiences. China's government has huge media power over the country. This campaign could therefore reach beyond the current movement that merely lectures people on their duty to be green, and help promote a different type of tourism that shows how fun green tourism can be, and how travelers can support the green movement while touring. The programs could be short and educational but also interactive, endorsing outdoor activities like hiking, and the concepts of lower impact tourism. It would be a slow process, but the solution of a very complicated issue relies not only on conservation and policy, but also the voluntary support of the tourist dollar.

FINAL THOUGHTS

Tourism is an important tool for the future of many communities in Yunnan, but in order to preserve the environmental integrity and marketability of these places, conservation techniques need to be properly introduced and balanced with economic development. "Ecotourism" in its Western definition does not necessarily apply to China's current tourism needs, and therefore Yunnan's (and China) sustainable tourism merits a distinct model that can involve a well managed high volume of tourists.

Shoes discarded along the river bank, Northwest Sichuan Province, Songpan. Photo Credit: Monica Liau

Monica Liau graduated from Mt Holyoke College with concentrations in Environmental Management, Urban Planning and Chinese. In 2007-2008 she served as a Fulbright Scholar in Western China researching ecotourism development. She has lived in China for 2 years, moving across the country—Beijing, Haerbin, Kunming, and Chengdu where she currently resides as a free lance writer.

NOTES

1. Yunnan also attracts many tourists to the area due to its particular "human fauna." Namely, Yunnan is home to 25 of China's 56 recognized ethnic minorities, more than any other province in the country. 38 percent of the population is officially an ethnic minority. It is also relevant to mention that the majority of those communities that stand to benefit from tourism (and sustainable tourism) are chiefly poor ethnic minority communities.
2. Yunnan is experiencing approximately 10 percent population growth annually. Yunnan Census, 2004
3. Due to the rural nature of most nature reserve sites, there are rarely any wastewater treatment plants.

SPOTLIGHT

China Youth Climate Action Network: Catalyzing Student Activism to Create a Low-Carbon Future

By Li Li

China Youth Climate Action Network (CYCAN) is a national network consisting of seven student green groups (including Green Student Forum in Beijing) that links over 200 universities in China. It is the first national network of its kind to coordinate action on a specific green issue—climate change. In addition to directing Chinese students to take action to combat climate change on an individual level, CYCAN aims to facilitate a 20 percent reduction of greenhouse gas emissions in pilot higher education institutions in China before 2012, which could contribute to the national objective of promoting energy saving and emissions reduction.

HISTORY OF CHINESE YOUTH PARTICIPATION IN ENVIRONMENTAL ISSUES

Environmental activism among university students has grown considerably both in breadth and depth since the first student environmental associations was formed in the late 1980s. However, student engagement in the realm of climate change has only slowly evolved over the past decade

The development of student climate activism can be divided into three stages:

Stage 1: 1990-1996. During this period, university student environmental associations thrived—increasing to over 200 groups nationwide. Chinese youth activities were limited to on-campus interest-based promotion and broadcasting, as well as research pertaining to environmental topics.

Stage 2: 1996-2001. In the second stage, regional/province-based student environmental associations prospered across China, which facilitated increased interaction and communication among individual university green groups, especially with regards to large research studies and programs. For example, the Green Student Forum (established in 1996) was sponsored by multiple college student environmental associations in Beijing. The Green Student Forum fueled the development of Green Camps that offered training to university students and pioneering members of Chinese nongovernmental organizations. The number of province-based regional youth environment associations is estimated to be more than 30. [*Editor's Note: See Wu Haoliang's Commentary in CES 8 for information on these emerging regional environmental youth associations*].

Stage 3: 2002-present. Over the past six years, the Internet and new media further facilitated the development of Chinese youth environmental associations. With the growth of both college and regional student associations—often supported by the national government and large NGOs—youth environmental associations have successfully promoted their agendas and programs on a national scale. For example, the Chinese Undergraduate Cooperation Forum, with the support of the International Fund for China's Environment, now hosts an annual gathering of Chinese youth environment associations. The Youngster Environmental Camps, supported by the Chinese Environmental Culture Committee, also has nurtured many talented youth in environmental protection.

Milestones in Student Activism Around Climate Change

The growing number of student environmental associations and growing interest in climate change among students laid the foundation for the creation of CYCAN. Greenpeace China was a major early player in helping to put the issue of climate change on the agenda of student activists, such as in 2004 when they conducted seminars on how youth could take an active role in dealing with climate change. Key milestones demonstrating a growing student activism around climate change include:

> **"…CYCAN aims to facilitate a 20 percent reduction of greenhouse gas emissions in pilot higher education institutions in China before 2012…"**

2005: In November, the International Renewable Energy Conference was held in Beijing. One month later, the UN Framework Convention on Climate Change Conference of the Parties 11 (COP11) was held in Montreal, Canada. Representatives from Chinese student environmental associations attended both meetings. In the COP11 conference, Chinese students for the first time spoke as observers. Together with their global peers Chinese students also helped formulate and support the 2005 Montreal International Youth Declaration "Our Climate, Our Challenge, Our Future."

2006: The Clean Development Mechanism (CDM) Committee of Beijing University—the first student association researching CDM—started exploring the field of environmental policy and technology to cope with global climate change. The CDM Committee formed the Joint Initiative for the Future, which sponsors climate change-themed gatherings on a monthly basis. For example, the New Energy Generation of Greenpeace recently presented their research on "The Coal Recourses of Shanxi Province."

2007: In April, with the support of the Disney Foundation, Taking It Global—China Global Youth Community carried out the first survey on Chinese youth's awareness of climate change. The survey was conducted in colleges and universities in more than 10 provincial capitals. The survey revealed that 99.8 percent of the Chinese students had heard about or had some knowledge of the theories and potential dangers of climate change and 98.41 percent believed that climate change is approaching. However, when asked who is responsible for addressing climate change, only 2.38 percent of the Chinese students believed they had a responsibility—the majority believed that government, businesses, research institutes, and even the general public (not including the students) should shoulder the responsibility. When asked about specific activities on climate change, nearly all the students indicated a willingness to make a contribution, but 80 percent had no idea how. This survey indicates a challenge in raising awareness, but also underscores a vast untapped resource for student involvement in climate change activities.

In June 2007, the fourth Chinese Undergraduates Environmental Organization Cooperation Forum was held in Wuhan with the theme "Climate Change and the Youth's Environmental Awareness." One hundred policy experts, researchers, and student leaders from China and abroad devoted to climate change participated in this forum. During the forum, participants discussed how Chinese students could address climate change through cooperation with other organizations. Late in the summer of 2007, with the support and cooperation of all the organizations that attended the fourth Chinese Undergraduates Environmental Organization Cooperation Forum, CYCAN was established.

ESTABLISHING THE CHINA YOUTH CLIMATE ACTION NETWORK

Since its founding in August 2007, CYCAN has been sponsored by six student organizations: (1) Beijing University's CDM Research Center is in charge of technological applications for operating, analyzing, and composing the reports; (2) Taking It Global is responsible for public relations and financing; (3) TUNZA-NEAYEN, part of the UN Environment Programme, has taken charge of communications; (4) Solar Generation of Greenpeace is responsible for propagating advocacy projects and guiding climate change projects; (5) China's Green Beat covers publicity and project promotion; and (6) Green Student Forum, having rich network resources, has led outreach programs in universities and colleges nationally.

After establishing CYCAN, colleges were recruited to launch a pilot project—Green Campus. In 2007, 23 universities in 22 provinces, including the University of Hong Kong and the University of Macau, participated in this pilot project. As of December 2008, CYCAN participant colleges covered every province on mainland China, as well as Taiwan.

Green Campus Program

Green Campus is a project based on intensive investigation and research, supported by powerful

data surveys, with simultaneous assessment in the use of energy-saving equipment, public awareness, and management patterns. Green Campus seeks the best energy-saving solutions on campus to reduce greenhouse gas emissions, including surveys and data analysis of energy consumption, analysis reports on saving energy, and youth participation in energy management. Green Campus also is building a network of universities and NGOs to implement energy management policies on campuses. To date, Green Campus has been launched in about 40 universities and one high school. CYCAN staff will write a report on the results of the pilot to presented to the Chinese government and related organizations of the United Nations, with the goal of soliciting support and advice to expand the Green Campus nationwide. Other CYCAN accomplishments and major activities include:

- September 2007: Established the CYCAN website (www.cycan.org).
- November 2007: Issued the bimonthly bulletin "GO GOOLER."
- December 2007: Representatives from CYCAN went to Bali to witness the UN Framework Convention on Climate Change COP13.
- March 2008: CYCAN representatives went to the South Pole to experience the E-base, and witnessed the melting pole and other climate change impacts.
- May 2008: Launched a database of energy consumption in Chinese universities.
- July 2008: CYCAN representatives were invited to participate in the Asian Youth Climate Change Summit Forum in Hong Kong.
- August 2008: Developed a green Olympics project, and participated in green Olympics activities; CYCAN representatives went to Taiwan to participate in environmental training camps.
- October 2008: CYCAN representatives were invited to participate in the Asian Youth Energy Summit held in Singapore.
- November 2008: CYCAN representatives attended Governors' Global Climate Summit in California.
- December 2008: "20 energy-saving actions campaign," sponsored by CYCAN and WWF-China was launched simultaneously in over 100 Chinese universities; CYCAN representatives were invited to attend the UN Framework Convention on Climate Change COP14.

NEXT STAGE: CHINA'S STUDENTS BECOMING AN IMPORTANT CLIMATE CHANGE FORCE

Since its establishment, CYCAN has paid great attention to learning and communicating with outsiders, as demonstrated by the many conferences we attended in the last two years. We hope that we can promote global interaction by learning and communicating with each other, and cooperating to promote mutual development. CYCAN's central goal is to help build the awareness and capacity of China's students to play an active role in addressing global climate change.

Li Li is president of China Youth Climate Action Network. He can be reached at mlmhslili@gmail.com.

COMMENTARY

Environmental Management and Public Health: Challenges and Opportunities in China's Mobile Phone and Telecommunication Industries

By Jacob Park

Since commercial mobile phone services were first launched in Japan thirty years ago in 1978, the number of mobile phone subscribers has exploded to 3.3 billion and nowhere has this surge in mobile phone use been more prominent than in China. In the same way the automobile became a symbol of U.S. industrial might, mobile phones have become a symbol of technological modernization in China with few parallels. If one had to use one symbol to mark China's economic and industrial development over the past 30 years, it might be a close competition between a mobile phone and a building crane.

When any technology reaches the global market penetration of a mobile phone, and when it is growing as rapidly as the mobile phone market in China, it is important to examine the public policy implications of this rapidly evolving consumer product. The introduction of new technologies has always had a profound impact on environment and public health concerns and mobile phones are likely to be no different. Technologies often generate far-reaching environmental and social impacts and as the author Edward Tenner observed in his 1996 book, *Why Things Bite Back: Technology and the Revenge of Unintended Consequences*, these impacts are often unanticipated and go unrecognized many years after the fact.

Some of these environmental and social impacts are becoming better recognized. On 9 November 2008, a 60 Minutes news segment entitled "The Wasteland" reported that 100 million cell phones and 130,000 computers are added to the waste stream in the United States every year. While some are properly recycled, a large percentage (2002 report by Basel Action Network and Silicon Valley Toxics Coalition estimate 50 to 80 percent) of the wastes are not recycled domestically, but placed on container ships bound for destinations like China. What makes this problem of influx of foreign electronic waste so acute in the case of China is the problem of domestically-generated electronic waste. The 60 Minutes segment did not 'break' the story of problem of electronic waste mismanagement in China; in fact, we have known about the problem for more than a decade. However, what the 60 Minutes segment did was bring the problem of electronic waste to the livingroom of millions of American homes and connect the e-waste dot between China and the United States.

ENVIRONMENTAL STEWARDSHIP AND THE MOBILE PHONE INDUSTRY IN CHINA

A quick glance at the list of the world's largest mobile phone companies shows how rapidly China has outdistanced itself from other countries. China Mobile is not only the largest mobile phone company in the world in terms of subscribers, this Hong Kong-based mobile phone company is larger than the number 2 (U.K.'s Vodafone) and number 3 (Spain's Telefonica) largest mobile phone companies combined and it has nearly 7 times the subscriber base of AT&T, the largest U.S. wireless company. In fact, China's second largest mobile phone company, China Unicom, is the fourth largest company in the world or bigger than any company in this industry except for Vodafone and Telefonica. The United States might have received

more total Olympic medals than China, but the United States would be more like South Korea or France if the wireless phone market reach was an Olympic sport.

As of July 2008, the number of mobile phone users in China had reached 600 million people, with over 86 million new subscribers added to the network and 150 million units of new phones being sold in 2007. The United States, by comparison, has a total of 260 mobile phone subscribers. A typical urban mobile phone user in Shanghai, Beijing, or elsewhere replaces his or her phone every two to three years (compared to 18 months in the United States), although it is not unheard of for young fashion-conscious Chinese to replace phones every year. As a result, China ends up discarding 30 million phones every year. These 30 million discarded phones are only part of the nearly 3,000 tons of television sets, computers, and other forms of electronic waste (e-waste) China generates every day. This is on top of the large volume of illegal and legal e-waste China imports every year, although the precise number has never been established.

> **"Years of international pressure…on the United States and other developed countries to manage their e-waste streams without using China as a dumping ground appear to have failed."**

If there is anything that is clear about China's e-waste stream, it is that 90 percent of China's electronic waste ends up in small and medium-sized family-owned e-waste dismantling enterprises in such places as Guiyu, Guangdong Province, where the November 2008 60 Minutes segment did the bulk of its news reporting. As noted by Jamie Choi (2008) in *China Environment Series* issue 9 and Sam Jones (2007) in the China Environmental Health Project Research Brief, Guiyu has rapidly metamorphosed from a small rice-growing village in Southern China to one of the most famous electronic waste dismantling hubs in the world, with over 5,500 households (over 50,000 people) working with e-waste and over 75 percent of the town's 300 odd private enterprises involved in the e-waste business.

FUTURE OUTLOOK FOR GREENING CHINA'S MOBILE PHONES AND THE CONSUMER ELECTRONICS & TELECOMMUNICATION INDUSTRIES

It might be worth asking if the illegal e-waste related environmental problems in Guiyu have been known for so many years, why has the situation improved? Years of international pressure by Greenpeace and other international NGOs on the United States and other developed countries to manage their e-waste streams without using China as a dumping ground appear to have failed. Ironically, this problem persists despite the fact there are eight high-tech, legal e-waste handling facilities under construction and/or in operation along the eastern coast of China. Unfortunately, the problem of mobile phones and other e-waste streams in China continues to pose environmental dilemmas, particularly in disposal because the cost of properly disposing electronic waste in the United States is significantly more than "exporting" the problem to a developing country like China. It should be stressed that the proper disposal of e-waste that meets domestic and international regulatory norms is possible in China.

With environmental pressures increasing due to deteriorating ecological systems, resource scarcity, and industrial pollution, the Chinese government has been forced to recognize the need for a new development strategy to navigate the tricky balance between economic growth, social stability, and environmental stewardship. This new regulatory policy, which some observers refer to as the "circular economy" (CE) approach, can be seen as a way to mediate the conflict between rapid economic growth and resource scarcity within China. Originating within the industrial ecology paradigm and building on the notion of industrial closed-loop supply chains emphasized in German and Swedish environmental policy, the CE concept has been actively promoted by Chinese government policymakers as a way to improve resource productivity, boost eco-efficiency, and strengthen environmental sustainability. Although there is no one single defini-

> **China's Ministry of Environmental Protection is currently researching the environmental and supply-chain management of China's information technology industry and working to establish a mechanism to monitor illegal e-waste imports."**

tion of CE, the circular (closed) flow of materials and energy remains a core feature of this concept, with similarities in practice with the "3R" principles—reduction, reuse, and recycling of materials and energy (Honchun, 2006).

Given the scope and degree of environmental stewardship concerns arising from the information technology sectors, there is an urgent need within China and globally to better understand what CE might imply in terms of business operations, public policy, and corporate strategy in the context of China's mobile phone, telecommunication, and consumer electronic industries. Underscoring the importance of this issue, China's Ministry of Environmental Protection is currently researching the environmental and supply-chain management of China's information technology industry and working to establish a mechanism to monitor illegal e-waste imports (Sarkis & Park, 2008). At the ruling party's National Congress in fall 2007, Chinese President Hu Jintao reiterated the need to protect the environment and conserve resources, which he said was vital to the "survival and development of the Chinese nation" (Subler & Xin, 2007).

Global business supply chains are increasingly being affected by rapid policy shifts in both industrialized and developing countries (e.g., the EU's RoHS and WEEE directives, China's new CE policy). But what happens in China, particular in terms of any new regulations governing the mobile phone industry, is likely to have a disproportionate global impact. Because of the central role China plays in the global supply chain and manufacturing process, any environmental regulations imposed by the Chinese government are bound to have an important global impact, whether or not a company is a major exporter to or importer from China. Companies, large and small, will be able to greatly improve the competitive stance of their organizations by anticipating international environmental policy shifts and adopting a proactive, "beyond compliance" perspective (Sarkis & Park, 2008).

Jacob Park is Associate Professor of Business Strategy and Sustainability at Green Mountain College in Vermont specializing in the teaching and research of global environment & business strategy, corporate social responsibility, and community-based entrepreneurship & social innovation with a special expertise/interest in Japan, China, and the Asia-Pacific region. He can be reached at: parkj@greenmtn.edu.

REFERENCES

Basel Action Network and Silicon Valley Toxics Coalition. (2002). *Exporting Harm: The High Tech Trashing of Asia*. [Online]. Available: http://www.ban.org/E-waste/technotrashfinalcomp.pdf.

Honchun, Zhou. (2006). "Circular Economy in China and Recommendations." *Ecological Economy*, 2:2, pp. 102-114. [Online]. Available: www.euroecolecon.org/pdf/EE2006-2.pdf.

Sarkis, Joe & Park, Jacob. (2008). "Understanding the linkages between IT, global supply chains, and the environment." *Cutter IT Journal*, Vol. 21, No. 2, February.

Subler, Jason & Zhou Xin. (2007). "China vows to rebalance economy, Nurse environment." *Reuters*, 15 October.

FEATURE BOX

Strategies for Decreasing the Carbon Footprint of Chinese Companies and Meeting Global Sustainability Challenges

By David Hathaway

As China becomes a dominant force on the world stage, Chinese corporations have the opportunity to adopt proactive environmental sustainability plans and lead the evolution to a more environmentally responsible business climate.

GLOBAL TRENDS

Environmental sustainability is becoming increasingly important in the global marketplace. Due to heightened consumer awareness and media attention, companies are paying more attention to environmental and sustainability performance, realizing that adopting a proactive stance makes good business sense.

Leadership in environmental sustainability is beginning to emerge within Chinese companies. For example, in the summer of 2008 in Shenzhen, one of the world's largest contract electronics manufacturers organized a social and environmental responsibility awareness conference with leading global electronics product companies to discuss options and strategies for improving social responsibility and environmental performance in its manufacturing facilities and supply chain. One of China's largest residential property developers also has taken steps towards developing a sustainable business strategy. Under growing international and domestic pressure, more Chinese companies will be exploring ways to reduce energy consumption, and low- to no-cost building operational changes are the most economical way to proceed.

GROWING PRESSURE

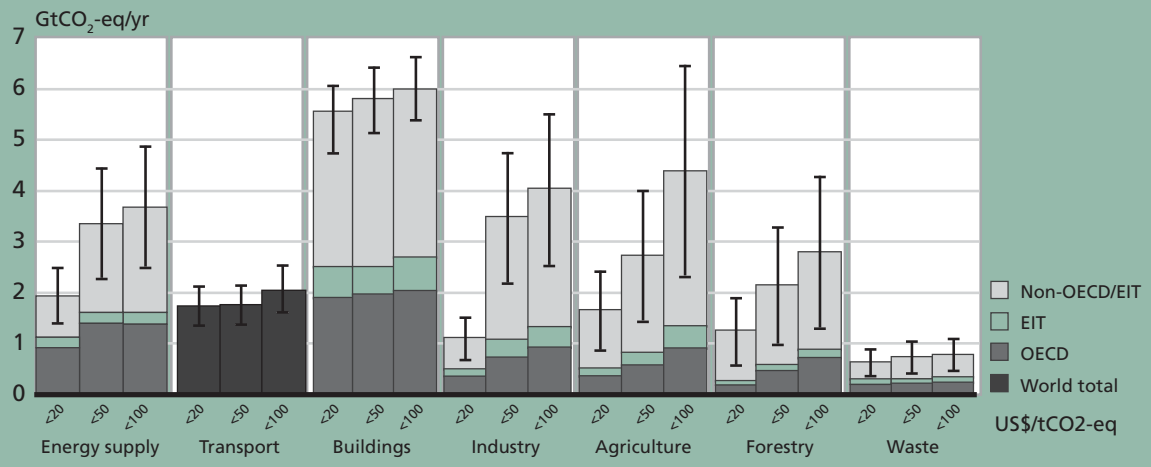
As the supply chain for most Western companies, Chinese companies will face increasing pressure to meet more stringent Western environmental sustainability standards and regulations. For example, many global electronics and IT product firms are rolling out increasingly comprehensive sustainability programs among their supply chain manufacturers. Chinese firms will also need to respond to standards that affect all global companies equally. For example, by 2012, all airlines with flights into and out of the European Union will be required to monitor and report their emissions of carbon dioxide to meet limits established by the EU Emissions Trading Scheme.[1] This new legislation will affect companies like China Southern Airlines, China Eastern Airlines, and Air China, to name a few.

In addition to increasing global pressure, Chinese companies face domestic pressure to improve environmental sustainability performance. For example, state-owned or partially state-owned companies are expected to meet China's Eleventh Five-Year Plan's target of 20 percent energy reduction by 2010.[2] The top 1,000 energy-consuming enterprises in China are also expected to reduce energy consumption from 10 percent to 25 percent by 2010 as part of the Energy-Consuming Enterprises Program launched in April 2006. The program has achieved a reported 28 percent of target energy savings within its first year.[3]

OPPORTUNITIES FOR CHINESE COMPANIES

In response to an increasing global focus on corporate social responsibility, and against a backdrop

Table 1: Economic Mitigation Potentials by Sector in 2030 Estimated from Bottom-up Studies



Source: International Panel on Climate Change (IPCC) AR4 (2007)
http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

of serious policy pressure for energy conservation on large Chinese energy users, there are strategies available that can do the following:

- Bring substantial bottom line business benefits;
- Provide robust inputs for successful environmental sustainability reporting;
- Demonstrate successful responsiveness to government energy policy; and,
- Support a growing movement towards broad-based carbon management by corporations.

STRATEGIES CHINESE COMPANIES CAN TAKE

Currently, there is little guidance available in the marketplace concerning how to initiate a corporate sustainability strategy, and companies in China (and globally) are struggling to develop the best approaches to improving performance. The best and most universally available strategy is to focus on corporate building energy use, along with close attention to tracking energy use data over time. Buildings are the largest controllable component of energy use and carbon emissions for most companies, and China's building stock is the fastest growing in the world. The World Bank estimates that, in the decade leading up to 2015, roughly half of the world's new building construction will take place in China. China's Ministry of Housing and Urban-Rural Construction estimates that the building stock in China will double by 2020.[4] Globally, building energy use has been identified as the single largest opportunity for reducing greenhouse gas emissions.

Improving energy performance across a corporate building portfolio is one option companies can take to cost-effectively improve overall environmental and sustainability performance. Reducing energy use benefits operational efficiency and bottom line business, in addition to being a key part of a carbon emissions reduction strategy.

Focus on No-Cost and Low-Cost Operational Excellence

U.S. Environmental Protection Agency's (EPA) studies show building operations as a critical driver of top building energy performance. In 1999, 2000, and 2001, EPA conducted studies to determine the key construction, equipment, and management characteristics of buildings in the United States that earned the ENERGY STAR® for top building energy performance. These buildings are approximately 40 percent more energy-efficient than average. The surprising finding of these studies was

Figure 1. Leading Chinese Companies Improving Environmental and Sustainability Performance

Globally: Distributes computers and software tools.

In China: Commands about one-third of the Personal Computer (PC) market. Number-one PC vendor in China for eight consecutive years.

Sustainability Efforts: Lenovo has taken steps towards CSR by disclosing greenhouse gas (GHG) emisions from its eight facilities in China, U.S., and Japan for 2007 and has set a voluntary target of improving operational carbon efficiency by 10% by 2012, against the 2007 baseline.

中国移动通信
CHINA MOBILE

Globally: The world's largest mobile network and the world's largest mobile subscriber base.

In China: 5th largest Chinese corporation.

Sustainability Efforts: China Mobile Communications Corporation recently signed a green action plan with mobile communication equipment suppliers and some mainstream support equipment suppliers to increase energy savings and reduce emissions.

that, "While the majority of ENERGY STAR® buildings understandably use highly efficient equipment, they are most similar to the poorest performing buildings from a technology perspective."[5] From this EPA concluded, "This observation does reinforce the need to look beyond technologies and design when defining building performance, and consider building operations and management practices as critical to the realization of a building that performs as well in the ground as it does on paper."[5]

Operational strategies not only drive top energy performance, but top financial performance as well. Most strategies are no- or low-cost to implement, do not require the purchase of new equipment or technology, and can be implemented by existing staff. Case studies in China, such as the iconic Jin Mao Tower in Shanghai (the world's fifth tallest building) demonstrate that the implementation of simple no- or low-cost operational strategies can save up to 20 percent annually in energy use and cost—a surprising finding for a building only several years old, designed by leading architects, and outfitted with the best available technologies.[6]

The energy and cost savings achieved through single-building operational strategies can be increased significantly when these strategies are applied across a building portfolio. Savills, a United Kingdom-based property management firm and a leader in the Chinese market, managing over 30 million square meters of building space in Greater China, is an example of a company successfully applying no- or low-cost operational strategies across its portfolios of managed buildings in Shanghai and Beijing. Savills has implemented innovative techniques to train management and engineering staff, identify opportunities, implement best-practices, and track performance improvement across multiple buildings simultaneously. Case studies of pilot buildings from Savills' Shanghai and Beijing portfolios show savings of up to 15 percent annually.

The Critical Role of Data Management

Collecting, organizing, and tracking energy performance data is essential to a successful, long-term environmental sustainability strategy. Two companies may take the same actions, but the company that tracks performance data will have more success, as it will be able to achieve the following:

- Establish goals and strategies;
- Set baseline performance and calculate savings;
- Identify problems early, before wasting money;

- Communicate data-rich success to investors, employees, customers, and other key stakeholders; and,
- Avoid accusations of 'greenwashing,' by ensuring that energy savings are real. (Most instances of corporate 'greenwashing' are a result of claims that are not clearly backed up by sound data.)

Furthermore, data is a critical component of a carbon offset or neutrality strategy. Companies that want to establish their carbon footprint, "go carbon neutral," or participate in an emerging carbon marketplace must have access to a reliable stream of energy data to quantify and manage their carbon.

A GOOD TIME TO TAKE ACTION

It is a good time for Chinese corporations to begin adopting proactive environmental sustainability strategies. These strategies can deliver significant financial benefits and respond to growing pressure from government, customers, employees, and other stakeholders. Simple, low-cost, and market-tested approaches, such as focusing on building portfolio operational excellence, are readily available. Chinese companies that pursue such strategies, track performance, and communicate success will be well positioned to lead in tomorrow's competitive and carbon-constrained marketplace.

David Hathaway is the managing director for ICF International in China. For more information on this topic, contact him at dhathaway@icfi.com or (86-10) 8523-3073.

NOTES

1. European Commission, Environment, Climate Change, Aviation. (2008, September 3). [Online]. Available : http://ec.europa.eu/environment/climat/aviation_en.htm.
2. To read the 11th Five-Year Plan in English see: http://english.gov.cn/special/115y_index.htm.
3. Price, Lynn & Wang, Xuejun. Lawrence Berkeley National Laboratory. (2007). "Constraining energy consumption of China's largest industrial enterprises through the top-100 energy-consuming enterprise program. [Online]. Available: http://ies.lbl.gov/iespubs/2007aceee.pdf.
4. Langer, Kenneth & Watson, Rob. "Bringing LEED to China." *Sustainable Business*. http://www.sustainablebusiness.com/index.cfm/go/news.feature/id/1289/page/1.
5. Hicks, T. & Von Neida, B. (2000). "Building performance defined: The ENERGY STAR® National Energy Performance Rating System." U.S. Environmental Protection Agency.
6. To view this and other case studies, go to www.epa.gov/eeBuildings.gov.

Figure 2. CSR Statistics for Chinese Firms

- Of the 28 Chinese firms in the Global Fortun 500, **43% have published CSR reports and 21% are members of the China Business Council for Sustainable Development (BCSD)**
- Of the top 100 Chinese companies, **13.6% have published CSR reports and 7% are members of BCSD.**
- **In 2007, 27 Chinese companies were asked to participate in the Carbon Disclosure Project**—an organization that works with shareholders and corporations to gather greenhouse gas emissions data for major global corporations.

COMMENTARY

Yours, Mine, Whose Water? Evolving Water and Property Rights in China

By Sonja Schiller

The fact that a legal or economic model does not exist for an activity or a behavior is no reason to oppose it, because the laws can develop out of experience and practice.

—Wu Guoping, Yangtze River Basin Commission[1]

In February 2009, the Chinese government announced that severe water shortages in northern China would lead to a 5.4 percent drop the country's grain harvest, affecting 43 percent of the winter crop.[2][3] Water shortages not only threaten food security in China, but also exacerbate health problems, particularly in the country's water-stressed rural areas, where illnesses and deaths from poor sanitation and dirty water are a growing concern. Nationwide, some 60,000 Chinese, half of whom are rural children, die each year due to diarrhea from drinking dirty water.[4] Moreover, nearly 4.37 million people and 2.1 million heads of livestock are having difficulty accessing any water in rural communities in northern and western China and such shortages catalyze a growing number of eco-refugees fleeing areas being taken over by desertification.[5] The UN estimates that by 2010 there could be as many as 50 million such people fleeing the oceans of sand in northern China.[6]

While population pressures and thirty years of ostensibly unchecked economic growth clearly have put major pressures on China's water resources, a major driver of water over-consumption and pollution is a lack of clear water property rights exacerbated by disparities in temporal and spatial distribution. For example, 60 to 80 percent of China's rainfall and runoff occur during the flood season.[7] China's annual per capita water supply of 2,200 cubic meters is only 25 percent the global average. Even more sobering is the estimate that by 2030 the per capita water supply could fall to 1,700 cubic meters.[8] China's northern regions have 65.4 percent of the cultivated land and 46.1 percent of the population but only 19 percent of the country's freshwater resources.[9] The Chinese government's solutions to water shortages in the north usually emphasize increasing water supply through engineering, such as the ambitious South Waters Northward Project, which aims to construct three canals to transfer water from the Yangtze River to the dry north. But this and other water transfer projects have become more difficult to implement as they are increasingly costly and contentious as some provinces losing water demand compensation.

Beset by the free rider problem inherent in unconstrained access to a (seemingly) limitless resource, water quantity and quality have been strained in China by the over-consumption of municipalities, farmers, and industry, all of whom have incomplete water property rights that discourage investment in improving water conservation and water quality.[10] Inefficient water resource management and poor enforcement of water pollution laws by local governments have further aggravated water scarcity in China. Local governments that have undertaken "blind pursuit of quick and short-term economic gain without regard to environmental consequences" have encouraged both domestic and foreign investment into large-scale polluting and resource-intensive industries in China.[11]

While there is no silver bullet to cure all of China's water challenges, many water experts within and outside China believe that to significantly

improve water quality and quantity the government must completely recognize and enforce water rights and move towards a system of economically efficient market-based water trading. Recent changes in China's water laws and the creation of a new property rights law have laid the framework for clarifying water rights and facilitating water trade, but challenges remain.

THE END OF SOCIAL CONTRACT

Since 1949, China's water resources have been regulated under a system of communal ownership, with ultimate ownership vested in the state.[12] Before the 1979 liberalization of the economy, Confucianism and Communism arguably provided the "moral and ethical…cement of social stability which ma[de] [the] economic system viable" and reduced the need for a strong rule of law.[13] Under China's Confucian and Communist ideological roots, ownership of a public good by the state[14] posed few problems, for natural resources were entrusted to the "fatherly" state, and a value for the community over individualism discouraged over-consumption for personal gain. These ideological norms helped curb water use—sometimes by simply permitting traditional water right regimes to operate quietly.[15] While the Communist regime reinforced these communal values to keep water users in check, sometimes its own campaigns led to considerable mismanagement of water, such the massive 1950s "Let Deserts Bloom" campaign when millions of citizens were relocated to promote agricultural development in China's dry northern and western regions, a development that greatly exacerbated water shortages and desertification. In the 1950s there were also campaigns to accelerate glacier melt by dumping coal dust in the Himalayas.[16] The rush to promote irrigation often led to water diversions and short-lived dams that quickly silted up and sparked conflicts among communities that previously shared water amicably.[17]

While considerable damage was done to water and other natural resources under Mao, the liberalization of the Chinese economy has resulted in increasing over-consumption of water resources. Because it is difficult to exclude use of such common-pool resources and because individual resource use detracts from other's consumption, free rider problems and water wastage are rampant in China.[18] Water use in the agricultural sector accounts for 65 percent of the country's total while the industrial sector consumes only 24 percent; yet only 45 percent is actually applied to crops due to wasteful irrigation practices.[19] The water-recycling rate in China is only 40 percent, compared to 75-85 percent in developed countries.[20]

The continued absence of a specified property rights regime also eliminated the incentive to invest in conserving water resources and improving water quality. In China, the lack of clear water rights combined with the difficulties in monitoring water use and the unequal bargaining power among users has impeded efficient allocation of water through private negotiations or trade. Instead, water users with greater financial means or higher bargaining power vis-à-vis the government have more water rights allocated to them.

Examples of water trade and transfers that leave some users literally "high and dry" are plentiful in northern China.[21] As Beijing exploded in size, its need for water trumped those of neighboring cities and provinces. For example, over the past decade Beijing has acquired the rights to reservoirs previously supplying other cities and emergency water transfers have often come at a cost to neighboring water-short Shaanxi Province. The need to provide Beijing and the rest of the dry north with water in time for the Olympics was notably the catalyst for constructing the long-debated South to North Water Transfer Project (SNWTP)—three canals intended to bring water from the Yangtze River to northern China. All of these water transfers have generated conflict, for example at the 2008 National People's Congress, delegates from Shanxi made demands for compensation for these excessive water withdrawals.[22] In Hebei, protests and petitions over exacerbated water shortages, land grabs and low or unpaid wages for project workers sometimes delayed work on the SNWTP.[23] Moreover, the second and third canals for the SNWTP have been postponed due to excessive costs and opposition from local governments.

CHINA DEVELOPS WATER RIGHTS

In recent years, the Chinese government has worked to transform water rights to address growing unequal access to water and the growing conflicts. In 2002, the amended Water Law[24] contained three crucial changes to address the challenges of water rights: (1) recognition of the right to transfer water resources; (2) increased autonomy for local governments to regulate water resources on a regional level; and (3) strengthened ability for river basin commissions to

> **"In recent years, the Chinese government has worked to transform water rights to address growing unequal access to water and the growing conflicts."**

manage water resources throughout the basin.[25] However, water policy in China is fragmented and uncoordinated, for in addition to the Ministry of Water Resources and the river commissions it oversees, the ministries of environmental protection, agriculture, construction, mines and minerals all have overlapping authority to manage water.[26]

Building on the 1988 Water Law, the 2002 amendments established a system of water use permits, in which water price was determined according to "compensation for cost, reasonable profits, quality, and equitable burden of price by all water users."[27] Again, in 2004, China's Water Law was further amended to reinforce allocation of water through a system of permits;[28] however, the 2004 Water Law failed to give legal recognition to compensation earned from trading water permits,[29] resulting in incompletely enforced water rights. A 2006 regulation further laid the framework for a system of water use permits by requiring water users to apply for water use permits and pay usage fees for water taken directly from rivers, lakes, or underground sources.[30]

Effective February 1, 2008, the Interim Measures for Water Quantity Allocation provide the principles and processes by which water resources may be efficiently and equitably allocated,[31] feasibly promoting the role of water trading and other market tools in the distribution of water resources.[32] According to China's Deputy Minister for Water Resources, Zhou Ying, "in combination with the existing regulations on management of water abstraction licenses," the Interim Measures "form the start of China's water rights trading system."[33] Specifically, under the Interim Measures, county officials allocate water resources to businesses, villages, and towns, and what the water users conserve, they may sell.[34] Significantly, *Shanghai Securities News* proffered that the Interim Measures could stimulate a water trading market, which indicates that Chinese finance analysts also see promise in what could be a significant new market.[35] While the state still maintains ownership of water resources under the Chinese Constitution,[36] the amendments of the Water Law and Interim Measures, as well as several recent, highly visible water transfers, indicate that the Chinese government has begun to acknowledge lesser property interests in water resources. (See Box 1).

PROPERTY RIGHTS DEFINED AND REDEFINED

China's changing economy has exposed the inefficiencies and shortcomings of the rigid definition of property rights in China's civil law framework. While common law systems describe ownership as a "bundle of sticks," with lesser ownership interests associated with various arrangements of the "sticks," China's civil law jurisprudence[37] considered ownership an indivisible and absolute whole. However, since 1979, China's ambitious market reforms have simultaneously decentralized the economy and started to "transfer" incidents of ownership to various economic agents.

To give legal protection to the various property interests emerging from China's new market economy, notable Chinese legal scholars have promoted recognition of decentralized, lesser "usufruct" rights (*yongyi wuquan*).[38] Proponents of changing China's property rights regime argue that under the new phase of economic development and consumerism, imprecise specification of property rights were insufficient to regulate ownership, which ultimately could hinder economic development.[39]

To respond to the changing dynamics in China's economy, the National People's Congress adapted previous rules regulating property rights and enacted the *Law on Real Property Rights* (Property Rights Law) on 16 March 2007. This law was clearly contentious, as it was enacted after thirteen years and eight rounds of formal deliberation.[40] The Property Rights Law gives unprecedented legal protection to private property ownership, in addition to lesser, usufruct interests ensuing from the decentralization of the economy: under Article 39, "the owner of a realty or chattel is entitled to possess, utilize, seek profits from and dispose of the realty or chattel."[41] Water rights are among those usufruct rights which can be considered property rights in relation to na-

BOX 1. **Under the Table Water Trades**

Although the 1988 and 2002 versions of China's National Water Law indicated legislative support for water trading to promote water conservation, the final laws did not include water trading provisions, implying a reluctance to accept trading as a tool of water resource management. In deliberations for drafts of the 2002 amendment, paid water rights transfers were contemplated, but ultimately rejected as too controversial. Nonetheless, water trading has played a significant—if informal role in recent water disputes.

For example, although they were not officially legal, several notable water transfers and sales have occurred and in effect they have advanced the development of a water rights regime. In 2000, Dongyang City and Yiwu City agreed to exchange $24 million for the annual transfer of 50 million cubic meters of water from Dongyang City's Hengjin Reservoir to Yiwu City. Yiwu City negotiated for a stipulated annual quantity of water at a specified water quality (Class I). Although the water use rights are transferred through the agreement, the ownership of the water does not change.[1]

Although the Dongyang-Yiwu agreement may be considered among China's first transfers of water use rights, the absence of a legal framework to support the agreement risks undermining the future stability of water use rights transfers. Since the Dongyang-Yiwu agreement there have been additional transfers of water for compensation. In 2002 and 2003, the local governments in the lower and upper regions of the Zhanghe River negotiated the transfer of 30 million cubic meters of water from five reservoirs. The documents supporting the sale clearly delineated the legal rights within the water distribution scheme, elucidating the status of related water rights.[2]

Wu Guoping from China's Yangtze River Basin Commission, whose quote opened this commentary, has argued that the recent illicit sale and trade of water permits has encouraged a market-based system of water exchange and has lead to an implicit recognition of property rights in water.[3]

NOTES

1. Bin Liu. (2005). "Institutional Design Considerations for Water Rights Development in China." *Water Rights Reform: Lessons for Institutional Design.* Bryan Randolph Bruns, Claudia Ringler, & Ruth Meinzen-Dick. (Eds.), 261, 267.
2. *Ibid.* at 265.
3. *See* Kinne. (December, 2005).

tional ownership of water resources.[42] The Property Rights Law's legal recognition of these usufruct interests also theoretically protects the profits earned from state-owned natural resources,[43] which arguably includes compensation earned through sale and trade of water permits.

THE NEED FOR STRUCTURAL AND LEGAL SUPPORT

Uncertain legal recognition and enforcement of water property rights in China has led to inefficient resource use and pervasive social unrest. Under the current system of water resource management, water permits have been allocated experimentally to Water Users Associations under a rapidly developing system of allocating water usufruct rights.[44] Many of these Water User Associations have notably been created as part of World Bank investments into irrigation projects. However, the usufruct rights in the water resources—or the compensation from the usufruct rights—have not been precisely specified.

Failure to legally define "water rights" has further obfuscated the ownership interests in water resources. In order to encourage the many individuals, corporations, and organizations to invest in efficient and sustainable water rights as China's economy keeps rising, water rights need to be unbundled, which includes right to access; right to withdraw; right to manage; right to exclude; and right to transfer.[45] Clearly delineated and regularly enforced water use rights will also encourage investments in improving water quality, which is crucial in such a water-short country.[46]

Waste water pipes emerge in the banks of a tributary to the Gansu River. A major driver of water over-consumption and pollution is a lack of clear water property rights. Photo Credit: Christina Larson

So as not to compromise human health or humanitarian need, water should be first allocated according to the public good. Even subsequent to enabling water markets, the government should maintain the ultimate right to intervene in water trading.[47] Pursuant to proper allocation of water, expanding the role of market-based water trading in China could improve water conservation and encourage the most economically viable use of the water. However, just as with any property rights regime, "the expansion of water markets and prices presupposes progress on establishing the institutional framework on property rights [water rights/entitlements],"[48] as well as sufficient public participation mechanisms to encourage public enforcement of environmental pollution and water use laws.

For water rights to be an effective means of conserving water resources and improving water quality, courts must protect the property interests of water rights holders. In recognition of this need, there has been innovation at the local level. Namely, five new "green courts" have been created in provinces in southern China with the primary aim to address water conflicts that cut across political jurisdictions.[49] China's new system of water rights will be more successful where there is procedural fairness and significant public participation in the development and enforcement of the water rights regime.[50]

Attributing rights to water permit holders has been offered by Chinese lawmakers not only as a means of improving the efficiency of water distribution, but also of ensuring the quality of water resources.[51] Prior to the development of statutory standing, the basic legal protections inherent in property, contract, and other privately held rights form the foundation of "environmental law." Absent statutory standing, property rights holders may assert claims under tort and nuisance law[52] and seek judicial intervention in cases of interference with their property.[53] Particularly in a developing legal system, enforcement of private property rights is fundamental to environmental regulation.[54] By giving legal protection to the usufruct interests in water resources, the 2007 Property Rights Law offers a notable step towards reducing water consumption and achieving environmentally sustainable use of water.

The grant of property rights to water (through water permits) will likely improve the private rights approach to environmental law enforcement. In the absence of a flexible property rights regime that recognizes usufructuary interests, environmental plaintiffs whose asserted injury concerns an interference with the property interest in the water itself have up to the present been denied standing.[55] China's recent legal recognition and protection of usufruct rights in water heralds the potential to achieve both economically efficient and environmentally sustainable water use. Uniform implementation of a market-based system[56] of water licenses and legal protection of water rights will increase efficient allocation and use of water resources, thereby avoiding social unrest and ensuring continued economic development.

In parallel with the progression of China's decentralized market economy, the development of a market-based, transparent system of water rights, concurrent with the improvement of mechanisms for public participation, will dramatically improve the quantity and quality of water resource management.[57] However, without structural and legal support, true market efficiency will develop slowly, at best.

The strength of property rights results not only from the precise specification of property rights, but also from the effectiveness of the institutions that enforce the rights. Imprecise delineation and irregular enforcement of property rights not only fail to give individual owners an incentive to improve the efficiency of resource consumption, but also encourage property owners to ignore social and other external costs, which results in the over-utilization of the resource.[58] Clear legal rights over water reduce future transaction costs by creating a precedent of acceptable behavior and improves the likelihood of achieving distributive justice.[59]

For her insight and guidance on this paper, special thanks to Jennifer Turner.

Sonja Schiller, a third-year law student at Washington University in St. Louis School of Law, is currently interning with the Office of the Co-Prosecutor at the Extraordinary Chambers in the Courts of Cambodia. From 2004 to 2005, Schiller lived in Guangzhou, China, where she was a Princeton-in-Asia fellow at Hua Shi Fu Zhong and where she worked for the U.S. Foreign Agricultural Service. In 2007, Schiller returned to China to intern in Shenzhen, where she was a law clerk at King & Wood, LLP. Sonja can be reached at: sonja.schiller@gmail.com.

NOTES

1. Quote paraphrased by Beth E. Kinne, in Beth Kinne, unpublished LL.M. Thesis. (December, 2005). *Developing Property Rights in Water in Modern China*, University of Washington.

2. *China Grains Market Report.* (2009, February 11). Beijing Orient Agribusiness Consultants Ltd. (BOABC). [Online]. Available: http://manager.boabc.com/Grains_Report/2009-02-12/1234412397003.html.

3. Lu Yanan. (2009, February 4). "Drought threatens China wheat production." *Xinhua*. [Online]. Available: http://news.xinhuanet.com/english/2009-02/04/content_10759053.htm.

4. OECD. (2007). *OECD Environmental Performance Reviews for China*. OECD Press.

5. Du Guodong, editor. (2009, February 8). "China to divert water from two longest rivers to ease drought. *Xinhua*." [Online]. Available: http://news.xinhuanet.com/english/2009-02/08/content_10781894.htm.

6. "China says desertification being controlled yet still grim." (2005, June 15). *Agence France-Presse*. [Online]. Available : http://news.inquirer.net/world/index.php?index=1&story_id=40369.

7. Bin Liu. (N.A.). *China's Agricultural Water Policy Reforms*. Department of Water Resources, Ministry of Water Resources, China. [Online]. Available: http://www.oecd.org/secure/docDocument/0,2827,en_21571361_34281952_37350964_1_1_1_1,00.doc.

8. Elizabeth C. Economy. (2006). *China's Environmental Challenges*, Testimony for the U.S.-China Economic and Security Review Commission Hearing on Major Challenges Facing Chinese Leadership, Washington, D.C. Feb. 2.

9. Bin Liu. (N.A.). *China's Agricultural Water Policy Reforms*.

10. For a discussion of the public good problem, *see* Douglass C. North (1981). *Structure and Change in Economic History*. W. W. Norton & Co.

11. Yuhong Zhao. (2007). "Trade and environment: Challenges after China's WTO accession." *Columbia Journal of Environmental Law*, 41, 49.

12. In further support of the theory that ideological norms structure property rights, before the establishment of Communism in China in 1949, water rights were regulated by a system of privately owned permits. According to Kinne, "the long and complex history of property rights in pre-1949 China, and the socioeconomic specificity of those rights, translates into social and legal norms that are not likely to be erased in a half-century of the 'New China'…. Those norms provide yet more theoretical and practical grounding for the extension of property rights to include water rights in contemporary China." Beth Kinne, unpublished LL.M. Thesis. (December, 2005). *Developing Property Rights in Water in Modern China*, University of Washington, p. 4.

13. *See* North (1981) and also John W. Head. (2003). "Codes, cultures, chaos, and champions: Common features of legal codification experiences in China, Europe, and North America." 13 *Duke Journal of Comparative & International Law*, 1, 37-38, which discussed how the informal, unwritten, and widely adhered to Confucian concept of *li* governed social relationships and reduced esteem for a written, formal legal code.

14. One could view water resource management "through a Confucian lens—the strong 'fatherly' central government doling out resources… under the centralized system [in which] the provincial 'sons' strained to get more resources." Subsequent to the 1978 market reforms, economic and administrative authority over water became more decentralized, which exacerbated local government bargaining with central officials for water rights. Wang Yahua. (2003). "Water dispute in the Yellow River Basin: Challenges to a centralized system." *China Environment Series 6*, p. 95.

15. Turner, Jennifer. (1997). *Authority Flowing Downwards? Local Government Entrepreneurshihp in the Chinese Water Sector.* Ph.D. Dissertation, Indiana University, Bloomington.

16. Shapiro, Judith. (2001). *Mao's War Against Nature. Politics and Environment in Revolutionary China.* Cambridge University Press..

17. Turner, Jennifer. (1997).

18. Dolsak, Nives & Elinor Ostrom. (2003). *The Commons in the New Millennium*. (MIT Press).

19. Sun Yunlong. (2009, February 9). "China faced with combined challenges from water scarcity, mounting demand." Xinhua. Available: http://news.xinhuanet.com/english/2009-02/09/content_10787282.htm.

20. *Ibid.*

21. Wang Yahua. (2003). Peisert, Christoph & Eva Sternfeld. (2005). "Quenching Beijing's thirst: The need for integrated management for the endangered Miyun Reservoir." *China Environment Series 7*, 33-45.

22. Bezlova, Antoaneta. (2008, March 14). "Faced

with Olympian water shortage." *IPS News*. [Online]. Available: http://ipsnews.net/news.asp?idnews=41591.

23. Buckley, Chis. (2008, January 22). "Beijing Olympic water scheme drains parched farmers." *Reuters*. [Online]. Available: http://www.reuters.com/article/newsmaps/iduspek345320080123?pageNumber=2&virtualBrandChannel=0&sp=true

24. The 2002 Law amended the 1988 Water Law, which defined a system of water management wherein "the state shall exercise a system of unified administrations on water resources in association with administration at various levels and by various departments." Zhongguo Shuifa [Water Law] (promulgated by the Standing Committee of China's National People's Congress Jan. 21, 1988, effective July 1, 1988), translated in *LawInfoChina*. While river basin management has a lengthy history in China, not until the 2002 Water Law was river basin management intricately detailed with a system for efficient water allocation for economic development, sustainable water utilization for social use, and prevention and control of water disasters. River basin management of water resources originated as early as the Xia Dynasty (2200 BC), where the Great Emperor Yu harnessed rivers and united the state. In the 1930s, the central government in China instituted modern river basin management organizations, and in 1949, the Chinese state instituted the Yellow Water Resources Commission under the auspices of the Ministry of Water Resources. Dajun Shen. (2004). "The 2002 Water Law: Its Impacts on River Basin Management in China." 6 *Water Policy*, 350. The 2002 Water Law declares "the state shall exercise a water resource management system of river basin management in conjunction with jurisdictional management." Zhongguo Shuifa yu [Water Law] (promulgated by the Standing Comm. Nat'l People's Cong. Aug. 29, 2002, effective Oct. 1, 2002), *translated in* LawInfoChina. [hereinafter 2002 Water Law].

25. An impetus for amending the system of water resource management, between 1972 and 1998, the Yellow River dried up during 21 years. Shen, *supra* note 23, at 350.

26. MEP regulates water quality; the Ministry of Construction monitors municipal water supply; the Ministry of Agriculture manages irrigation; and the Ministry of Mines and Minerals is responsible for groundwater supplies. U.S. Embassy Beijing. (2002). *Clearing Muddy Waters: China Centralizing Water Management Authority*. [Online]. Available: http://beijing.usembassy-china.org.cn/report0702water.html.

27. *See* 2002 Water Law, art. 7 & art. 55. Patricia Wouters et al. (2004). "The New Development of Water Law in China." 7 *University of Denver Water Law Review* 243, 282.

28. Kinne. (December 2005).

29. Wang Yahua. (2003).

30. *See* Regulation on the Administration of the License for Water Drawing and the Levy of Water Resource Fees (promulgated by the State Council Feb. 21, 2006, effective Apr. 15, 2006), art. 2, translated in LawInfoChina. *See also* Zijun Li. (2006). "China issues new regulation on water management, sets fees for usage." Worldwatch Institute. [Online]. Available: http://www.worldwatch.org/node/3892.

31. The Interim Measures for Water Quantity Allocation (promulgated by the Nat'l People's Cong., May 12, 2007, effective Feb. 1, 2008), translated in LawInfoChina.

32. Yingling Liu. (2008). *Water Trading in China: A Step Towards Sustainability.* [Online]. Available: http://www.worldchanging.com/archives/008029.html.

33. Zhou Jigang et al., *Trading Water in Thirsty China*, Time & Truth News, June 26, 2008, *available at* http://www.chinadialogue.net/article/show/single/en/2144.

34. *Ibid.*

35. *Ibid.*

36. Xian Fa, art. 9 (promulgated by the Nat'l People's Cong., Dec. 4, 1982, effective Dec. 4, 1982), *translated in* LawInfoChina.

37. In Chinese law, the conception of the totality of ownership arose from the Soviet civil law jurisprudence, in which ownership was understood as an indivisible, absolute whole and *jura in re aliena* was not permitted. Frank Xianfeng Huang. (2004). "The Path to Clarity: Development of Property Rights in China." 17 *Columbia Journal Asian Law* 191, 206-07.

38. *Ibid.*

39. Andrew C. Mertha. (2007). "From "Rustless Screws" to "Nail Houses:" The Evolution of Property Rights in China."

40. Zhu Keliang & Li Ping. (2007). "Rural Land Rights Under the P.R.C. Property Law." *China Law & Practice*, 23, 23.

41. Real Right Law of the People's Republic of China, art. 39, (promulgated by the Standing Comm. Nat'l People's Cong., Mar. 16, 2007, effective October 1, 2007).

42. B. Liu. (2005). *Institutional Design Considerations for Water Rights Development in China*, *in* Water Rights Reform: Lessons for Institutional Design 260 (Bryan Randolph Bruns, Claudia Ringler & Ruth Meinzen-Dick eds.).

43. Frank Xianfeng Huang. (2004). "The Path to Clarity: Development of Property Rights in China." 17 *Columbia Journal of Asian Law*, 191, 208.

44. Liu, *supra* note 41, at 272.

45. Edella Schlager & Elinor Ostrom. (1992). "Common Property and Natural Resources: A Conceptual Analysis." 68 *Land Economics*, 249, 249-52.

46. Development of "exclusive property rights which reward the owners provide[s] a direct incentive

to improve efficiency and productivity." Douglass C. North. (1981).

47. Zmarak Shalizi. (2006). "Addressing China's Growing Water Shortages and Associated Social and Environmental Consequences." *Development Research Group*, World Bank Policy Research Working Paper 3895.

48. *Ibid* at p. 17 (emphasis in original).

49. Ellis, Linden. (2008). "Giving the courts green teeth." China Environment Forum Meeting Summary. [Online]. Available: http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.event_summary&event_id=477342.

50. Wang Rong. (2007). "Conceptualizing the Development of Water Rights in China." 4 *United States-China Law Review*, 28.

51. *Ibid* at 33-34.

52. Eric W. Orts. (2003). "Environmental Law with Chinese Characteristics." 11 *William & Mary Bill of Rights Journal*, 545, 559 n.97. *See Boomer v. Atlantic Cement, Co., Inc.*, 257 N.E.2d 87 (N.Y. 1970) (granting relief where landowners alleged a nuisance claim where the polluting operations of a neighboring cement plant created substantial injury to their property).

53. Orts, *supra* note 51, at 558.

54. The 2001 desertification law, for example, grants property rights to citizens who contribute to land improvement and conservation. Other recent laws have similarly begun to acknowledge the benefits of a private rights-based system of environmental protection. U.S. Embassy Beijing. (2001). *China Adopts Law to Control Desertification*. [Online]. Available: http://www.usembassy-china.org.cn/sandt/desertification_law.htm.

55. Patti Goldman. (2007). "Public Interest Environmental Litigation in China: Lessons Learned from the U.S. Experience." 8 *Vermont Journal of Environmental Law*, 251, 257 n.28.

56. In parts of the United States, active water-trading markets help ensure efficient allocation of water resources, and when on a large-scale, water trading contributes to economic development. To diminish the impact of unrestricted water trading on water use, state governments maintain the right to intervene in water trading. Y.S. Cao. (2006). "Addressing Water Scarcity, Evolution of Integrated Approaches to Water Resource Management in Europe and the United States." *The World Bank Analytical & Advisory Assistance (AAA) Program China*, 18-19 [Online]. Available: http://siteresources.worldbank.org/INTEAPREGTOPENVIRONMENT/Resources/WRM_US_EU_experience_EN.pdf.

57. Michael Eng & Ma Jun. (2006). "Building sustainable solutions to water conflicts in the United States and China." *China Environment Series* 8, Special Report, p. 155.

58. Douglass C. North. (1981).

59. North (1981) proposes that where ideologies are widely shared and legal codes are widely adhered to, states achieve economies of scale within their systems of law and transaction costs subsequently decrease.

SPOTLIGHT

Redefining the GMO Debate in China: Greenpeace China

By Lorena Luo

As the most populated country in the world, with over 1.3 billion people and only 8 percent of the world's arable land, China has always put food security as its top priority. Genetically modified organisms (GMOs)—with their multifold promises of pesticide reduction, disease resistance, and drought tolerance—have garnered strong interest from Chinese policymakers as a potential solution to the country's agricultural challenges. Nevertheless, the environmental and food safety uncertainties associated with this technology also call for a cautious approach to the application and regulation of GMOs. Civil society should play a key role in the ongoing debate in China over agricultural GMOs, as consumers and farmers need to have a say in the future of their food and crops. Since 2000, Greenpeace China has carried out a campaign on GMOs that exposes gaps in regulation, informs consumers, and promotes the precautionary principle in the application of this controversial technology. Through investigations, outreach, publications, and other campaign work, Greenpeace China has done the following:

- Assisted the Chinese government in discovering and addressing major loopholes in its regulation of GM rice field trials;
- Worked with major domestic and international food companies to establish a non-GM food policy for the Chinese market;
- Tested popular food products and published testing results to ensure Chinese consumers' right to access information on the GMO issue; and,
- Conducted independent assessments on the ecological and food safety risks of GM crops and their intellectual property issues in China.

INVESTIGATING ILLEGAL GM RICE

In late 2004, A *Newsweek* report indicated that a GM rice variety not yet approved for commercialization by the Chinese government was already being grown in central China's Hubei Province. Following the news, a Greenpeace investigation team immediately went to Hubei to assess the situation. From February to August of 2005, the team visited Hubei Province numerous times conducting undercover investigations of the illegal sale of the GM rice seed and tracing the spread of the rice in the food market. The team talked to seed companies, agricultural extension stations, farmers, rice millers, and rice sellers. They collected samples of seeds, seedlings, and rice products. The Greenpeace team also documented the investigation process in collaboration with investigative journalists from leading Chinese news organizations.[1] The investigation uncovered a widespread leakage of illegal GM rice (a pest-resistant variety called Bt63) to the market, which posed serious environmental and food safety risks, as it had not yet been labeled safe by China's Ministry of Agriculture.

A follow-up Greenpeace investigation of the food market in China also found that illegal GM rice from Hubei had contaminated rice products sold by leading supermarkets and baby food brands as far away as Guangdong Province and Hong Kong. In 2006, Greenpeace offices in several European countries including the United Kingdom, France, and Germany discovered that the illegal GM rice was present in rice products imported from China.

Upon the initial discovery of the illegal GM rice in Hubei Province, Greenpeace immediately informed the Chinese government and released the information to the public. Subsequent government investigations into the illegal sale and growth

Early in the GMO Campaign, Greenpeace organized a sit in on 28 May 2001 outside the Nestlé factory in Hong Kong Yuen Long. Photo Credit: Greenpeace China

of GM rice in Hubei resulted in the destruction of illegal GM rice fields, punishment of three seed companies, and stricter oversight of companies producing and exporting rice products.

In 2008, Greenpeace also exposed another illegal GM seed case in Hunan Province, in which a scientist presented a GM seed as a conventional seed for the national seed registration test. After Greenpeace's investigative report, this GM seed did not pass the seed registration.

WORKING WITHIN CHINA'S FOOD INDUSTRY

Urban Chinese consumers are increasingly concerned with food safety issues, including GM food. Since 2004, Greenpeace China has been monitoring Chinese consumer awareness of GM food in collaboration with polling organizations. The latest Greenpeace/Ipsos survey of 600 Chinese consumers in three cities in 2007 revealed that 65 percent of consumers in Beijing, Shanghai, and Guangzhou prefer non-GM food and 97 percent feel China should have a mandatory labeling system for GM ingredients.

Currently, China has a GM labeling regulation covering only non-processed and half-processed products such as seeds and oil. To better support the consumers' right to access information in mainland China and Hong Kong, Greenpeace China has been using different campaign tools such as direct action and negotiations to push food companies to open their ingredient policy to the public. Greenpeace staff has also been working with Chinese officials to advocate the establishment of a non-GM food policy in China to reduce the release of GMOs into the environment.

Since 2001, Greenpeace China has been publishing a consumer guide that categorizes both domestic and international food companies according to their GM ingredient policy in forms that are clear and accessible to Chinese consumers.[2] This guide has been updated regularly, with more food companies publicly announcing their non-GM food policy for the Chinese market. The latest version of the consumer guide (2007) covers almost all of the big food brands in China. Leading global food companies such as Coca-Cola, Pepsi Food, Dannon (Groupe Danone), and Kraft Foods

are among those that have committed to use only non-GM ingredients in their products in China. Greenpeace also tests popular food products produced by our listed companies in the market and releases testing reports as a monitoring mechanism for food company policies.

INDEPENDENT VOICE

Greenpeace has been closely monitoring the development of GM crops in China to provide an independent third-party perspective. In 2002, Greenpeace worked with scientists from the Nanjing Environmental Science Institute to publish a study on some of the key ecological risks associated with GM cotton in China, including its potential for pest resistance and risk of secondary pests.

In 2004, Greenpeace scientists in the U.K. also conducted independent assessments on the environmental and food safety aspects of several Chinese GM rice varieties awaiting approval for commercialization in China. The assessment report was submitted to members of the Biosafety Committee—an advisory group organized by China's Ministry of Agriculture to do GMO safety assessments; it was also released to the public through the news media.

A 2008 Greenpeace study of global food patents notably found that foreign patents are heavily involved in key GM rice varieties in China, despite the Chinese government's considerable emphasis on self-owned property rights in this field. The finding raises serious questions about the implications of foreign patents on the country's food security and the farmers' livelihood. If China approves the commercialization of GM rice, it could risk the staple food grain on which 1.3 billion people rely for survival. There are cases in other countries that show the prices of seeds of GM crops are much higher than those of conventional non-GM seeds, which could eventually result in price increases of seeds at large in the country. Foreign patent holders may also file damaging lawsuits against farmers and seed companies.

PROMOTING SUSTAINABLE AGRICULTURE IN CHINA

Greenpeace believes that genetic modification and heavy industrial agriculture are not the answers to China's agricultural problems. From the very beginning of its work in China, Greenpeace has been promoting ecological agriculture solutions as an alternative future of China's "rice bowl." Greenpeace researchers have been documenting local sustainable agricultural practices such as multicropping—particularly the rice-duck model—and working with Chinese scientists to demonstrate the potential of other eco-friendly practices.[3] These practices also have helped farmers express their feelings towards land use and cultivation using their own creative ways.[4] One of the Greenpeace activities in 2006 was to give local farmers cameras so they could document their lives. The results—three photo exhibitions around China—were excellent; the farmers' viewpoints left a remarkable impression on their viewers and the media.

Lorena Luo is the head GMO campaigner for Greenpeace China where she has worked for over one year. She can be reached at lorena.luo@cn.greenpeace.org.

NOTES

1. Examples of news reports coming out of the investigations: Lin, Gu, (2005, July 15). "Seeds of ignorance," *South China Morning Post*. [Online]. Available: http://www.agbios.com/main.php?action=ShowNewsItem&id=6670 and Liu, Jianqiang, (2005, Apr 14). "GM rice leaked to Wuhan market, revealing regulatory loopholes," *Southern Weekend*. [Online]. Available: http://news.sina.com.cn/c/2005-04-14/18266388397.shtml. Barboza, David, (2005, April 16). "China's problem with 'anti-pest' rice," *The New York Times*. [Online]. Available: http://query.nytimes.com/gst/fullpage.html?res=950DE4D7113EF935A25757C0A9639C8B63&sec=&spon=&pagewanted=2.

2. See Greenpeace China Website: http://www.greenpeace.org/china/zh/campaigns/food-and-agriculture/ge-food/food-safety/foodguide.

3. See Greenpeace China Website: http://www.greenpeace.org/china/zh/news/rice-and-its-partners.

4. See Greenpeace China Website: http://www.greenpeace.org/china/zh/press/releases/20060607-rice-farmers-photo-exhibition.

COMMENTARY

Turning a Double Exposure into a Double Dividend: Black Carbon From Indoor Air Pollution in Rural Yunnan

By Jill Baumgartner and Nina Trautmann Chaopricha

In a village near Lashi Lake in northwest Yunnan Province, Mu Xuequan guides us through her household courtyard and into a small kitchen. "Nothing special," shrugs Mu. "It's the same as most kitchens in this area." Smoke billows up from an open hearth where Mu has balanced a large pot on top of smouldering pine logs. The blackened kitchen walls indicate years of using firewood for cooking. "We built that many years ago," says Mu, motioning to an enclosed and vented cook stove at the opposite end of the kitchen, "but we only use it during family gatherings." She acknowledges that the smoke sometimes bothers her eyes, but still continues to burn wood in the open hearth for cooking and boiling water—the same method her family has used for generations.

Despite having access to existing clean energy fuels and technologies such as liquefied propane gas or biogas, the use of traditional open fire cooking with biomass, mainly wood and crop residues, is persistent among households in this region of Yunnan. Indoor biomass combustion has considerable consequences for environmental and human health due to the emission of pollutants into household kitchens, neighborhoods, and the atmosphere. A particle pollutant from biomass burning that is increasingly blamed for a significant proportion of the negative impacts on both human health and the environment is black carbon (BC). Thus immediate public health and climate-related benefits could be achieved through reducing BC emissions from biomass combustion by substituting biomass with other fuels and combustion methods, many of which are commercially available throughout China. Yet even the most well-intentioned clean energy projects in areas like northwest Yunnan have met with only limited success.

THE HUMAN HEALTH AND CLIMATE EFFECTS OF BLACK CARBON

Rural households in northwest Yunnan are particularly vulnerable to environmental exposures such as indoor air pollution; that is, due to various household constraints, they are not able to avoid or manage their levels of exposure. In fact, many of the households in this region can be considered as "doubly exposed" to potential consequences of domestic biomass combustion: the first being direct exposure to pollutants from indoor cooking and heating and the second being the environmental consequences of regional climate effects. Women and children are particularly vulnerable to the direct impacts as they tend to spend the most time near the domestic hearth.

Households in rural Yunnan—as in much of rural China—typically burn biomass in unvented, inefficient stoves. Smoke from biomass combustion contains a large number of known health hazards and pollutants including particulate matter, carbon monoxide, polynuclear aromatic hydrocarbons (PAHs), and black carbon (BC). There is strong evidence that chronic exposure to particle pollution increases respiratory illnesses in both children and adults. In particular, several recent studies suggest that exposure to BC particles is associated with decreased cognitive function in infants (Suglia, 2008) and both cardiovascular and respiratory illness in adults (Zanobetti, 2006). A 2000 study by the World Health Organization estimated that household solid fuel use was the single largest environmental human health risk factor in China (Zhang, 2005). Moreover, the economic costs of seeking medical care and lost days of work or school due to illness or caregiving further reinforce the poverty traps that many poor households find difficult to escape.

In addition to health impacts, BC particles impact regional climate primarily by absorbing incoming solar radiation and thus warming the atmosphere, and secondarily, by influencing precipitation and temperature patterns with significant regional climate effects (IPCC, 2001). Considering that an estimated 60 percent of China's residential energy derives from biofuels, indoor cooking fires play a major role in regional BC emissions (Fernandes, 2007), which may be contributing to the recent tendency in increased precipitation events and flooding in southwest China (Menon, 2002). Rural households—which are typically those most exposed to indoor pollutants—also tend to be disproportionately affected by the agricultural, water resources, and human health consequences of floods given their dependence on natural resources and limited coping mechanisms.

TURNING A DOUBLE-EXPOSURE INTO A DOUBLE-DIVIDEND

In light of the double-exposure in regions like northwest Yunnan where biomass combustion—especially fuelwood—is the largest source of BC emissions, transition to cleaner-burning fuels and improved energy technologies translates into a double-dividend. First, it would reduce the illness associated with particle pollution exposure for the millions relying on biomass for household energy needs while, second, help to mitigate climate effects (Venkataraman, 2005; IGSD/INECE, 2008).

Despite improvements across most health indicators in China, a closer look reveals considerable differences in regional and urban/rural health outcomes. For instance, life expectancy in rural areas of Yunnan is estimated at almost ten years less than China's average (Congdon, 2007), and maternal mortality in the northwest region of Yunnan is twice that of urban areas of the province and five times China's average (Tien, 2007). Yunnan's rugged and mountainous terrain inhibits access to healthcare centers for many rural dwellers. Further, as each province is largely responsible for its own healthcare provision, prosperous regions in the east of China are comparatively better able to provide healthcare for their population while poorer regions like Yunnan must settle for less (Blumenthal, 2005). In this context, preventative measures resulting in substantial health improvements and less need for healthcare utilization—such as decreasing exposure to indoor air pollution—are important steps in reducing health disparities on both a regional and national scale in China.

In addition, some estimates suggest that BC could have as much as 55 percent of the current global warming effect of carbon dioxide (Ramanathan, 2008). Fortunately, however, reductions in BC aerosols may offer a nearly instant return on investment. While greenhouse gases like methane and carbon dioxide remain in the atmosphere for years and about a century, respectively, BC particles remain airborne for mere days or weeks. Thus, the impact of reducing BC emissions would create almost immediate and regionalized benefits in China, particularly for populations considered most vulnerable to the effects of regional environmental change.

MOVING FORWARD: REDUCING BLACK CARBON EMISSIONS IN RURAL HOUSEHOLDS

The solutions for reducing black carbon emissions from household biomass combustion may initially appear to be very straightforward: transition to cleaner-burning fuels like biogas and liquefied propane gas and implement more efficient biomass-burning stoves in households where financial constraints prohibit sustained use of more expensive fuels. Yet the case of Lashi Lake highlights how technology-based intervention programs must also carefully consider cultural and social complexities in conjunction with both the health and environmental implications for a program to be sustained.

The continued reliance of many northwest Yunnan households on highly polluting open fires are at least in part attributable to a lack of consciousness about the health effects of indoor air pollution. Local knowledge of pollution-health links appears to be minimal in some villages and, mirroring the sentiments of Weller and colleagues working in other rural areas of China (Weller, 1998), coping with indoor air pollution and its associated ills and discomforts are often viewed as an accepted characteristic of rural life. Social marketing campaigns that alert people to the health risks of indoor pollution exposure may encourage a willingness to alter culturally embedded living practices and thereby reduce health hazards and, subsequently, environmental impacts.

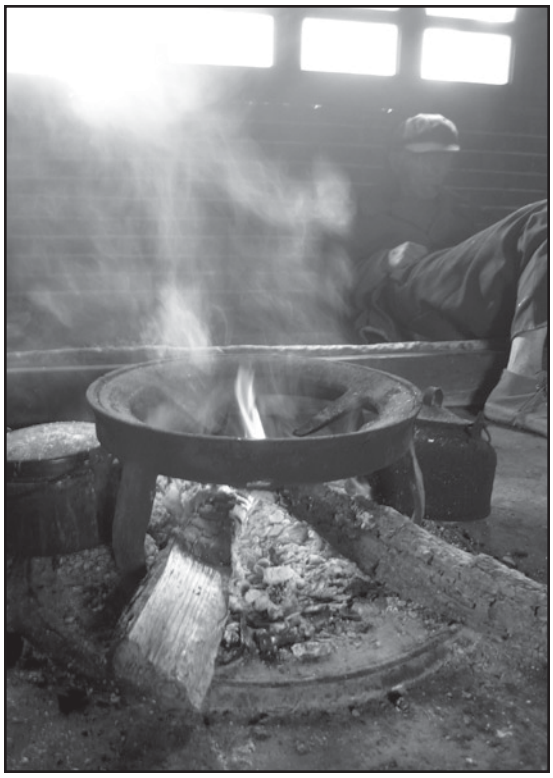
Recent rural energy projects in the Lashi Lake region emphasized technology-based solutions such as biogas or improved stoves with the chief objective of reducing fuelwood consumption in

the name of environmental sustainability. These efforts are certainly an important step; however, even in households around Lashi Lake that already own biogas and improved stove technologies, improved stoves are often only used in conjunction with open fires or as a secondary source to their traditional methods during large family gatherings. Reluctance to make a complete transition appears to stem from a complex interaction of social and cultural factors. Our fieldwork revealed that members of several Lashi Lake households, for instance, pointed to the dual capacity of cooking *and* space heating that open fires provide relative to single-purpose cookstoves. Others expressed their desire to socialize around the open hearth. Assessing the social and cultural barriers to technology adoption in the planning stages of a program will facilitate a better understanding of barriers to improved adoption and sustained use of improved stoves.

Lessons from other intervention programs in different regions of China indicate awareness of health risks alone cannot lead to changes in fuel and stove choices if there is insufficient physical and financial access to alternative fuels and stoves. Results from a recent multi-provincial clean stove intervention study in China indicate that, in the short term, health education and behavioral interventions conducted in isolation have no benefits for indoor air pollution reduction (Baris, 2007).

Successful interventions are likely to need both in-depth input from the targeted communities and clever strategies to address cultural barriers to implementation. For households, there is a trade-off between difficulties in changing habits and daily routines in the short-term and receiving the health and environmental benefits with payoffs in the medium- to long-term. These concerns must be appropriately addressed by both public health and environmental organizations for clean energy project success.

"A 2000 study by the WHO estimated that household solid fuel use was the single largest environmental human health risk factor in China."



A typical open cook stove in rural China.
Photo Credit: Jill Baumgartner and Nina Trautmann Chaopicha

We thank Xia Zuzhang (The Nature Conservancy), Mu Liqin (The Lijiang Government Research and Policy Institute) and Chen Yongsong (Yunnan Eco-Network) for their insights into energy use in northwest Yunnan and their strong commitment to serving rural populations. We also greatly appreciate funding from the University of Wisconsin-Madison National Science Foundation IGERT China Program.

Jill Baumgartner is a doctoral student in environmental epidemiology at the University of Wisconsin-Madison. She was a Peace Corps volunteer in Sichuan from 2000-2002 and is currently studying the health effects of indoor air pollution in rural Yunnan, China. She can be reached at jcbaumgartne@wisc.edu.

Nina Trautmann Chaopricha is a Ph.D. student at the University of Wisconsin-Madison studying sustainable development in Yunnan, China through the Nelson Institute for Environmental Studies' Environment & Resources program. She can be reached at trautmann@wisc.edu.

REFERENCES

Baris, E. & Ezzati, M. (Eds). (2007). Household Energy, Indoor Air Pollution and Health: A Multisectoral Intervention Program in Rural China. Energy Sector Management Assistance Program. [Online]. Available: http://www.esmap.org/filez/pubs/7132007104252_ChinaIAPSpecialReport.pdf.

Blumenthal, D. & Hsiao, W. (2005). "Privatization and its discontents—The evolving Chinese health care system." *New England Journal of Medicine,* 353(11), 1165-1170.

Congdon, Peter. (2007). "A model for spatial variations in life expectancy; mortality in Chinese regions in 2000." *International Journal of Health Geographics* 6, 16-29.

Fernandes, S.D.; Trautmann, N.M.; Streets, D.G.; Roden, C.A.; & Bond, T.C. (2007). "Global biofuel use, 1850-2000." *Global Biogeochmical Cycles* 21, GB2019.

Franco Suglia, S; Gryparis, A; Wright, R.O.; Schwartz, J. & Wright, R.J. (2008). "Association of black carbon with cognition among children in a prospective birth cohort study." *American Journal of Epidemiology,* 167, 280-286.

IGSD/INECE. (2008, August 4). *Climate Briefing, Reducing Black Carbon May Be Fastest Strategy for Slowing Climate Change*.

Intergovernmental Panel on Climate Change (IPCC). (2001). *Climate Change 2001: The Scientific Basis* (Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change). [Online]. Available: http://www.grida.no/climate/ipcc_tar/wg1/index.htm.

Menon, S.; Hansen, J.; Nazarenko, L.; Luo, Y. (2002). "Climate effects of black carbon aerosols in China and India." *Science* (297) 2250-2253.

Ramanathan, V. and Carmichael, G. (2008). "Global and regional climate changes due to black carbon." *Nature Geoscience* (4) 221-227.

Tien, L.C; Li, J.H.; Zhang, K.N.; & Guest, P. (2007). "Women's status, institutional barriers and reproductive health care: A case study in Yunnan, China." *Health Policy* 84, 284–297.

Venkataraman, C.; Habib, G.; Eiguren-Fernandez, A., Miguel, A. H.; & Friedlander, S. K. (2005). "Residential biofuels in South Asia: Carbonaceous aerosol emissions and climate impacts" *Science* 307(5714), 1454.

Weller, R.P. & Bol, P.K. (1998). "From Heaven-and-Earth to nature: Chinese concepts of the environment and their influence on policy implementation." In *Confucianism and Ecology: The Interrelation of Heaven, Earth, and Humans,* edited by Tucker, Mary Evelyn and John Berthrong. Cambridge, MA: Harvard University Center for the Study of World Religions.

Zanobetti, A & Schwartz, J. (2006). "Air pollution and emergency admissions in Boston, MA." *Journal of Epidemiological Community Health* 60, 890–895.

Zhang, J. & Smith, K.R. (2005). *Indoor Air Pollution from Household Fuel Combustion in China: A Review*. Paper presented at the 10th International Conference on Indoor Air Quality and Climate, September 4-9, 2005, Beijing, China.

Zhang, J. & Smith, K.R. (2007). "Households air pollution from coal and biomass fuels in China: Measurements, health impacts and interventions." *Environmental Health Perspectives* 115, 848-855.

FEATURE BOX

Digging Behind the Scenes: China Environmental Health Project Research Brief Series

By Linden J. Ellis and Jennifer L. Turner

Since February 2007, the China Environment Forum (CEF) has been publishing research briefs online under the auspices of Western Kentucky University's Hoffman Environmental Institute's China Environmental Health Project, an initiative supported by the U.S. Agency for International Development. Despite a rather academic title, these briefs are a hybrid between anthropocentric journalism and academic research that target practitioners by highlighting opportunities for international cooperation with China on environmental health issues. Through the briefs, CEF seeks the underscore not only the economic and environmental impacts, but also the human health threats linked to pollution and natural resource degradation in China. Rather than only focusing on major issues in the news, CEF often chooses little-known topics where research is challenging, or topics that are rife with misinformation. Through interviews with experts in the field or expert writers (who have authored over a quarter of the briefs), most briefs outline the complexity of the environmental health issue, inventory who is already working on it, and emphasize untapped opportunities for further collaboration or research. Some newer briefs are short case studies of Chinese environmental nongovernmental organizations and overviews of provincial or regional environmental health challenges.

Of the 40+ briefs posted online at this time, some of our most popular include:

- "China as E-Waste Dumping Ground: A Growing Challenge to Ecological and Human Health."
- "Transboundary Air Pollution—Will China Choke On Its Success?"
- "Pesticides and Environmental Health Trends in China."
- "Desertification and Environmental Health Trends in China."

A brief by CEF's Catherine Tai and Linden Ellis tackled Lake Tai, one of China's three most polluted lakes. By combining Chinese language research and interviews with experts in the field, CEF uncovered the complex causes and implications of the major algae blooms on the lake. Although industry is often blamed for the outbreaks, agriculture—particularly aquaculture—and municipal waste are far greater contributors to the toxic slime. Algae expert Hans Paerl, working in partnership with the Institute for Marine Sciences of the University of North Carolina at Chapel Hill and the Chinese Academy of Social Sciences, noted that a full 50 percent of the nitrogen and phosphorus in Lake Tai likely comes from municipal wastewater, which incidentally is the easiest form of water pollution to mitigate.

CEF has produced a number of CEHP research briefs focused on medical, hazardous, electric, and municipal waste, as well as rural "trash villages" in China. In the above photo, a volunteer trash collector in Gansu Province is standing next to mound of rubbish he collected from local roadways and rivers. Photo Credit: Christine Larson.

Far from the slimy green Lake Tai, cotton is growing in the desert. CEF's Erika Scull dug through politics and scarce sources to investigate environmental health in China's Xinjiang Autonomous Region. In Xinjiang's dry and salty Tarim Basin, 70 percent of cultivated land is devoted to labor- and water-intensive cotton. To reclaim salinized and desertified land, farmers flush glacier-dependent river water through the soil before planting—sending salt, pesticides, and fertilizers downstream.

CEF's Elisa Lai targets glacier melt in her brief on the biophysical impacts of climate change. In China's Himalayan glaciers the average temperature has risen 1 degree Celsius over the past decade, triggering glacier retreat at a rate of 7 percent annually, which means permanent water scarcity is a looming reality in the highly populated and water-intensive basins like the Tarim, as well as the Yangtze and Yellow river basins. This brief also presents details on glacier lake floods, sea level rise, biodiversity loss, and coral reef destruction, and increases in natural disasters linked to climate change.

Not all the briefs are doom and gloom at CEF. The Chinese government is aware of its environmental crisis and is approaching the issues with innovation and openness to international collaboration. CEF's Zhimin Mao examines the prospects of one such international initiative—carbon trading as part of the Clean Development Mechanism (CDM). According to the World Bank, China leads the world in CDM projects that comprise 73 percent of the global market share and account for more than 50 percent of the world's average annual Certified Emissions Reductions (CERs). Climate experts have questioned whether China's boon in CDM projects has met the additionality criteria or if they are even significantly lowering carbon emissions. Such doubts combined with uncertainty about the post-2012 carbon market situation have led to a recent slowdown in approvals in China.

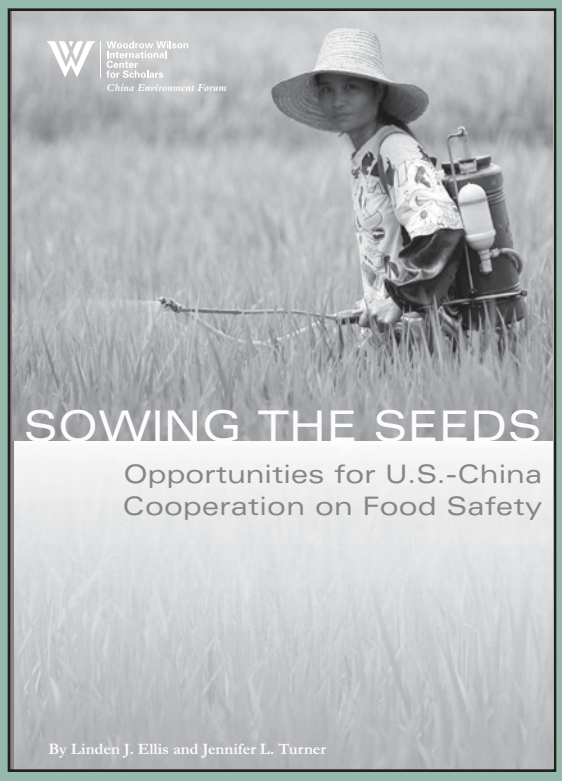
CEFs research briefs can be found online at www.wilsoncenter.org/cef: click on "Briefs" on the right-hand sidebar. For more information on the CEHP see: http://www.wku.edu/cehp/

FEATURE BOX

China Environment Forum Report: *Sowing the Seeds: Opportunities for U.S.-China Cooperation on Food Safety*

By Linden J. Ellis and Jennifer L. Turner

At the crest of a recent wave of import concern, China's food regulatory system and food processing industries have come under intense criticism both domestically and internationally. However, despite the international hype about food contaminated with veterinary drugs and industrial components, the number one domestic food-borne threat to human health in China is microbial contamination from poor handling. China's capacity to effectively protect food quality is hampered by a weak legal, political, and regulatory infrastructure that has not forced food producers and processors to be accountable. Key weaknesses in China's food safety governance system include strong local government protectionism of industries; a lack of a product liability law; and weak monitoring capacity of food products, due both to the vast numbers of small-scale food producers and processors and competition among regulating agencies. China also lacks an independent court system, which could better protect consumers and company whistle blowers. Consumer education is also lagging, in part due to few consumer watchdog organizations. Now, with the development of the Chinese middle class truly underway, China's urbanites are demanding safer food. But answering the demands of urbanites without addressing the rest of the population may create a dual system of food safety, potentially sparking social unrest.



Consumer demands plus an explosion of negative news media attention on food exports have greatly accelerated food safety reforms in China. These same forces also have already begun to catalyze repairs to the U.S. food safety monitoring system, which has long been underfunded and understaffed—with the U.S. Food and Drug Administration inspecting a mere 1 percent of food imports and only analyzing 0.2 percent of the total in laboratories.

Food safety demands the active collaboration of the government, food safety technology leaders, the food industry, and consumers both within countries and across borders. International collaboration on food safety generally prioritizes food security and international trade, but often overlooks the equally

important pursuits of (1) promoting food production systems that protect the environment, and (2) empowering citizens and civil society groups to be involved in monitoring the regulation of food. Food safety offers an important opportunity for the United States and China to collaborate for the benefit of both countries. While the main responsibility for solving China's food safety problems rests with the Chinese government and people, food safety is a global concern, one that all countries must diligently address domestically, and an area in which cooperation among nations is vital.

In 2008, the China Environment Forum, with generous support from Waters Corporation, examined these issues in *Sowing the Seeds: Opportunity for U.S.-China Cooperation on Food Safety*.

Sowing the Seeds is available online at www.wilsoncenter.org/cef or email CEF@wilsoncenter.org to receive a print copy.

COMMENTARY

Risk Management: Lessons Learned From the Snow Crisis in China

By Guizhen He, Yonglong Lu, and Lei Zhang

In January 2008, just before the Chinese Lunar New Year, 21 of China's 31 provinces were hit by an unexpected snowstorm. This large-scale snow was most intense in the usually warm southern China and the storm caused unprecedented havoc for millions of holiday travelers. While the direct economic damage was estimated to be $21 billion, the subsequent bill for infrastructure repairs, living allowances, and agricultural production restoration totaled nearly $35 billion. More than 100 million people throughout the country were directly impacted and more than 129 people died. This snow disaster tested the newly established Chinese emergency response system and exposed the weaknesses of the current risk management system.

China has long been a country plagued by natural disasters, but in today's more interconnected world, Chinese and international journalists, as well as Chinese bloggers are quick to disseminate information on earthquakes, floods, and landslides, as well as the growing number of serious pollution accidents, major disease outbreaks, and food safety incidents. Thus, the Chinese government has come under increasing pressure to show adequate responses to all types of major emergencies. The snow disaster offered Chinese officials many important lessons that were useful in responding to the subsequent earthquake in Sichuan Province in May of 2008.

CHINA RECEIVES A "VICIOUS SLAP FROM MOTHER NATURE"

As the Chinese New Year approached in January of 2008, many in China viewed the upcoming year as an exciting one with the summer Olympic Games opening in Beijing. Ironically, on January 10, just as many were speculating about excessively hot weather for the Games and with no warning from China's Meteorological Administration, the country was hit by a massive snowstorm. This snow marked China's coldest winter in 50 years and even in the past 100 years in some regions (Zheng, 2008). In total, 21 provinces in China were hit by snow and icy rain. (See Map 1). The icy rain and snow lingered for more than 30 days and even provinces that rarely receive excessive snow—such as Hunan and Hubei—were blanketed in heavy snow. The total number of consecutive days of icy rain broke the record in 56 counties of Guizhou Province ("Consecutive days," 2008). With more than half of a meter (18 inches), this storm shattered snow accumulation records from 1951 in parts of six provinces.

This snow disaster overwhelmed the Chinese transport and energy systems, wreaked havoc on food and agriculture, and tested China's fledgling risk management system. The snow halted all New Year's travel in the southern provinces, leaving five million travelers—from what is the world's largest annual migration—stranded. More than 2,850 trains were postponed, and over 3,000 flights cancelled and 5,550 delayed in the 15 days following the snowstorm. The travel woes hit hardest in Guangzhou, where more than one million migrant workers waited in the cold for nearly two weeks for trains to resume service—for most, trains did not start soon enough to return home ("Dynamic news," 2008).

Many more people in China experienced a cold and dark New Year's festival without electricity.

Some 8,000 freight trains were delayed, triggering the country's most serious power crisis as coal deliveries languished on stranded trains. A large number of power lines and towers collapsed

Map 1: Provinces and regions affected by the snowstorms and icy rains in China in January 2008

Source: Authors

under the heavy snow and ice. Parts of central and eastern China saw the worst power failures in the country's history. Nineteen provinces and regions suffered blackouts with some areas losing electricity for nearly two weeks, as was the case in Chenzhou, a city of 4.5 million people in Hunan Province ("Notice of the State Council," 2008). In Guangdong, emergency supplies of coal arrived on a fleet of 125 cargo ships.

Although most Chinese citizens blamed severe winter weather for the power crisis, policymakers are now being forced to admit their own role in the crisis by imposing low, state-set electricity fees that cause power generators to run in the red as coal prices leap. Recent crackdowns on small, unsafe coal mines also led to rising coal prices and shortages. With enormous efforts and investments, on February 6, 2008—almost a month after the storm began—power was restored at least partly to 164 of the 169 counties, including the most affected city of Chenzhou ("Electricity back," 2008). The energy problems following the snow crisis catalyzed more aggressive laws and standards to push for energy efficiency. A stronger amended *Energy Conservation Law* went into effect on April 1, 2008, and 46 national energy-saving standards were promulgated and implemented in the months following the snow disaster.

IMPROVING THE CHINESE RISK MANAGEMENT SYSTEM

Of course, it is easy to criticize China's energy and transportation sectors for poor infrastructure and design flaws that could not withstand the snowstorm. The political institutions also exacerbated the problems—most notable were the failures of the weather forecasting system to provide early warning of the snow and the subsequent slow responses of the central and local governments. However, it is more important to understand the fundamental institutional and management causes behind these problems. Learning from globally established models, a national risk management system should be based on the principles of prevention, preparedness, response, and recovery. The recent snowstorm tested the effectiveness of the country's nascent risk management system and indicated that many improvements are needed. Before reflecting on future changes, it is helpful to examine recent natural and pollution disasters that have shaped the Chinese government's actions in creating better emergency response and risk assessment systems.

Major Pollution Incidents and SARS Catalyze New Planning and Laws

China has been jolted by a series of pollution accidents and major disease outbreaks in recent years—such as the heavily reported Severe Acute

Respiratory Syndrome (SARS) outbreak in 2003, followed by the serious emergence of avian flu, the chemical spill into the Songhua River in 2005, and the toxic algae blooms on Lake Tai in 2007. The central government paid closer attention to emergency response capacity building after the SARS outbreak, which led to 685 deaths within China (including Mainland, Hong Kong, Macao and Taiwan) and 89 abroad. The Chinese government's initial cover-up and later mishandling of the outbreak led to considerable unwanted scrutiny, which prompted the formulation in 2003 of more than 100 emergency response plans at various levels in China. However, most of these were sector or subject-based (e.g., *Emergency Response Plan for Public Incidents of Beijing Municipality*, *National Emergency Response Plan for Environmental Incidents*) rather than integrated plans. Most problematic is the fact that these were quickly prepared campaign-style plans rather than true institution-building mechanisms. Furthermore, the current emergency management system focuses only on the responses to past disasters rather than anticipated or unseen crises.

On the heels of the November 2005 Songhua River chemical spill, China's State Council passed initial measures to establish a formal emergency management system, mainly dealing with natural disasters, catastrophic incidents, public health, and social security issues. On January 8, 2006, when the State Council officially issued the *National Emergency Response Plan*, all the provinces and municipalities had completed their plans, which provided guidelines for officials dealing with different emergencies. These guidelines boosted China's crisis management capacity. *The Emergency Response Law*, which came into effect on November 1, 2007, put into effect the principals of "protecting the security of public lives and property and rescuing humans after sudden incidents." About two months later, the new law was challenged by the snowstorm. Effective responses to this snow disaster demanded coordinated and integrated measures between transportation, power, and communication sectors and public health authorities. However, as the emergency response plans remained simply principles on paper, it is not surprising that miscommunication and inaction by some government authorities were observed during the snow disaster.

Struggles in Top-Down Coordination

Arguably, a formal institutional network for comprehensive emergency management was nonexistent in China before SARS, which was a major shortcoming that the central government tried to address by creating the National Emergency Response Office (NERO) to act as a liaison between the State Council and other governmental authorities in 2006 right after the Songhua spill. Although NERO is responsible for coordination among different organizations and mobilizing resources needed in cases of emergency, given its limited capacity and authority, it performed poorly during the snowstorm. For example, NERO did not issue the "Notice of Low Temperatures and Heavy Snow" until January 21.

The poor coordination during the snowstorm led the State Council to set up an ad hoc national Command Center on January 28 (nearly three weeks after the snow started) to coordinate relief work and direct operations in the coal, oil, and power sectors ("The State Council," 2008). Six offices were established under the Command Center during the first three days and dealt with the following areas: (1) transportation of coal, power, and oil; (2) road repairs; (3) power line repairs; (4) rescue and market safeguards; (5) post-disaster restoration; and (6) news media and public outreach. These offices marked an important model for better disaster preparedness, as was demonstrated during the earthquake in Sichuan in May 2008.

During the Sichuan earthquake (Wenchuan earthquake) the government coordinated a national first-class response to the disaster. The State Council's Earthquake Relief Headquarters, headed by Premier Wen Jiabao, was established several *hours* after the earthquake. Eight working groups dealing with rescue, forecast and monitoring, medicine and sanitation, infrastructure, production recovery, living resettlement, security, and publicity were organized rapidly. Although NERO played an active part in collecting and releasing information (e.g., number of deaths), it did not act as a leading organ or coordinating backbone in the disaster relief. Although the ad hoc response center did function well, ideally the Chinese government should have empowered NERO—potentially drawing on the experiences of American and European systems—to become a more effective management system covering prevention, preparedness, response, and recovery, and the formulation of strategic guidelines for risk management. NERO and its provincial counterparts also need specific training to enhance the management skills and understanding of risk management.

Using the principles of prevention, preparedness, response, and recovery, Table 1 outlines some of the weaknesses of China's emergency management system in response to two pollution incidents (the Songhua River chemical spill and the Lake Taialgae bloom) and two major natural disasters (the snowstorm in southern China and the Wenchuan earthquake). All four cases took place within the past four years and each demonstrated insufficient prevention and inadequate preparation.

Uneven News Reporting

Apart from the important role of the government, a quick response from the news media is crucial for decision-making and communication with the public when a disaster occurs. A review of the news records by Chinese Central Television (CCTV) shows that 68 'snow' news items were released from January 11 to 31, of which only 8 articles were published during the first 10 days. Strikingly, no news was reported between January 14 and 16. These gaps in reporting may be linked to the restrictions placed on journalists after the Songhua River incident, during which the Chinese news media responded quickly and carried out fairly critical investigative reporting into failings by local governments in preventing and reporting the accident. Following the Songhua incident journalists were required to get permission from editors before reporting on environmental accidents and natural disasters. China's news outlets are often ordered not to report on such crises. In contrast to the news media during the Songhua River spill, none of the news content during the snow disaster was critical about the performances of the local governments in the crisis. Moreover, some news stories were even misleading. For instance, the news reports on January 23 declared that the train system was back in order, causing thousands of passengers to push back into the Guangzhou railway station even though the trains were not yet running normally. During the snowstorm the public's right-to-know was not fully protected. The passage of the 2008 Open Information Measures did lift some of the restrictions on journalists. If the news media in China can play its proper role in disaster communication, the Chinese people would benefit from better decision-making.

However, the situation is changing, as can be seen in the Wenchuan earthquake just 12 days after the *Decree of Government Information Openness* was put into effect on May 1, 2008. Notably the new open environmental information measures passed on the same day made misleading and restricted reporting illegal, allowing for much freer reporting during the earthquake. As Table 1 noted, the response time and access to information linked to the Wenchuan earthquake was significantly better than what occurred in previous disasters. Ultimately, timely and sufficient information played a crucial role in decision-making for rescuing people and mitigating losses following the earthquake ("Three breakthroughs," 2008).

CONSIDERING THE ENVIRONMENTAL AND HEALTH IMPACTS OF THE SNOW CRISIS

This crisis also raised questions about environmental and ecological protection in China. Scientists say the snowstorms in China were not directly linked to climate change, but simply an extreme event caused by very cold winter temperatures and a La Niña weather pattern. However, the devastating snowstorms show that China and rest of the world must prepare for possibly increasing and new types of disasters. The storm underlined the need for greater global cooperation on global weather forecasting. Following the lead of many countries that set up key bodies on climate change, China should identify and support science to provide reliable forecasting.

The snowstorms also indicated a need for energy efficiency, which could have helped maintain power to affected areas, and green technology to help in disaster relief. Regarding the latter point, during the snowstorm an average of 60,000-100,000 tons of chemical snow-thawing agents were used in each of the affected provinces. Some researchers have pointed out that the use of these chemical snow-thawing agents has polluted drinking water, damaged or even destroyed plants and animals, and increased saline in soils in Guangdong, Anhui, Jiangsu and Hubei provinces (Peng & Lai, 2008; Wang, 2008).

The direct and indirect ecological impacts of the snowstorm also should not be ignored, especially on forest ecosystems. One-tenth of China's total forested area was destroyed in the snowstorm, which resulted in habitat loss and starvation of many kinds of wildlife (Pan, 2008). The potential, cumulative, and long-term effects of the storm on natural ecosystems will need further research to understand the full extent of the damage.

Table 1: Weaknesses of the Risk Management System in Major Accidents in China

INCIDENT	TIMELINE	WEAKNESSES
Songhua River Chemical Spill (2005)	13 November Explosion at a petrochemical plant in Jilin City, Jilin Province; officials do not notify downstream Harbin city in Heilongjiang Province until eight days later. 21 November Harbin officials cut off water to the city, initially explaining it was for routine maintenance, but public outcry leads to admission about the spill, catalyzes massive news media coverage. 22 November State media says water could have been contaminated after the blast; PLA sent in to bring water to Harbin. 23 November Authorities admit very high levels of benzene have been found in the water. 25 December The polluted water flows into Russia.	Insufficient prevention: Poor governance of chemical enterprises; unsound industrial arrangements; no alternative drinking water sources. Lack of preparation: Petrochemical plant, provinces, and cities lack emergency plans, skills, and technologies to deal with pollution emergencies; no plans for industrial accidents or public information systems. Bad response: Tight control of information in Jilin and Harbin; slow handling of the case; insufficient communication with the public; uncoordinated government agencies at all levels; inappropriate mitigation measures; insufficient emergency response equipment; uncooperative actions by some officials. Difficult recovery: Studies of short-, medium-, and long-term impacts on human health should be conducted; survey of risk assessment at a random sample of Chinese chemical factories needed; aquatic toxicity research should be promoted; cooperation and coordination between China and Russia over the incident should be improved; lessons learned from the incident should be incorporated into legislation and policy enforcement.
Algae Bloom of Lake Tai Lake (2007)	7 April Blue-green algae fans out across Lake Tai. 25 April The algae bloom reaches Meiliang Bay in Lake Tai. 28 May A severe algae outbreak causes water quality to deteriorate, tap water becomes undrinkable for 2.3 million residents in Wuxi City, Jiangsu Province. 29 May Algae bloom threatens water for millions; local residents flock to buy bottled water and bread; local governments take emergency response measures. 1 June The water quality improves; crisis is relieved for the short term. 4 June Water supplies are fixed.	Insufficient prevention: Too much industrial waste discharge; poor governance of industry and agriculture; no alternative drinking water sources. Inadequate preparation: Shortage of pure water; undeveloped emergency response plans and technologies. Imperfect response: Timely yet ineffective (or short-term) solutions; completely inaccurate labeling of the algae bloom as a "natural disaster;" lack of collaboration at all levels of government. Long-term recovery: Uncoordinated government agencies for Lake Tai pollution control; aggressive long-term recovery strategy.

Table 1 (continued)

INCIDENT	TIMELINE	WEAKNESSES
Snowstorm in Southern China (2008)	10 January Epic snowstorms start to slam central and southern China. 22 January The National Emergency Response Office (NERO) releases an urgent notice for preparation and relief of the snow disaster. 25 January Snow disasters exacerbate; trains and aircraft in southern China are almost completely paralyzed. 26 January Coal shortage; 19 provinces and regions suffer blackouts. 27 January More than 100,000 passengers stranded at Guangzhou Railway Station; the China Meteorological Administration issues a red alert warning of more snowstorms and blizzards in central and eastern China. 28 January The snowstorm spreads to 14 provinces and cities in China, affecting nearly 100 million people. 29 January The China Meteorological Administration issues its second red alert warning. 1 February The disaster relief and emergency command center under the State Council is established. 5 February The snow stops. 6 February Snow-plagued residents in central Chinese cities bid farewell to darkness. 9 February China's snowstorm-hit areas begin to recover gradually.	Insufficient prevention: Incomplete road systems; unsuitable power transmission lines; antiquated and inefficient power grid; vulnerable infrastructure; inadequate energy supply; inadequate emergency consciousness and knowledge among officials and citizens. Lack of preparation: Overburdened railways; uncoordinated government response from the top down; separate and narrow emergency response plans; uneven news reporting; unsatisfactory weather forecast system. Slow response: Ineffective response measures; uncoordinated actions; poor communication with the public; ineffective alarm system; uncoordinated mechanism for sudden incidents; nontransparent information. Difficult recovery: Slow recovery of power lines and grids on a large-scale; damage to agricultural and industrial production.
Wenchuan Earthquake (2008)	14:28 Beijing time, 12 May A massive earthquake measuring 8.0 on the Richter scale strikes Wenchuan County, Sichuan Province. 15:40 Beijing time, 12 May National Emergency Response Plan started up. 21:00 Beijing time, 12 May The Command Center for Disaster-Relief of the State Council is established; Premier Wen Jiabao is the commander; eight working groups are organized. 12-15 May A 72-hour period of relief; troops arrive in the affected areas. 4-8 June "Regulations on Post-Wenchuan Earthquake Rehabilitation and Reconstruction" adopted at the 11th executive meeting of the State Council on June 4 and come into effect on June 8.	Insufficient prevention: Poorly constructed buildings; inadequate relief materials; unsuitable urban planning. Inadequate preparation: Unsatisfactory earthquake prediction system; impractical emergency response plans. Timely response and open information: Effective anti-crisis strategy: Command, Control and Communication; uncoordinated and highly helpful spontaneous citizen assistance and donations. Hard recovery: Integrated post-earthquake evaluation needed; extensive reconstruction of infrastructure; human health and psychological therapy required; catastrophe models research needed.

Stranded passengers in Guangzhou railway station.
Photo Credit: Authors

In the background of natural and anthropocentric environmental changes, sufficient public awareness and general knowledge about risks can help reduce damage during disasters. The public should learn about different weather events, their causes and effects, and the regions most likely to experience them. Surveying and researching public health is necessary for building disaster response and prevention capacity within public medicine and sanitation organizations ("The retrospective survey,"2008).

FUTURE CONCERNS

In order to ensure people's health and safety in snow affected areas, the governments had to take precautious measures to prevent the outbreak of infectious diseases. Geological disasters resulting from melting snow should be closely monitored because there are many mountains in southern China where landslide accidents often take place. Between January and March 2008 more than 2,000 instances of snow-melt-induced landslides occurred across Hunan, Hubei, Anhui, Guangxi, Guizhou, and Jiangxi provinces. One major landslide took place in Sichuan two months after the snowstorm (March 22), which caused seven deaths (CIGEM, 2008).

The snow also called into question whether the Chinese government can successfully control inflation. The low temperatures and snow destroyed many vegetable, tea, grain, and fruit crops in China's usually temperate south, leading to food scarcity and higher prices. Clearly China's risk management system needs to include solutions on how to recover agricultural production following a severe weather disaster.

The disaster took a short-term toll on China's economy. However, the snow has also exposed deeper structural problems in the economy. Massive transportation bottlenecks and power shortages are a reminder that, despite years of intense growth, China still has a tremendous need for investment in roads and other infrastructure. Those issues will not melt away with the snow and dealing with these weaknesses is a crucial part of a truly comprehensive risk management system.

Like the SARS outbreak, the snowstorm and earthquake incidents temporarily slowed the economy and caused short-term pain. In the past, the Chinese government has used ad hoc measures to adequately respond to the immediate impacts of disasters, but more needs to be done to coordinate agencies, improve follow through after initial crises, and take measures to better anticipate disasters.

ACKNOWLEDGMENTS

We are grateful to Hongchang Ren for his assistance in making the GIS map. Financial support was provided by the National Basic Research Program of China (2007CB407307), the cooperative project between the Netherlands Royal Academy of Arts and Sciences and Chinese Academy of Sciences (No. 04CDP014), and the Pilot Project of Knowledge Innovation Program of Chinese Academy of Sciences (KZCX2-YW-420-5).

Guizhen He is assistant professor at the Research Centre for Eco-Environmental Sciences (RCEES) under the Chinese Academy of Sciences (CAS). Her interests are environmental management, policy analysis and assessment, and environmental auditing. She can be reached at heguizh@yahoo.com.cn.

Yonglong Lu is professor at RCEES and is currently the director general of Bureau of International Cooperation, CAS. His research interests include environmental management and policy, environmental technology innovation, sustainability science, systems ecology, and strategic planning. He can be reached at yllu@rcees.ac.cn.

Lei Zhang is assistant professor of Wageningen University in the Netherlands. Her main fields of research are environmental policies and management, environmental sociology, risk management, and strategic environmental assessment. She can be contacted at lei.zhang@wur.nl.

REFERENCES

China Institute of Geological Environmental Monitoring (CIGEM). (2008, May 5). *Bulletin of Geological Hazards Occurred in China from January to March, 2008* [in Chinese]. [Online]. Available: http://www.cigem.gov.cn/readnews.asp?newsid=14659.

"Consecutive days of snow and icy rain broke the record in 53 counties of Guizhou Province." [in Chinese]. (2008, February 4). [Online]. Available: http://news.xinhuanet.com/newscenter/2008-02/04/content_7566919.htm.

"Direct economic damage of snowstorms in China mounts to 151.6 billion Yuan." [in Chinese]. (2008, February 23). [Online]. Available: http://www.chinanews.com.cn/gn/news/2008/02-23/1171910.shtml.

"Dynamic news about trains in the Lunar New Year holidays." [in Chinese]. (From 2008, January 25 to 2008, February 6). [Online]. Available: http://www.ycwb.com/news_special/news_special_08chunyun_train.htm.

"Electricity back to most affected counties by snow crisis." [in Chinese]. (2008, February 6). [Online]. Available: http://www.chinanews.com.cn/gn/news/2008/02-06/1158870.shtml.

Guo Jun. (2008, January 26). The air and land traffic in Guangdong were suffocated by the bad weather, and the Emergency Plans were put into effect [in Chinese]. China News [Online]. Available: http://www.chinanews.com.cn/gn/news/2008/01-26/1146906.shtml.

"Notice of the State Council: Promote the Power Demand Side Management and Orderly Use of Electricity." [in Chinese]. (2008, February 3). *Peoples Daily.* [Online]. Available: http://paper.people.com.cn/rmrb/html/2008-02/03/node_16.htm.

Pan, Shaojun. (2008, March 13). Snow and ice disaster destroyed the forest ecosystem. *Peoples Daily*. [Online]. Available: http://paper.people.com.cn/rmrb/html/2008-03/13/node_3.htm.

Peng, Wei, Lai Nanpo. (2008, February 16). "More than 10,000 villagers faced the drinking water problems in Guangdong Province because snow-thawing agent in flooded into water sources." *Yangcheng Evening Mews*. [Online]. Available: http://www.ycwb.com/ePaper/ycwb/html/2008-02/16/content_134573.htm.

Ruwitch, J. (2008, January 30). "Millions stranded by snow in China holiday havoc." *Reuters*. [Online]. Available: http://www.reuters.com/article/worldNews/idUSPEK11184620080130.

"Some diseases should be cared in the snow storm." (2008). [Online]. Available: http://health.sohu.com/s2008/snowstorm/.

"The State Council established an Emergency Response Command Centre." (2008, February 2). *People's Daily Overseas Edition.* [Online]. Available: http://paper.people.com.cn/rmrbhwb/html/2008-02/02/content_41548687.htm.

"The retrospective survey of public health is conducted in Jiangbei during the snow storm." (2008, March 31). [Online]. Available: http://www.nbjiangbei.gov.cn/art/2008/3/31/art_175_30151.html.

"Three breakthroughs of the Chinese media in Wenchuan earthquake." (2008, June 19). *Xinhua*. [Online]. Available: http://news.xinhuanet.com/newmedia/2008-06/19/content_8397141_3.htm.

Wang, Yu. (2008, February 20). "Resisting snow storm vs polluting drinking water sources?" [Online]. Available: http://env.people.com.cn/GB/6898527.html

Zhang, Lei. (2002). *Ecologizing Industrialization in Chinese Small Towns*. Doctoral dissertation, Wageningen University, The Netherlands.

Zhang, Ping. (2008). "Report of the State Council on the fight against large-scale disasters of low temperature, frozen rain and snow, and the rebuilding works post-disaster". At the 2nd Session of the Standing Committee of the 11th National People's Congress of the People's Republic of China, 22 April, 2008. [Online]. Available: www.npc.gov.cn.

Zheng, Guo Guang. (2008, February 4). "China is suffering from an unpredicted low temperature, icy rain and snow storm disaster in history." [in Chinese]. *Peoples Daily.* [Online]. Available: http://paper.people.com.cn/rmrb/html/2008-02/04/node_10.htm.

COMMENTARY

Citizens Finding a Voice: Bottom-up Politics in China's Nuclear Power Debate

By Xiang Fang

Citizens have not often had a great voice in shaping policies and development decisions in China, but over the past twenty years there has been some political space opening for individuals and environmental nongovernmental organizations (NGO). Much has been written on China's emerging green NGO sector and the growing number of citizen protests over pollution impacting their communities, such as the highly publicized mass protest of citizens in Xiamen city that halted the planned construction of a chemical plant in a residential community. Less studied is the relatively new phenomenon of citizens reaching out to local legislative representatives to express discontent over development projects that they perceive as harmful to the environment and human health. One documented example, was the case of provincial People's Congress deputies stepping in to a debate on the Sihui industrial park pollution in Guangdong Province. [Editor's Note: See CES 9 Feature on Guangdong]. Such involvement of People's Congress deputies offers a potentially effective new model of public engagement in environmental policymaking. Specifically, pollution victims could potentially use People's Congress deputies at the national, provincial, and/or county levels to put forward proposals to suspend construction of polluting companies or even to demand compensation for pollution victims (Shi & Zhang, 2006).

Some researchers have observed that members of the Local People' Congresses in China are becoming increasingly active in environmental issues (Lo & Leung 2000), which is an emerging trend I opted to examine in my own dissertation work. As part of my research, I explored a case of bottom-up pressure by Chinese citizens and their People's Congress deputies against the planned construction of an inland nuclear power station in Dapu Townland in Guangdong Province.

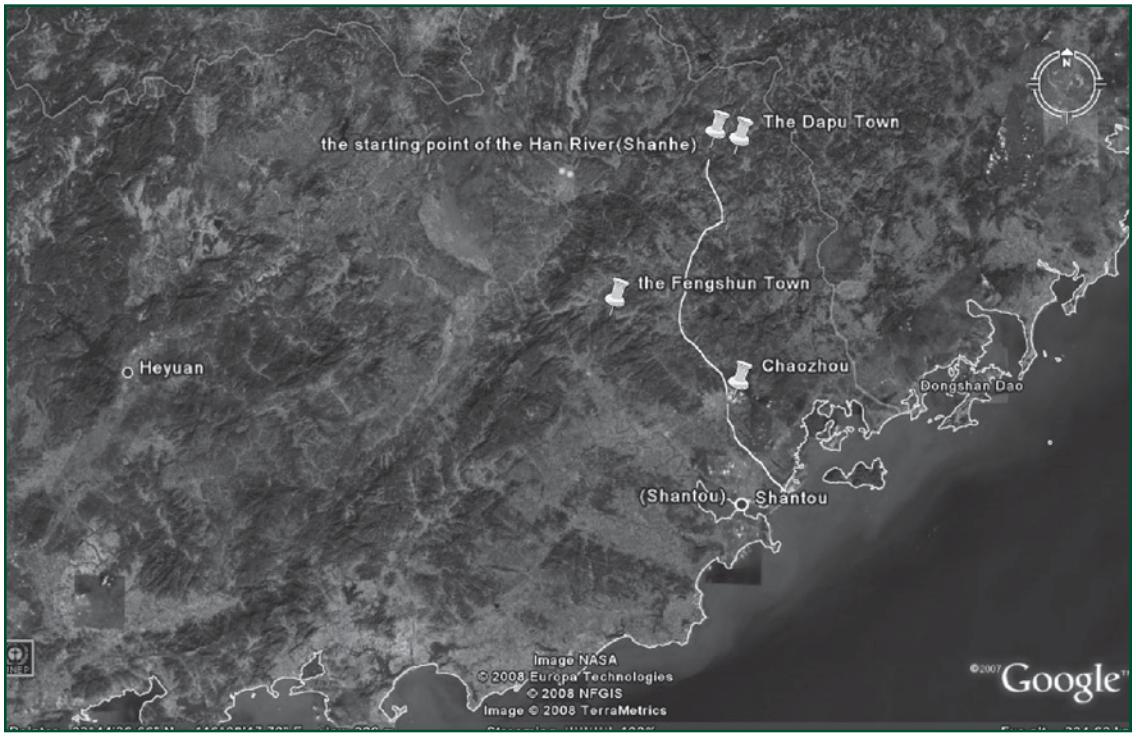
NUCLEAR POWER PRIORITIES

China currently has 11 nuclear power plants that supply 2.3 percent of the country's energy.[1] In 2007, the National Development and Reform Commission (NDRC) stated that China will construct 30 nuclear power plants by 2020 to help lessen dependence on coal (NDRC, 2007). Notably, China's energy demand is growing so fast that even if completed these nuclear power plants will provide only 4 percent of the country's energy supply (Shen, 2005). To begin reaching this nuclear power goal, in 2005 the NDRC announced plans to set up inland nuclear power stations as part of the Twelfth Five-Year Program, which means construction of these stations will start in earnest in 2012 (NDRC, 2007). Chinese provinces already have started to inspect potential locations along main rivers,[2] in compete effectively for central government investment into inland nuclear power projects that will be part of this new five-year program. Guangdong Province has been most aggressive in proposing such plants, for while the province has 2 nuclear power plants that supply 6.5 percent of the province's energy, it needs more. Guangdong lacks coal and oil resources and thus has faced big challenges in securing steady energy supplies.

On April 2007, Guangdong provincial authorities announced the potential sites for the inland nuclear power station on the upper reaches of the Han River (inside Dapu Township), a less-industrialized area in southeastern Guangdong that is targeted for development. News of the project provoked uproar from local people, which prompted the People's

Map 1. From Google Earth with markings by author

Map 2. From Google Earth with markings by author



Chaozhou City at the headwaters of the Han River.
Photo Credit: Xiang Fang

Deputies in Shantou and Chaozhou cities to take the unusual step of asking for an inquiry meeting to address the issue. This is the first time that civil nuclear power development in mainland China has provoked negative media coverage and opened up a public debate. In order to investigate this controversy, I spent two months conducting an ethnographic style case study in three cities (Meizhou, Chaozhou, and Shantou) in eastern Guangdong. From June to August of 2007, I explored local perspectives on the inland nuclear power station in the upper reaches of the Han River. My goal was to investigate the reactions of citizens and the local officials to the potential inland nuclear power project. This case not only examines the role People's Deputies took in advocating for their citizens, but it also reveals the growing willingness of Chinese citizens to voice their concerns about the risks of civil nuclear power.

INITIATION OF THE INLAND NUCLEAR POWER PROJECT IN THE HAN RIVER

The Han River is located in Guangdong Province and is the source of drinking water for over 10 million people living in South East Guangdong. (See Map 1). East Guangdong is the breadbasket of the province, producing mainly rice and cash crops. The Han River is a large river that today adequately supplies water for agriculture, industry, and major cities in the basin—a rarity in much of China. According to the Shantou City Environmental Protection Bureau's weekly online water quality reports, the drinking water quality of the Han River is very good Grade II rating. Provincial government and municipalities along the Han River have enforced water protection regulations and plans that have helped maintain this high water quality. Local governments and citizens in Shantou city are very serious about protecting of the river since it is the only unpolluted river in the city. When I visited the automatic water monitoring station in Shantou city I discovered that it had been publicizing its daily reports of Han River quality since October 2003.

Since 2006, scientists and experts from the Guangdong Development and Reform Commission, Guangdong Nuclear Power Group, and China Nuclear Power Cooperation started to test the potential for building an inland nuclear power station in the upper reaches of the Han River. They identified three potential locations in Dapu and Fengshan counties (see Map II), which exhibited excellent/satisfactory geological conditions. According to local

BOX 1. **Sceptical People's Deputies**

Below are some of the comments made by Shantou and Chanzhou People's Deputies to Provincial People's Congress on 4 February 2004 in an inquiry about building nuclear power plant along the Han River (Chen, 2007).

There are Daya Bay, Lingao and Yangjiang nuclear power stations which have been built up or being built up inside Guangdong Province. We have very long costal line inside the province. Why is the province still planning to build inland nuclear power stations? Why pick up the Dapu and Fengshun town district in Meizhou City district? May I have officers from the Development and Reform Commission of Guangdong Province explain this? —Chen Han Chu PD from Shantou City

The Han River is not the Daya Bay. It is our mother river. Over 10,000,000 people living in the middle and lower reaches of the Han River depend on it for drinking water. I asked the question on behalf of these 10,000,000 people: if (they are) really going to build the nuclear power station in the upper reaches, will there be any pollution on the water? —Liang Yinying PD from Chaozhou City

I studied biology before. The temperature of this cooling water can get up to 310 degrees. There must be bad influence to aquatic creatures in the river! —Chen Shaohe pearl growing expert and PD from Shantou City

officials I interviewed, over one hundred scientists and experts participated in the exploratory studies in the counties over the past two years. If the project is confirmed, it would be the third civil nuclear power base inside Guangdong Province, apart from the Daya Bay (Shenzhen City) and the Yangjiang (Yangjiang City) nuclear power base.

ATTITUDES ABOUT THE NUCLEAR POWER PROJECT IN THE DOWNSTREAM

My fieldwork research, which included interviews with local citizens and officials and information from newspapers and online forums, revealed that people who live in the lower reaches of the Han River base are broadly opposed to the nuclear power project. Local people are concerned that the power station may pollute the drinking water resources. After reading the news about the planned nuclear power project in the *Meizhou Daily News* in early September 2006, some people in Shantou and Chaozhou cities wrote to the city council to inquire about the project. People's Deputies (PDs) also received inquires and complaints about the project. Mr. Chen Han Chu a provincial PD in Shantou City organized other PDs in the city to discuss this issue on 6 December 2006 at the Shantou City People's Congress. Mr. Chen informed me in an interview that some of the city PDs had scientific knowledge in this area and included Professor Gao Kun Shan the director of Ocean Biological Research Centre of Shantou University and Professor Chen Xu Shen from the Physics Department of Shantou University. After the meeting, PDs expressed their concerns and questions about the possible environmental health problems of the nuclear power plant at the Fifth Conference of the Tenth Provincial People's Congress on 4 February 2007. After the conference Mr. Chen also wrote a letter to summarize their suggestions for the province leaders. An edited translated of their comments and questions included the following (*Shantou Social and Science Journal* 2007.3):

(1) The Han River is the mother river of Shantou, Chaozhou, and Meizhou cities. A nuclear leakage would have catastrophic results, for it would not only pollute the ocean, but also the Han River Basin, putting the lives of the ten million people who depend on it for drinking water in danger. When reference is made to other countries' experiences with nuclear power operation; nuclear power is not 100 percent safe. To date there have been several serious nuclear accidents

in Western countries. Additionally, scientists and experts do not have very strong evidence to show that there are no risks from nuclear reactor operations, and they cannot guarantee there will not be any invisible pollution of the river which could have consequences for the later generations of inhabitants.

(2) It was reported that the capability of the reactor will be up to 1,000 MW. How much cooling water is needed to support this nuclear reactor? How much is the current capability of the Han River to supply this cooling water in the winter and dry seasons? Could the nuclear power plant create "warm pollution" that damages fish and other aquatic creatures? If the temperature rises, bacteria and microbes will increase, potentially turning the river into a dead river.

(3) There are concerns regarding the safety of shipping the building materials as well as radiation materials and waste. Shipping those materials to the upper reaches of the Han River will be expensive and will also create the risk of water pollution. Considering this issue, we suggest that it might be better to build the nuclear power plant along the Guangdong's long coastline where any accidents might inflict lower damanges and costs.

(4) The Han River is the best drinking water resource and fish producer in the province. We do not accept putting this excellent river in Guangdong Province at risk of pollution. Such pollution would violate the requirements in the newly issued *Guangdong Drinking Water Resource Protection Regulations.*

(5) Recently the economic development of east Guangdong has seen a period of downturn. The provincial government's plan has policies to improve economic performance in east Guangdong and we are concerned that the nuclear power station will have a negative influence on the investment environment of Shantou and Chaozhou cities.

Apart from these comments and suggestions, Mr Chen Han Chu and the other PDs in Shantou and Chaozhou cities also asked for an inquiry meeting in the Provincial People's Congress on 4 February 2007. The PDs used this meeting to express their anxieties about the nuclear power project. This meeting was surprisingly transparent, with some of the questions the PDs being reported in the *Southern Daily*. (See Box 1).

REPLY FROM THE PROVINCIAL COUNCIL

Replies from officers and experts at the inquiry meeting in the Provincial People's Congress on 4 February 2007 responded to concerns but indicated support for continuing the planning:

1. The inland nuclear power station is just at the preliminary testing stage. The project will start in 2012.
2. Regional and central governments are taking the safety and environmental impact of nuclear power plants very seriously. Once the government has approved this project there will be agencies to guarantee its safety and manage and monitor the pollution risk. It is certain that a Chernobyl-style accident will not happen in China.
3. The regional and central government will seriously consider people's opinions on civil nuclear power projects.

Support for the project appeared to be waning, when four months later in June of 2007, PDs in Shantou city received a reply letter from the Guangdong Development and Reform Administration, stating that the province did not plan to build any nuclear power stations on the upper reaches of the main rivers inside Guangdong Province before 2015. Until that time, the province's nuclear power plan will continue to concentrate on the coastline. Because so much of the debate on such development issues it is difficult to know definitively if the Shantou PDs did shape the decision to postpone the planning, but citizens who were against the nuclear power plant most likely saw the postponement as their success.

PONDERING THE POTENTIAL OF BOTTOM-UP POWER IN NUCLEAR ENERGY DEVELOPMENT

While People's Congresses in China have often been considered rubber stamp organizations, at the local level PDs are potentially evolving into a means for citizens to express concerns about new policies and investments. According to the law of China, deputies to county and township People's Congresses are directly elected. Deputies to the People's Congress above the county level are elected by deputies at lower levels. National People's Congress deputies are supervised by delegates at lower levels, but PDs at all levels are ultimately re-

sponsible to the people, who can recall them. PDs can raise motion (*yian*) to formally discuss a broad range of issues when the People's Congress is in session. Alternately, they also have the right to raise a suggestion (*jianiyi*) at anytime, which is becoming a casual way for PDs to give suggestions, critiques, and opinions to government agencies at their own level or below or to communicate with People's Congress at the higher level. In the Han River case, PDs from Shantou and Chaozhou city responded to public demands and asked for the inquiry meeting and wrote letters to the provincial government to represent their disagreement with the nuclear power project.

According to my research findings, the case in Guangdong demonstrates that bottom-up policies led to the successful resistance of the nuclear power project in the upper-reaches of the Han River. A citizen protest against such a development project could very well have been suppressed because the project would be viewed as a central government priority. Citizens instead used the PDs to help them ask questions about this major civil nuclear power project. Guangdong thus provides a clear example from which other provinces have the opportunity to learn. Although PDs played an important role in expressing the concerns of citizens in the Han River case, dependence on the PDs to resist or oversee the location of nuclear power projects is not enough. Ultimately China needs NGOs that have the ability to become involved in the nuclear power debate to promote transparency and public participation (Wen, 2007). Notably, citizens in Guangdong did self organize in lobbying their PDs, through online forums and letters. However, for the public to engage further in the policymaking process of civil nuclear power projects in the China, NGOs represent an important mechanism that could be used to supplement PDs.

Xiang Fang is a Doctoral Research Student in the Research Centre for Social Science, Institute for the Study of Science, Technology & Innovation, University of Edinburgh. She is doing research on China's civil nuclear power development policy. She can be reached at: s0454740@sms.ed.ac.uk.

REFERENCES

Chen Feng. (2007). "A nuclear power station might be built up in the upper reaches of the Han River. People's Deputies asked for an inquiring meeting—10,000,000 People's Drinking Water Might be Polluted?" *The Southern Daily* (Guangzhou), A04.

"The First Inland Nuclear Power Station is Going to Locate in the Meizhou City." (2006, August 9). *The Maizhou Daily.*

NDRC. (2007). *Civil Nuclear Power Mid-Long Term Development Schedule (2005-2020).*

People's Deputies Working Handbook. (1999). The Guangdong People's Publishing House.

The Shantou Society and Science, vol. 1 2007 P81 (Internal Document).

Shen Wenquan. (2005). "Reflections on the Sustainable Development of China's Nuclear Power Industry." *Energy of China,* 7, 5-7.

"The Special Report for People's Congress" (2007, February 5) *The Southern Daily*, A4. [Online]. Available: http://www.southcn.com/news/gdnews/sd/200702050042.htm.

Wen Bo. (2007). "A Call for Transparency: China's Emerging Anti-Nuclear Movement." *China Environment Series* 9, 106-10.

NOTES

1. World Nuclear Association. "Nuclear Power in China" [Online]. Available. http://www.world-nuclear.org/info/inf63.html

2. Nuclear power stations need huge amount of cooling-water from rivers or seas. That is why inland nuclear power stations have to be built by the side of major rivers.

SPOTLIGHT

A Wake-Up Call to Polluting Companies

By Christine Boyle & Jing Chen

It is a crisp Beijing morning in February 2008, and the phone at the Institute for Public and Environmental Affairs (IPE) office will not stop ringing. A Hong Kong-based businessman has read in the morning paper that his company is listed as an environmental offender in China. A public relations representative of an American company reports that he has heard from concerned stockholders that their company sources products from several "listed" environmental polluters in China. A well known soft drink company official calls to inquire as to how her company could be "listed" as violating China's environmental laws when the company follows a strict code of sustainable business practices. It is a typical day on the phones for IPE staff following the posting of the latest government-released data on factories committing environmental infractions on IPE's online Pollution Map of China (www.ipe.org.cn).

The Pollution Map of China is an online tool that IPE developed to display pollution violation records that took place over the past four years (2004-2008). To date, the map's database contains the names of more than 32,000 companies that have been cited by China's environmental protection bureaus for violating air and water pollution standards As the Chinese government pushes for more information transparency—such as the 2008 *Environmental Information Disclosure Measures*—and greater engagement of the public in environmental decision-making, the number of companies cited for violations, as well as detailed data on their discharges, are expected only to increase.

> **"The China Pollution Map…underscores how public accountability could become a new tool in tackling China's environmental pollution."**

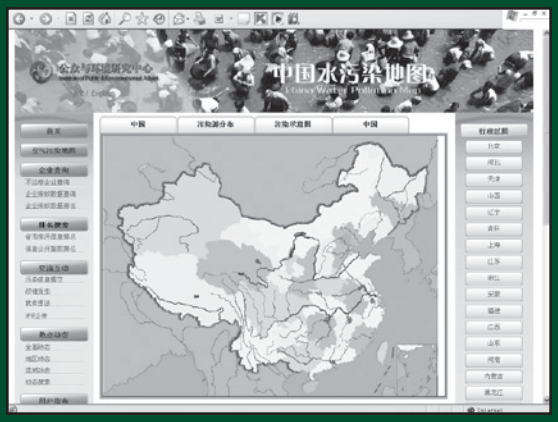
With many international companies headquartered far from polluting activities in China, corporate executives previously were unaware of the environmental damages inflicted by their manufacturers and suppliers. With the widespread publicity and utilization of IPE's China Pollution Map, publicly available data on the environmental infractions of manufacturers throughout China are accessible to the public and to companies for addressing pollution within their supply chains.

The China Pollution Map is recognized globally by environmental groups, the media, and international companies for its novel and effective approach of combining information disclosure and civil society participation to improve environmental performance in China.

BLAZING A NEW PATH FOR ENVIRONMENTAL PROTECTION IN CHINA

The China Pollution Map has been successful in raising awareness of the magnitude of pollution problems and underscores how public accountability could become a new tool in tackling China's environmental pollution. However, while the China Pollution Map publicizes environmental infractions, publicity alone does not provide a proactive solution for companies looking to clean up their supply chains. The next step in addressing industrial pollution needs to integrate accountability into

The China Pollution Map



supply-chain management by making both buyers and suppliers responsible for how manufacturers treat the environment. In August 2008 at a gathering of CEOS at a Green Olympics Forum in Beijing, Ma Jun, IPE's founder and executive director, announced his NGO's next step in promoting responsible supply-chain management—the Green Choice Alliance for Responsible Supply Chain Management Program. This program aims to curb environmental pollution in China's manufacturing hubs by integrating transparency and stakeholder participation into existing supply-chain management systems. Following the meeting, CEOs approached Ma Jun in wonder at the ingenuity of the program, and also to comment that no other civil society organization in the world is systematically tracking regional pollution infractions in order to hold corporations accountable.

Green Choice (GC) Alliance uses the constantly updated IPE database to assist corporate citizens in monitoring the environmental compliance records of their suppliers. The GC Alliance principles aim to hold corporations accountable for the environmental performance of their supply chain partners in China in a practical, verifiable, and transparent way. Membership in this alliance is open to corporations that buy or produce products in China and NGOs in China that serve as external monitors for auditing and verification of factories' environmental compliance. IPE requires each member company involved in the GC Alliance to do the following:

- Commit to reject products or services provided by a supplier identified as a violator of environmental rules and standards in China and is verified as being unwilling or incapable of taking actions to achieve compliance with relevant environmental regulations;
- Draft an Action Plan illustrating how the company will meet the requirements to use the GC Violators Database and utilize the market-based GC Audit as a tool to verify results of remediation efforts made by government-listed violators;
- Use only accredited GC auditing companies; and,
- Mandate Chinese NGO participation in the GC Audit process to ensure external validity and enhance transparency (the NGO participants are members of the GC Alliance and have completed requisite training courses prior to attending GC Audits).

THE CHALLENGES OF MANAGING GLOBAL SUPPLY-CHAIN PERFORMANCE

In recent years, multinational corporations (MNCs) have found that poor business practices overseas have long-standing impacts on their brands. Public scandals regarding labor rights, such as the ones faced by some major apparel brands, have proved to MNCs that contracting production to another legal entity does not absolve a brand name from responsibility over production of its products. In response to calls from shareholders and customers, MNCs have begun integrating corporate social responsibility (CSR) into their business operations to meet growing demands for environmentally responsible product sourcing, similar to strategies addressing labor issues a decade ago. However, despite MNCs strong public statements, environmental management remains a weak link in extending CSR to supply chains, due to the technological complexity of environmental performance monitoring. Such monitoring is particularly difficult in China where the manufacturing sector is made up of many small companies that often change names and location and transactions are often made in cash.

A CALL TO ACTION

This opportunity for responsible corporate citizens to proactively green their supply chains has prompted two of the world's largest retailers to join GC Alliance as the first two corporate members. On 22 October 2008, Ma Jun participated in Wal-Mart's Sustainability Summit in Beijing where

Wal-Mart CEO Lee Scott announced to over 500 suppliers a business strategy that matches IPE's fundamental principle for MNCs: "Wal-Mart will no longer do business with suppliers that are unwilling to comply with basic environmental laws of China." This initial commitment is not only important to build the GC Alliance and implement processes for building green supply chains, but also to level the playing field for all manufacturers in China.

Pressures to maintain low prices, meet buyers' quality standards, and produce adequate quantities have led some suppliers to cut corners on environmental protection. Suppliers are rightfully concerned that they cannot remain competitive if they make large capital investments into cleaner technologies such as water purification, scrubbers, industrial wastewater treatment, and other waste processing equipment. The commitment to common sourcing practices developed by GC Alliance member companies may raise the bar so that suppliers compete above the baseline requirements of legal compliance.

The GC Audit of alliance members is different from the usual supply-chain audit because it requires the audit be done by professional institutions under the supervision of local Chinese NGOs. Requiring professional institutions to conduct the GC Audit means to ensure the professional capacity of auditors. The participation of local NGOs aims to ensure the impartiality of the process and build the capacity of Chinese environmental groups. The transparency and NGO participation aims to minimize conflicts of interest by the auditor. To date IDE's Green Choice Audit mechanism has a proven track record of over 14 successful cases with leading multinational companies.

Christine Boyle is a doctoral student in the Department of City and Regional Planning at the University of North Carolina at Chapel Hill. Her dissertation fieldwork began in 2008 and focuses on irrigation decision-making processes in northern China. She can be contacted at cboyle@email.unc.edu. Jing Chen was a summer 2008 intern at the China Environment Forum. She is a graduate student at the University of Maryland and can be reached at jichen@gvpt.umd.edu.

COMMENTARY

Provincial Impacts of Multilateral Cooperation: The Greater Tumen Initiative and Environmental Protection in Jilin

By See-Won Byun

Plagued by political tensions within a complex security environment, Northeast Asia has historically lacked an effective mechanism for regional cooperation. The Greater Tumen Initiative (GTI) is the only existing intergovernmental effort for cooperation in Northeast Asia, evolving from the Tumen River Area Development Programme (TRADP) launched by the United Nations Development Programme (UNDP) in 1991 to facilitate trade and investment and promote sustainable economic development. With a membership of five countries including China, Mongolia, North Korea, South Korea, and Russia, many experts regard the Tumen project a failure as both a regional economic scheme and a mechanism to protect the Tumen River Basin's ecosystem.

This economically attractive yet politically complicated project has brought some development to the region. However, the environmental impact of this growth, particularly within China, has raised concerns among environmentalists given the prevalence of rare species in the river basin's ecosystem and potential devastation from unchecked development. This concern is ironic considering that the environment was one of the first focus areas of Tumen cooperation, attracting 85 percent of total program funding by 2004 and serving as the cross-cutting sector among the priority areas of energy, trade and investment, transportation, and tourism (Tumen Secretariat, 2005).

Jilin Province has been the key participant in the GTI on the Chinese side. The idea of Tumen cooperation first unfolded in Jilin in the 1980s as a result of collaboration among experts and officials at Changchun's Northeastern Normal University, the China Center for International Studies, the East-West Center in Hawaii, and the State Science and Technology Commission (Cotton, 1996). Despite the weaknesses of the Tumen project, regional cooperation has clearly benefited the provincial economy through dynamic interactions between central, local, and regional efforts to attract foreign trade and investment. The province is also cooperating with domestic and regional "green" nongovernmental organizations (NGOs). As further growth puts greater pressure on the environment, Jilin's economic outreach also has involved progressive environmental initiatives that reflect this central-local-regional dynamic.

DEVELOPMENT VERSUS POLLUTION

China is the main source of pollution in the Tumen River area, with 70 percent of the watershed located in the Yanbian Korean Autonomous Prefecture in Jilin. Two state-owned pulp and paper mills in Yanbian account for over 90 percent of the river pollution from Chinese sources but also importantly support Yanbian's town economies (Tumen Secretariat, 2002a). Water pollution is the most serious problem, threatening the health of the 2.2 million local Chinese who rely on downstream water for farming and drinking, destroying fish stocks across the region, and affecting coastal waters of North Korea and Russia. In 2006, the China's Ministry of Environmental Protection (MEP) indicated the water quality of 75 percent of the Tumen River as Class V, unsuitable for natural reserves or drinking, or domestic, industrial, and agricultural use (SEPA, 2007).

Pollution of surface water had already reached high levels in the early phases of Tumen coopera-

The Tumen River as the China-North Korea-Russia Border.
Photo Credit: Author

tion, mostly from industrial sources (Zhu, Li, & Lu, 1997). According to Chinese researchers, the development of urban infrastructure, especially water treatment facilities, have lagged behind rapid urbanization and industrialization in the Tumen region (Wang, Wang, & Yang, 2002). Further commercialization is likely to drive local growth while exacerbating the environmental challenges. The Hunchun Border Economic Cooperation Zone in Yanbian was established in 1992 without an environmental impact assessment, which was undertaken seven years later amid the pressures of rising investment (CRAES, 2000). A joint study by South Korean and Chinese environmental organizations in 2001 found that large-scale development projects have led to significant deterioration in water quality, with up to 80 percent of the river unsuitable for even industrial use and a decline in wildlife in the river area ("Tumen River polluted," 2001).

Since the Tumen River is a border river between China, Russia, and North Korea, the key constraint to environmental protection has been the lack of sustained political support from all participating governments. Although Russian water quality monitoring data has indicated some progress over the years, further regional cooperation is required to address Tumen River pollution in a more comprehensive and integrated manner (MOE, 2002).

MULTILATERAL ENVIRONMENTAL COOPERATION

The GTI addresses common environmental concerns throughout its focus sectors, integrating such issues as clean technology, ecologically sustainable tourism, and climate change into its development projects. Environmental work is led by the TumenNet initiative of the Global Environmental Facility (GEF), jointly financed by the World Bank, UNDP, and the United Nations Environment Programme (UNEP) (UNDP, 2002). TumenNet's Strategic Action Programme (2006-2015) sets the basic foundation for long-term regional environmental cooperation, with a particular focus on biodiversity and water issues.

This action plan remains unsigned due to disagreements among some member states. However, several important initiatives have continued under the broader GTI framework. Most notable are public-private partnerships in clean production and the modernization of waste treatment facilities. Current efforts in this direction include a Feasibility Study on Tumen River Water Protection, a multinational project for 2008-2010 launched by Japan's Economic Research Institute for Northeast Asia to monitor water quality in the Tumen River and develop corresponding policy tools for water protection (Tumen Secretariat, 2007a). As an initial step to clean up the Tumen River, the Finnish government in 2002 funded two pre-feasibility studies on upgrading Yanbian's pulp and paper plants, in collaboration with the United Nations Office for Project Services and the China International Center for Economic and Technical Exchanges (Tumen Secretariat, 2002b). Given the wide inconsistencies in environmental data within and between the five member countries, the GTI Environmental Cooperation project proposed in November 2007 aims to harmonize data collection methods and transboundary environmental criteria, build national and local assessment capacity, and promote multilateral cooperation on development planning (Tumen Secretariat, 2007b).

To coordinate the various environmental efforts of the GTI, the 2007 Consultative Commission meeting produced the Cooperation Framework on Environment (CFE), including a coordination unit

and functional working groups (UNDP, 2007). As a formal mechanism for regional environmental cooperation, the CFE is important for strengthening existing initiatives while negotiations continue for a long-term action plan.

JILIN'S ENVIRONMENTAL OUTREACH

The inaugural meeting for the TumenNet action plan in 2002 recognized China's progress in addressing water pollution of the Tumen River (MOE, 2002). While many environmental groups have pointed to the risks of developing the region, environmental protection has depended on the local response to Tumen cooperation and development. In addition to the regional efforts of the GTI, Jilin's environmental outreach has been complemented by central policies, local initiatives, bilateral and international cooperation, and public participation.

Under the TumenNet program, the Jilin Provincial Institute for Environmental Protection leads the regional effort to develop an Environmental Information System, designed to manage regional data on international waters and biodiversity. A series of meetings on environmental issues concerning offshore oil and gas development, the mining sector, and other areas have been held to build capacity among local experts and raise awareness among government officials. Along with TumenNet, the United Nations Educational, Scientific and Cultural Organization (UNESCO); and Green Yanbian (a Jilin-based NGO); the Yanbian prefectural government has held workshops on northeast Asian environmental cooperation focusing on conservation and development in the Tumen River area (Korean National Commission for UNESCO, 2001). These workshops have served as an important forum for discussing international approaches to environmentally-sustainable development.

Provincial laws and regulations in Jilin have followed developments in national environmental legislation establishing maximum levels of pollutants for wastewater and solid waste. Completed and ongoing projects include sewage treatment facilities for the Kaishantun chemical fiber pulp plant and Shixian paper mill—the two plants responsible for the bulk of the water pollution—and municipal wastewater and garbage treatment plants in the cities of Yanji, Hunchun, and Longjing, Yanbian's major economic centers.

Bilaterally, the Yanbian prefectural government and the Korea Environment Institute have been cooperating on personnel exchanges and joint research for the protection of the Tumen River in recent years ("South Korea says," 2003). Jilin's environmental concerns have also attracted financial and technical assistance from international donors, addressing the funding inadequacies of the GTI. The Asian Development Bank (ADB) is extensively involved in Jilin's water resource management and urban infrastructural development through projects that aim to improve the water quality of Tumen and other river basins in the province (ADB, 2006). At the local level, the ADB is also supporting the Yanji municipal government and the Yanji Municipal Sewerage Treatment Company to expand the wastewater treatment capacity in Yanji city (ADB, 2007). ADB involvement is important not only for funding but also for its experience in fostering cross-border economic cooperation through the Greater Mekong Subregion (GMS) initiative in Indochina.

Finally, the environmental implications of Tumen development have prompted regional cooperation among environmental NGOs. South Korean and Chinese environmental groups including Green Korea United (GKU) and Greenpeace China have launched a joint campaign to protect the Tumen River and Changbai Mountain on the Sino-Korean border ("Environmental groups," 2000). Green Yanbian in Jilin has actively promoted Tumen protection since its establishment in 2000 by ethnic Koreans returning from South Korea (Awaji, 2006). Modeled on South Korean environmental NGOs, the group is 80 percent ethnic Korean and leads the exchanges between Chinese and Korean NGOs on the Tumen region. Sponsored by TumenNet, the two NGOs Green Yanbian and GKU worked together in summer 2001 to monitor the environmental situation along the Tumen River and raise awareness both locally and in South Korea (GKU, 2001). Green Yanbian has now expanded contact with other Chinese NGOs and environmental experts in Beijing and Northeast China.

Greater international contact especially between Chinese and Korean NGOs could strengthen the role of local environmental groups like Green Yanbian. However, NGO activities in Northeast Asia have often been hampered by diplomatic considerations, furthering the already significant restrictions on NGOs in China. When Green Yanbian conducted a month-long environmental study along the Tumen River in May 2001, Chinese authorities did not allow the group to release their

> **When Green Yanbian conducted a month-long environmental study along the Tumen River… Chinese authorities did not allow the group to release their findings on…pollution and watershed damage arising from activities in the North Korean side."**

findings on the extent of river pollution and watershed damage arising from activities in the North Korean side (Awaji, 2006).

SUSTAINABLE COOPERATION

Despite the challenges faced over a decade of engagement, member countries in 2005 extended the period of Tumen cooperation for ten more years, taking full ownership of the project with continued support from UNDP. The GTI has now evolved into a geographically larger, country-driven, and private sector-focused effort. Although the Tumen project has suffered from limited high-level political support and a lack of funding, cooperation in energy, trade, transport, and tourism has increased substantially from nonexistent levels in 1995 (Meyer, 2004).

Each member country joined the GTI for different reasons. Having first conceived the idea of Tumen cooperation, China is primarily driven by the need to boost its stagnating northeast region. Domestic policies have played a major role in shaping the course of both economic and environmental cooperation in Northeast Asia. With transboundary implications, environmental protection in the Tumen region requires both domestic and regional action. Just as the GTI has dynamically shaped Jilin's economic strategies, continued development has also demanded coordinated environmental adaptations at central, local, and regional levels.

The GTI has progressed against a unique historical setting where political tensions have undermined any cooperative programs. Although geographically and ethnically the Tumen region presents significant advantages, sensitive political issues weigh heavily on the prospects of cooperation. Given its volatile geopolitical situation, the Tumen River Basin is among the world's 17 river basins identified by UNESCO as potential conflict zones for water disputes in the near to long term ("Agency will mediate," 2003). The GTI's success depends critically on sustained political commitment from all member countries to make the Tumen project both a feasible and necessary effort. While the GTI as a whole faces considerable political obstacles, Jilin's response suggests that multilateral cooperation may positively shape provincial environmental efforts in China.

See-Won Byun is a master's candidate in international affairs at the George Washington University and is assisting research for the Freeman Chair in China Studies at the Center for Strategic and International Studies. She can be contacted at Byunsw@gwmail.gwu.edu.

REFERENCES

"Agency will mediate in water disputes." (2003, March 21). *BBC*.

Asian Development Bank. (2006, June). *People's Republic of China: Preparing the Jilin Urban Infrastructure Project. Technical Assistance Report*, Manila.

_____ (2007, June 20). "Jilin urban environmental improvement project: Yanji effluent reuse and sewerage upgrade and expansion." Resettlement Action Plan Document prepared by Yanji Municipal Sewerage Treatment Company and China Northeast Urban Infrastructure Engineering Design and Research Institute, Manila.

Awaji, Takehisa. (2006). *The State of the Environment in Asia 2005/2006*, New York, NY: Springer.

Chinese Research Academy of Environmental Sciences, Center for Environmental Impact Assessment. (2000, January 18). *Environmental Impact Statement for Hunchun Border Economic Cooperation Zone*, Beijing.

Cotton, James. (1996, November). "China and Tumen River cooperation: Jilin's coastal development strategy," *Asian Survey*, Vol. 36, No. 11.

"Environmental groups from South, China to mount joint campaign." (2000, November 17). *Yonhap News*.

Green Korea United. (2001, October 29). *Tumen River pilgrimage report: Environmental values and threats in the Tumen River Area.*

Korean National Commission for UNESCO. (2001, October 29). The Second Workshop on Environmental Peace in Northeast Asia: Transboundary Conservation Cooperation in the Tumen River Area.

Ministry of Environment of the Republic of Korea. (2002, June 6). *Memorandum of Understanding of TumenNet SAP TRZ Meeting*. Changchun, China.

Meyer, Renaud. (2004, September 25). "Regional cooperation to revitalize Northeast China." Speech delivered at the "International Conference on Revitalizing Northeast China and Promoting Regional Cooperation in Northeast Asia," Dalian.

"South Korea says North mines, China mills polluting Tumen River." (2003, October 30). *Yonhap News*.

State Environmental Protection Agency. (2007). *Report on the State of the Environment in China 2006*.

"Tumen River Found Severely Polluted." (2001, July 23). *Korea Times*.

Tumen Secretariat. (2002, July 19). "Environment Information." [Online]. Available: http://www.tumenprogramme.org/news.php?id=173.

_____ (2002, September 15)."Pulp and paper mill prefeasibility study." [Online]. Available: http://www.tumenprogramme.org/news.php?id=304.

_____ (2005, September 2). *Greater Tumen Initiative: Strategic Action Plan for the Period 2006-2015*. Changchun.

_____ (2007, December 19). "Feasibility study on Tumen River water protection." [Online]. Available: http://www.tumenprogramme.org/news.php?id=490.

_____ (2007, December 19). *GTI Environmental Cooperation*. [Online]. Available: http://www.tumenprogramme.org/news.php?id=489.

United Nations Development Programme. (2002). *Preparation of a Strategic Action Programme and Transboundary Diagnostic Analysis for the Tumen River Area, Its Coastal Regions and Related Northeast Asian Environs*. [Online]. Available: http://www.undp.org/gef/05/portfolio/writeups.html.

_____ (2007, November 15). "9th Consultative Commission Meeting of the Greater Tumen Initiative." Meeting Report, Vladivostok.

Wang Shi-Jun, Wang Dan, & Yang Xiang-Hua. (2002, September). "Urbanization and Its Impacts on Water Environment in Tumen River Basin." *Chinese Geographical Science*, Vol. 12, No. 3.

Zhu Yanming, Li Jinsong, & Lu Xueqiang. (1997, June). "A study on quality of aquatic environment in Tumen River Area." *Chinese Geographical Science*, Vol. 8, No. 2.

FEATURE BOX

Social Science Research Council's China Environment and Health Initiative

By Jennifer Holdaway

Since 2006, the China Environment and Health Initiative (CEHI) of the Social Science Research Council (SSRC) has been assessing the current state of knowledge about environment-related health risks in China, and the responses of state and societal actors. In April 2008, CEHI organized an *International Workshop on Environment and Health in China: Perspectives from the Disciplines*. The meeting brought together health and environmental scientists, along with social scientists working in the fields of anthropology, sociology, political science, and legal studies to discuss the state of the field in China and share their disciplinary perspectives. A set of papers from the meeting will be published as a special issue of the *Journal of Contemporary China* in winter 2009.

The mapping process that took place at the workshop revealed that although concern over the health impacts of environmental change in China is mounting, the capacity of government and civil society to respond effectively remains weak. Environment and health remain largely separate streams of research and policy, and the knowledge base to inform policy and other responses is thin.

As many articles in the *China Environment Series* have illustrated with regard to specific environmental health problems, policy initiatives in China are fragmented, with multiple agencies involved in monitoring and responding to various environment-related health threats—often with limited success. Although many environmental health problems are rooted in complex political, economic and social contexts, most responses are reactive and focus on technical solutions. Rarely do these responses address the underlying need to integrate concern for the health impacts of environmental change into development policy at the national and local levels, or involve all the parties whose cooperation is necessary to ensure results.

"…with regard to specific environmental health problems, policy initiatives in China are fragmented, with multiple agencies involved in monitoring and responding to various environment-related health threats—often with limited success."

MIND THE RESEARCH GAPS

To date, the contribution of the social sciences to our understanding of these environmental health problems in China has been minimal, but there are many areas in which research is needed. For example, there is much discussion of the need to increase public awareness and participation with regard to environmental health, and an assumption that more information will necessarily translate into improved enforcement. However, we know from other policy areas (for example, efforts to reduce smoking or HIV/AIDS in China and elsewhere) that the relationship between information and behavior is

by no means straightforward. Researchers and international environmental organizations operating in China currently have very little understanding of what Chinese officials or ordinary people actually know about environmental health risks, where their knowledge comes from, and how they interpret and act upon it in the context of other influences, including economic interests, social relationships and personal identity. Without such knowledge, efforts to increase awareness and participation are unlikely to be effective.

Local protectionism and corruption are serious problems blamed for the failure to implement more effective measures to protect the public from environmental health threats, yet there is little detailed analysis of the very real constraints that local governments face in addressing these problems. These include: (1) the need to generate revenue to provide public services, often in the context of limited development options; (2) a lack of staff with the necessary training to enforce regulations or diagnose and treat environmental health problems; and (3) performance standards that still emphasize economic growth indicators over public health and environmental protection. Without a better understanding of these constraints and how they might be addressed, improving enforcement will be hard.

China's enormous diversity in terms of natural, economic and human resources means that the causes of environmental health risks, and potential responses to them, cannot be understood without research in specific locations and on particular populations. Also, the tangled web of economic, institutional and socio-cultural factors involved means that a multi-disciplinary approach is necessary.

CEHI ADDRESSES THE UNDERLYING PROBLEMS

In the second phase of its work, CEHI is seeking to stimulate multi-disciplinary research that can inform policy and other responses to environmental health problems. In December 2008, with support from the Rockefeller Brothers Fund, SSRC made seven grants for collaborative research on environment and health in China.

Each of the seven teams funded by SSRC includes both social scientists and health or environmental scientists who will work together to research some of the most challenging environment-related health risks facing rural areas in China: non-point source pollution; health risks posed by intensive animal husbandry; pollution from rural industry and mining; and health problems associated with changes in agricultural practices and lifestyles.

"Researchers and international environmental organizations operating in China currently have very little understanding of what Chinese officials or ordinary people actually know about environmental health risks, where their knowledge comes from, and how they interpret and act upon it."

Each project includes a focus on some aspect of governance, including the ways in which fiscal constraints affect efforts to provide safer drinking water; the potential for farmers' cooperatives to play a role in reducing the risks to health associated with intensive livestock farming; and the ways in which risk awareness shapes citizen responses to rural industrial pollution. Research will be conducted in six provinces in southern China.

FOREHEAD

In order to provide a platform for sustained communication and collaboration among researchers, policymakers and others concerned with environmental health problems, SSRC has now joined with a consortium of Chinese institutions to establish the Forum on Health, Environment and Development in China (FORHEAD). This forum will expand the knowledge base through interdisciplinary working groups that will synthesize current research on particular topics and provide the basis for the development of cross-disciplinary and cross-institutional collaborations. FORHEAD will hold an annual conference featuring new research, policy and NGO initiatives in the field, as well as organize an in-

terdisciplinary Summer Institute that will provide intensive training for early career researchers and NGO staffers. Through seminars and other activities, FOREHEAD will seek to make research on environment and health issues available to a broad range of publics in China. Background and updates on FOREHEAD work can be found at: http://programs.ssrc.org/eastasia/forum.

China Environment and Health Resource Hub

Another barrier to progress in addressing environmental health problems in China is that existing knowledge is scattered and often not easily accessible. As an ongoing part of its work, CEHI is continuing to develop tools to make information about environment and health more widely available in forms that are useful to a range of audiences. The program has established an online searchable database, The China Environment and Health Resource Hub, which contains over 3,500 references to relevant literature, as well as information about organizations and individuals working in this field. The research hub can be found at: http://ceh.resourcehub.ssrc.org.

Translation Work

CEHI is also organizing the translation of a number of key articles relating to environment and health, including essays that illustrate important conceptual or methodological approaches from across the disciplines or that report policy and other responses being employed in other countries. A first set of translations will be published in March 2009 as a special issue of the journal of the Yunnan Health and Development Association. Others will be published online as they become available.

Jennifer Holdaway is program director/China representative of Environment and Health in China. She can be reached at holdaway@ssrc.org. *For more information regarding the International Workshop on Environment and Health in China: Perspectives from the Disciplines, please visit http://programs.ssrc.org/eastasia/chinese/. For more information regarding the Rockefeller Brothers Fund supported SSRC grants, please visit their website at http://programs.ssrc.org/eastasia/program/.*

SPOTLIGHT

Eco-Toilets in Turpan: Improving Sanitation and Water Quality in Xinjiang

By Daniela Salaverry

In September 2008, I flew to western China's Xinjiang Autonomous Region to visit a pilot project installing eco-toilets in a small village near Turpan. As Xinjiang is on the brink of a public health crisis due to increasing water scarcity, pollution, and problems exacerbated by climate change, one local environmental NGO is taking action from the bottom up, literally. This year, the Xinjiang Conservation Fund (XCF), a grassroots NGO, is working with local residents and community officials to install eco-toilets in the small grape-growing village.

"This is the Gobi," says Dong Zhaolin, XCF's eco-sanitation project manager, as he points to the black rock desert outside the bus window. The Gobi is one of the world's largest deserts; at 1,295,000 square kilometers, it dominates much of Xinjiang. The region's unique landscape includes three mountain ranges (Altai, Tianshan, and Kunlun) and two river basins (Tarim and Junggar).

The stark contrast between pristine wildland, such as China's only old-growth Siberian forest near Kanas Lake in the north, and rapid development, including some of the world's largest oil fields, epitomizes Xinjiang's struggle with rapid development and environmental protection. Since the "Go West Campaign" of the late 1990s, Xinjiang has seen some of China's highest provincial gross domestic product growth rates. Xinjiang, a melting pot of Han Chinese, Uyghur, Kazak, and ten other ethnic groups, relies primarily on meltwater from winter snowpack to feed the rivers and meet the needs of a population of 20 million.

Turpan's traditional lifestyle still dominates the region—Uyghur farming families raise grapes and melons in the desert oasis town. The grape vineyards stay green and are well watered, despite summer temperatures reaching higher than 45 degrees Celsius; this is attributed to the *karez*—an ancient underground aquifer built thousands of years ago to carry freshwater from the mountains to the residents and vineyards of Turpan. The farmers of Turpan represent China's rural population, many of whom live on less than 1,000 dollars a year, relying on the income from the autumn harvest to stay afloat year-round. Living in one-room mud brick homes, Turpan's farmers also have limited, if any, sanitation and waste treatment resources.

Unfettered development, combined with the threat of climate change has caused many to become concerned over water availability in this already fragile region, and specifically how water scarcity may impact public health. XCF is working with farming villages in Turpan to educate residents on water conservation and on the importance of sanitation to improve public health and water quality, while also installing eco-toilets.

XCF is working with farmers in Turpan to help keep water in the ancient *karez*, as well as in the modern reservoir, free from human waste contaminants by means of installing eco-toilets. XCF's overall goal is to develop a zero-waste waste treatment system where microorganisms can process urine and feces, upon which waste matter is dehydrated and ultimately used as fertilizer. XCF is not only educating village residents and farmers on public health and sanitation issues, but also is planning to install 50 eco-toilets in one farm village in the region.

Xinjiang is China's "Wild West," and environmental NGO work in the region is in its nascent stage. In fact, XCF is the region's only grassroots environmental NGO. Given the complex cultural and political landscape in the province, XCF staff members have to build strong relationships with local government and researchers to gain support for projects.

To launch the eco-toilet pilot, XCF's Dong Zhaolin, a Han Chinese from Urumqi, has worked for over a year to build strong partnerships with local government and village representatives, especially since he is not a local resident. Furthermore,

Outdoor Ecotoilet being built in Turpan by the Xinjiang Conservation Fund for eco-sanitation development in Xinjiang. Photo Credit: Daniela Salaverry

he needed to find a local representative who would help him navigate the language barrier during his outreach and education campaigns. Another challenge to implementing the eco-toilet project was cost—rising inflation rates required the group to temporarily cut its projected number of toilets from 50 to 10. Despite these challenges, the low-tech project received a positive response from local government and villagers especially because there is little existing sanitation, and people are eager to improve their homes and lifestyles.

Over the past year, Dong and his new partners from the village and county governments went door-to-door interviewing over 50 families, assessing their interest in and need for an eco-toilet. Dong also worked with the local governments to host public information meetings, where up to 40 could people come and learn about the eco-toilet project and various methods to reduce waste and improve sanitation in the home. This ongoing community organizing approach has been crucial to building broad-based support in the village. The toilets themselves are popular as well, requiring no water, and are great alternatives to water-intense modern sanitation, or no sanitation at all.

As of October 2008, XCF staff and volunteers have begun the building and installing of their initial eco-toilets. Once these pilot toilets are installed and completed, Dong will begin his next phase of community organizing, which includes educating users and providing follow-up trainings on maintenance. Furthermore, it is only after these toilets are installed and used that XCF will be able to truly measure the sanitation and environmental improvements of these eco-toilets. XCF also will gather feedback from the families where the toilets are installed to determine how the toilets improved health. Dong is confident that because the pilot project is small, XCF will be able to conduct adequate follow-ups and in determining the impacts of the eco-toilets. XCF plans to replicate this pilot project in other farming villages near Turpan in the coming year.

This project's origins are no doubt humble, but there could be resounding impacts from this initiative. It has huge potential for making a difference in this underserved region, especially as existing water quality and sanitation problems become exacerbated by climate change.

Daniela Salaverry is Pacific Environment's China Program co-director. She can be reached at dsalaverry@pacificenvironment.org

COMMENTARY

Double Benefits: Saving Energy and Reducing Emissions in Hainan

By Lei Bi & Qian Wang

Ratification of the Kyoto Protocol marked a historical step of global efforts in reversing the inexorable increase of greenhouse gas (GHG) emissions (Dagoumas, Papagiannis, & Dokopoulos, 2006). The progress not only affirms quantitative obligations[1] for industrialized countries to limit emissions of GHGs, but also exerts intense pressure on developing countries to consider controlling their uses of carbon-based energy sources (Boyd & Ibarraran, 2002). As a developing country, China was not subjected to the quantitative commitments of the Kyoto Protocol. However, the Chinese government has included saving energy and reducing emissions (*jieneng jianpai*) as a national environmental policy in the 11th Five-Year Programme (FYP, 2006 - 2010), driven in great part by the high costs of pollution to the national economy and public health (CNDRC, 2005). According to the 11th FYP, China aims to reduce energy consumption per unit of GDP[2] by 20 percent and overall emissions[3] by 10 percent from 2006 to 2010 (CNDRC, 2006). To fulfill these goals, the Chinese government has established specific energy saving and pollution reduction objectives for its provinces and regions and begun evaluating local officials on their ability to meet these "green" goals (CNDRC, 2006) Understanding how some provinces are working to fulfill these objectives offers insight into what China's capacity could be in the upcoming global climate agreement.

HAINAN PROVINCE: LOCAL FULFILMENT OF CENTRAL GOVERNMENT REQUIREMENTS

Hainan is the smallest and among the most economically backward provinces in China (HPBS, 2004).[4] Thus, the Chinese central government has assigned Hainan comparably lower objectives for saving energy and reducing emissions in the 11th FYP (CNDRC, 2006). Specifically, Hainan is slated to reduce its per unit GDP energy consumption by 12 percent from 2006 to 2010, which translates to a drop from 0.92 tons of coal equivalence (TCE) per 10,000 Yuan in 2005 to 0.81 TCE per 10,000 Yuan in 2010 (CNDRC, 2006). With comparably lower levels of industrial emissions,[5] the central government requires Hainan to control and maintain the current emission levels from 2006 to 2010. This means maintaining the annual chemical oxygen demand (COD) emissions at 95,000 tons; SO_2 emissions at 22,000 tons; recycle/reuse at least 75 percent of industrial solid wastes; and treat 70 percent of municipal wastewater (CNDRC, 2006).

Although air and water pollution on this island province is not as severe as some its mainland counterparts, the Hainan government has seen how pollution has seriously damaged the economy and human health in other provinces.[6] This awareness led the Hainan government to formulate the "Eco-province" strategy in 1999, which lays out clear requirements of energy efficiency and emission reduction actions (HLER, 1999). Notably, the Hainan government has given local governments considerable leeway in how they meet these requirements.

ACTIONS IN HAINAN

The energy conservation and emissions reduction work under the Eco-Province strategy was catalyzed in 2006 with the enactment of the *Comprehensive Working Plan of Saving Energy and Reducing Emissions in Hainan,* which lists specific tasks for all agencies in the province. The actions in Hainan are carried out in two primary areas—controlling the access of new industries and improving the performance of existing industries.

Controlling the Access of New Industries

Since 2006, the provincial government of Hainan has scrutinized the establishment, rebuilding and expansion of industries in the province to ensure new facilities are not energy intensive or highly polluting. The provincial government only approves projects that pass a series of rigorous environmental, land use, and energy input assessments, which are needed to obtain a government building permit. Without the permits, it can be difficult to receive loans. New projects that potentially save or replace petroleum or coal products (such as plants that use biogas to meet energy needs) are given government preference. Through these approval policies, research and development of renewable energy technologies have made considerable progress in Hainan. For example, use of solar energy is incorporated into nearly all building construction and lighting projects in Hainan. The adoption of solar water heaters has accelerated especially in Hainan's rural areas. In addition to the current wind power plant in Dongfang, another 4 wind power plants with a total generating capacity of 50 million watts was established in Hainan by 2008. Biomass and other alternative fuels have been adopted as well, as evidenced by a lepra tree planting project in Wenchang and various large biogas projects surrounding large factory farms.[7]

Improving the Performance of Existing Industries

The Hainan government requires existing industries to increase energy efficiency and reduce emissions, and designates specific objectives for important industries to achieve. Since 2006, the provincial government has put increasing restrictions on small-scale industries that are high energy consumers and pollution emitters.[8] Not only has the export of products from these industries been controlled, but small factories with poor environmental performance have been denied electricity supply and are being eliminated gradually. For instance, a number of small-scale iron and steel production factories have been closed and the production of solid clay brick was banned in Hainan by the end of 2007.

Currently, operation of four electricity generators from Huaneng Power Plant in Haikou is being interrupted to install desulphurization equipment. Of the current 4 million-ton shaft kiln cement production in the province, 2.5 million tons will be discontinued by 2010. While shutting down small industries, the provincial government encourages large companies to establish environmentally responsible industries in Hainan. For example, the new 8 million-ton oil refinery project, developed by China Petroleum and Chemical Corporation in Yangpu, has embraced an investment of 3 billion Yuan for environmental protection. The investment aims to ensure waste gases from production are reclaimed and wastewater is treated with high environmental standards before being released for safe agricultural use.

> **"…cement production in China is the leading emitter of particulates, which cause serious respiratory problems in surrounding communities."**

CHALLENGES

Despite the admirable energy efficiency and emission reduction policies under the Eco-province strategy, Hainan did not meet the per unit GDP drop in energy consumption goals of 2.5 percent in either 2006 or 2007. Rather, both the overall energy input and energy consumption per unit of GDP in 2007 rose slightly higher than 2006 (Li, 2008). Although the existing industries in Hainan did reduce the per unit of GDP energy consumption in 2007, a number of new energy intensive industries came into production—such as the 0.6 million methanol project developed by China National Offshore Oil Corporation in Dongfang—which offset the energy-saving efforts from existing industries. The overall air and water emissions also increased slightly in both 2006 and 2007, mainly because no new sewage plant projects were completed and the sulphur removal project of Huaneng Power Plant in Haikou had not yet been completed (Li, 2008).

The failure of saving energy and reducing emissions in 2006 and 2007 has increased difficulties for Hainan to meet the national requirements. In other words, Hainan needs to reduce the energy consumption per unit of GDP by 3.6 percent in 2008, 2009, and 2010. Since the current levels of industrialization of Hainan are not high, there is a limited potential of

Authors and local researchers in a roundtable discussion of Hainan's Eco-province efforts.
Photo Credit: Lei Bi and Qian Wang

saving energy input and reducing emissions within existing industries. Some headway could be made if the urgently needed sewage and solid waste treatment plants are constructed, but funding for such projects is slow due to a shortage of funding, exacerbated by the global financial crisis. Additionally, plentiful oil and natural gas resources are being discovered in the South China Sea surrounding Hainan, which offers major industrial and development opportunities for this poor province.[9] If Hainan does end up increasing its oil and gas consumption to fuel growth, it will be extremely challenging for Hainan to meet the national requirements of saving energy and reducing emissions.

OPPORTUNITIES

With constraints of limited funding, technologies and personnel, industries in Hainan have opportunities to strengthen international cooperation through Emission Trade, Joint Implementation and Clean Development Mechanisms, which are supported by the Kyoto Protocol. Although the national requirements are difficult to meet, Hainan certainly has the potentials to improve its current industrial structure and productivity. As a Hainan official explained (Interview, 2007), if the annual old and waste iron and steel of Hainan could be collected and processed together, the province could save massive amounts of energy. If the current 4 million ton shaft kiln cement facility is transformed into a rotary kiln facility and equipped with electricity generators to make use of the excess heat,[10] the annual total energy input in Hainan's cement production could be reduced by 50 thousand TCE. The retrofitted kiln could save 300 million KWh in annual electricity consumption. Lower energy use and more efficient cement production also means less air pollution—cement production in China is the leading emitter of particulates, which cause serious respiratory problems in surrounding communities. In Hainan's building sector, if the annual 1 billion solid clay bricks could be replaced with new energy-saving wall materials, the annual energy consumption savings in construction could be at least 60 thousand TCE. In total, the above projects could save energy of 160 thousand TCE and approximately 400 million KWh in electricity in Hainan (Interview, 2007).

POLICY IMPLICATION

Given the challenges and opportunities that Hainan has, technical innovation is strongly encouraged in

existing industrial sectors to upgrade the current industrial structure of Hainan. The average energy efficiency of industries in Hainan can be increased by developing waste recovery activities—which is an area that the newest McKinsey Company report *China's Green Revolution* (2009) identified as a potentially significant area for CO_2 emission reductions in China. Wastes and by-products, especially the excess heat present major cost and energy saving opportunities. At present, the total facility capacity of generating electricity from the remaining heat of cement production in Hainan is about 15,550 kilowatts which could produce 100 million KWh annually. In the oil and gas processing and papermaking industries, the total capacity for generating electricity from waste and excel heat is 258 thousand kilowatts, which could produce 1.1 billion KWh in annual electricity generation (Interview, 2007).

Hainan's "to-do" for strengthening its Eco-province strategy is long—continue to close small factories with low productivity and high emissions; encourage low-energy industries; increase renewable energy and alternate fuels development; promote energy efficiency, and encourage low energy industries. Major public campaign and incentives to improve energy conservation will be crucial. For example, encouraging people to lower of indoor air conditioning to 26 degree Celsius alone could have a huge impact on the Hainan's energy savings. According to provincial estimates, summer air conditioning use accounts for a quarter of the total energy load in the province (Interview, 2007).

All of these strategies will demand much better environmental governance in the province along with capacity-building initiatives, such as the creation of a provincial energy saving center to help formulate and implement accountability assessment methods to meet energy consumption and emission reductions. The government could also enfranchise the local government with the rights to adjust electricity prices so they can use market incentives to promote energy saving and lower emissions.

The Chinese government has been reluctant to set specific caps on GHG emissions for as the Hainan case illustrated, many provinces struggle to meet even domestic energy efficiency and emission reduction targets. The current global economic crisis could make it even more difficult for local governments in China to invest into cleaner technologies necessary to improve pollution emissions. However, as the Hainan case illustrated, China's provinces are taking significant steps to reduce energy consumption and pollution, which opens up opportunities for international cooperation in joint technology development, energy conservation, water recovery, and policy design—all areas in which could help China's provinces make more progress in lowering overall emissions as their local economies continue to expand.

ACKNOWLEDGEMENTS

Many thanks to Jennifer Turner for pertinent suggestions, cogent comments and detailed editing.

Lei Bi is a graduate student of School of Planning, Faculty of Environmental Studies, University of Waterloo. With funding from the Canadian International Development Agency [CIDA] through the Ecoplan China project, his graduate research focuses on environmental policy, energy planning and rural community development in Hainan Province. He can be reached at: lbi@fes.uwaterloo.ca. Qian Wang received the BS degree in environmental planning from Nankai University in 2001 and the MES degree in Geography from the University of Waterloo in 2004. After two years' working at Scott Wilson as an environmental planner, he is now a doctoral student in System Design Engineering in the University of Waterloo. He has published a couple of papers on Brownfield redevelopment, emission trading policy, and industrial ecology. He can be reached at: q4wang@uwaterloo.ca.

REFERENCES

Boyd, R.; & Ibarraran, M. E. (2002). "Costs of compliance with the Kyoto Protocol: A developing country perspective." *Energy Economics, 24*(1), 21-39.

Chinese Ministry of Environmental Protection (2006). *The Report of National Environmental Statistics (2005).* Beijing: Chinese Ministry of Environmental Protection.

Chinese National Development and Reform Commission. (2005). "Environment and Resources." [Online]. Available: http://www.sdpc.gov.cn/hgbh/.

Chinese National Development and Reform Commission. (2006). "The Chinese Eleventh Five-Year Plan of Economic and Social Development." Beijing: Chinese National Development and Reform Commission.

Dagoumas, A. S.; Papagiannis, G. K.; & Dokopoulos, P. S. (2006). "An economic assessment of the Kyoto Protocol application." *Energy Policy, 34*(1), 26-39.

Duic, N.; Juretic, F.; Zeljkoc, M.; & Bogdana, Z. (2005). "Croatia energy planning and Kyoto protocol."

Energy Policy, 33(8), 1003-1010.
Gu, K.; & Wall, G. (2007). "Rapid urbanization in a transitional economy in China the case of Hainan Island." *Singapore Journal of Tropical Geography, 28*: 158-170.
Hainan Department of Land, Environment and Resources. (1999). "Proposal for the Creation of an Eco-province in Hainan." Haikou: Hainan Provincial Government.
Hainan Provincial Bureau of Statistics. (2004). "Hainan Statistical Yearbook." Beijing: China Statistical Publishing House.
Interview with Hainan Provincial Official, December 2007.
Li, Shengdong. (2008). "A Need Exists to Reconsider the Assignments of Saving Energy and Reducing Emissions for Hainan Province." [Online]. Available: http://www.hkwb.net/html/2008/01/19/48742.html.
United Nations Framework Convention on Climate Change. (2003). "Kyoto Protocol." [Online]. Available: http://unfccc.int/kyoto_protocol/items/2830.php.
Xu, Shijie. (1988). "Hainan Province: Nature, History, Current Status and Future." Beijing: Shangwu Press.

NOTES

1. According to the Protocol, developed countries referred in Annex I are obliged to reduce their emissions of GHGs some 5% below their country specific 1990 levels in the period 2008-2012 with penalization clauses in case on non compliance (UNFCCC, 2003).

2. The Chinese per GDP energy consumption in 2005 was 1.22 Tons of Coal Equivalent [TCE] per 10,000 Yuan RMB (CMEP, 2006).

3. Specifically in 2005, waste water 52.45 billion tons, amount of Chemical Oxygen Demand [COD] 14.14 million tons, ammonia and nitrogen 1.50 million tons, sulphur dioxide 25.49 million tons, dust 11.83 million tons, industrial solid wastes 1.34 billion tons (CMEP, 2006).

4. Due to previous military considerations, the Chinese central government had paid little development attention to Hainan prior to 1988 (Xu, 1988).

5. Since Hainan is still dominantly rural, the provincial economic development is much based upon agriculture and the recent rapidly expanding tourism industry (Gu & Wall, 2007). As a result, levels of industrial emissions of Hainan are comparably lower than some of other highly industrialized provinces, such as Jilin, Shanxi, and Gansu.

6. In mainland China, the costs of environmental pollution to the national economy in 2004 reached 511.8 billion Yuan RMB, equivalent to 3% of the GDP. About 300 million rural people did not have access to clean fresh water and 400 million people in mega-cities exposed to polluted air. In the 11 biggest Chinese cities, 50 thousand people died and 40 million people got infected with chronic bronchitis in a year due to the heavy dust and particles in the air (CMEP, 2006).

7. Lepra trees are used to develop biodiesel or other biofuels in the project.

8. Particularly cement manufacturing, iron and steel production, electricity generating, rubber processing, solid clay brick production and mining industries.

9. Among the 39 basins which were recently found, there are huge reserves of 15.2 billion tons of petroleum and 4,000 billion cubic meters of natural gases.

10. 360 thousand kw.

SPOTLIGHT

A Guardian for China's Western Rivers: The Hengduan Mountain Society

By Yang Yong (Translated and Edited by Jing Chen and Zhimin Mao)

I began to explore western China's rivers some 20 years ago. In 1986, I initiated and participated in the five-month Yangtze River scientific expedition—three Chinese teams and one American team racing to be the first to descend the upper Yangtze River on rafts. As the chief of a local environmental monitoring station in Sichuan Province, I was the only Chinese team member out of 15 with experience in environmental protection. At an elevation of 4,500 meters at the Yangtze River's headwaters, the expedition teams collected more than 1,000 hydrological and geological samples and took more than 3,000 pictures. The teams also investigated landslides along the river. My team made the descent before the American team, but at a great price. Five people lost their lives from my team alone; 10 total from the three Chinese teams. While this first comprehensive investigation of the Yangtze River was costly, it catalyzed a wave of expeditions by young Chinese scientists. The trip changed my life, inspiring me to become an independent geological scientist and investigator of China's rivers.

A NEW PATH AS A RIVER RESEARCHER

Since 1986, some of us who participated in the first Yangtze River expedition continued to explore rivers in the region, including the Jinsha and Yalong—tributaries to the Yangtze River—and rivers originating in Tibet, such as the Nu, Lancang, and Yarlung Zangbo. These rivers flow in areas characterized by extreme and dangerous geographic environments that few, if any, have visited. Through these explorations, we obtained considerable first-hand data on the geological and geographic conditions of western China and developed unique insights into ecological changes in the region.

In 1998, the Chinese government launched the Great Western Development Program. This program aims to increase economic development in remote areas of China, where per capita gross domestic product is significantly lower than the booming eastern urban areas. The program has notably spurred considerable new investment in dams and water transfer projects in southwest China, leading me to shift my research to investigate the feasibility and impact of these major river development projects. My research examines the impacts of the hydroelectric stations on the Tibetan Plateau and the western line of the South-North Water Transfer Project (SNWTP), which are among the largest river infrastructure development projects in human history.

HENGDUAN MOUNTAIN SOCIETY

The dams and water transfer projects in southwest China are but one example of how China's rapid economic development is degrading the environment at an ever-faster pace, resulting in increasingly visible conflict between development and conservation. With these challenges in mind, I established the Hengduan Mountain Society in 2004 as a nonprofit center for research and activism based in Chengdu. The Hengduan Mountain Society is a research network of over 500 volunteer scientists and students who—either as volunteers or consultants—help conduct research and gather data on river ecosystems in western China. Besides fieldwork in the Hengduan area—covering large parts of western Sichuan, Yunnan, and eastern Tibet—I often travel to Beijing to meet with nongovernmental organizations and research institutions to discuss the findings of my network, for the data we collect is unique and much appreciated by activists and researchers. Our direct cooperation with the government remains low, but is likely to increase in the future.

ADDRESSING HYDROLOGICAL PROJECTS IN WEST CHINA

As part of the Great Western Development Program, a number of dams and hydropower stations have been designed and constructed on China's western rivers. Many of these rivers are located on the Tibet Plateau and in southwestern China. In the face of this trend, the Hengduan Mountain Society investigated the area and found many potential geological, ecological, and cultural dangers associated with excessive and uncoordinated development in this area:

• **Complex Geological Activity**. Southwest China is one of the most geologically active and complicated regions in the world. Current studies on this area are not sufficient to explain many of the frequent natural occurrences including earthquakes, landslides, and sedimentation. The Wenchuan Earthquake in May 2008 exposed the risks of constructing dams on geologically active areas, as hundreds of hydropower stations were damaged to various degrees, leaving numerous unstable reservoirs a threat to downstream cities.

• **Complex Ecology**. This region is a world biodiversity hotspot, holding an important ecological function in not only China but all of Asia; it also plays a key role in maintaining the stability and water quality of the middle and lower reaches of the river basins in Southeast Asia.

• **Cultural and Historical Heritage**. This region is home to at least 10 ethnic minorities, with diverse traditions and cultural heritage, who face potential threats to livelihood due to resettlement from dam sites. There are also a number of World Natural and Cultural Heritage Sites and national nature reserves, all of which risk significant damage should these planned water transfer and dam projects be constructed.

DIAGNOSIS ON THE SOUTH-NORTH WATER TRANSFER PROJECT

Fifty-six years ago, Chairman Mao envisioned a solution to China's problem of uneven water distribution: "Southern water is plentiful, northern water scarce. Borrowing some water would be good." As water scarcity becomes an increasingly urgent problem in northern China, this imaginative and bold idea was picked up and converted into an ambitious project, known as the South-North Water Transfer Project (SNWTP). In 2002, the State Council, China's highest executive body, approved the construction of three canals for SNWTP, a project that has no comparable precedent in the world. The eastern canal is already transferring water and the middle line began construction, which was later halted in late 2008 due to conflicts and cost issues. The most expensive and difficult western line that aims to draw water from Sichuan is in the planning stage. Notably, provincial officials and researchers have formally complained about the central government's initial environmental impact assessment, which claimed the water transfer would have little ecological impact on the region.

In order to provide a truthful, independent, and objective feasibility analysis for the west line of SNWTP, the Hengduan Mountain Society organized and conducted studies on the western reaches of the Yangtze River between 2005 and 2008. In 2007 alone, the Hengduan team traveled twice to the Yangtze River Basin to collect ecological and hydrological data for both the summer and winter seasons. The research covered the Dadu and Min rivers, as well as the three major sources of the Yangtze River—the Chumaer, Tuotuo, and Dangqu rivers—and the planned SNWT western project area. This investigation found the following:

• The Hengduan mountain region, where the west line of SNWTP is planned, has high geological and ecological risks. Moreover, the area is frozen for over five months, making normal water transfer challenging.

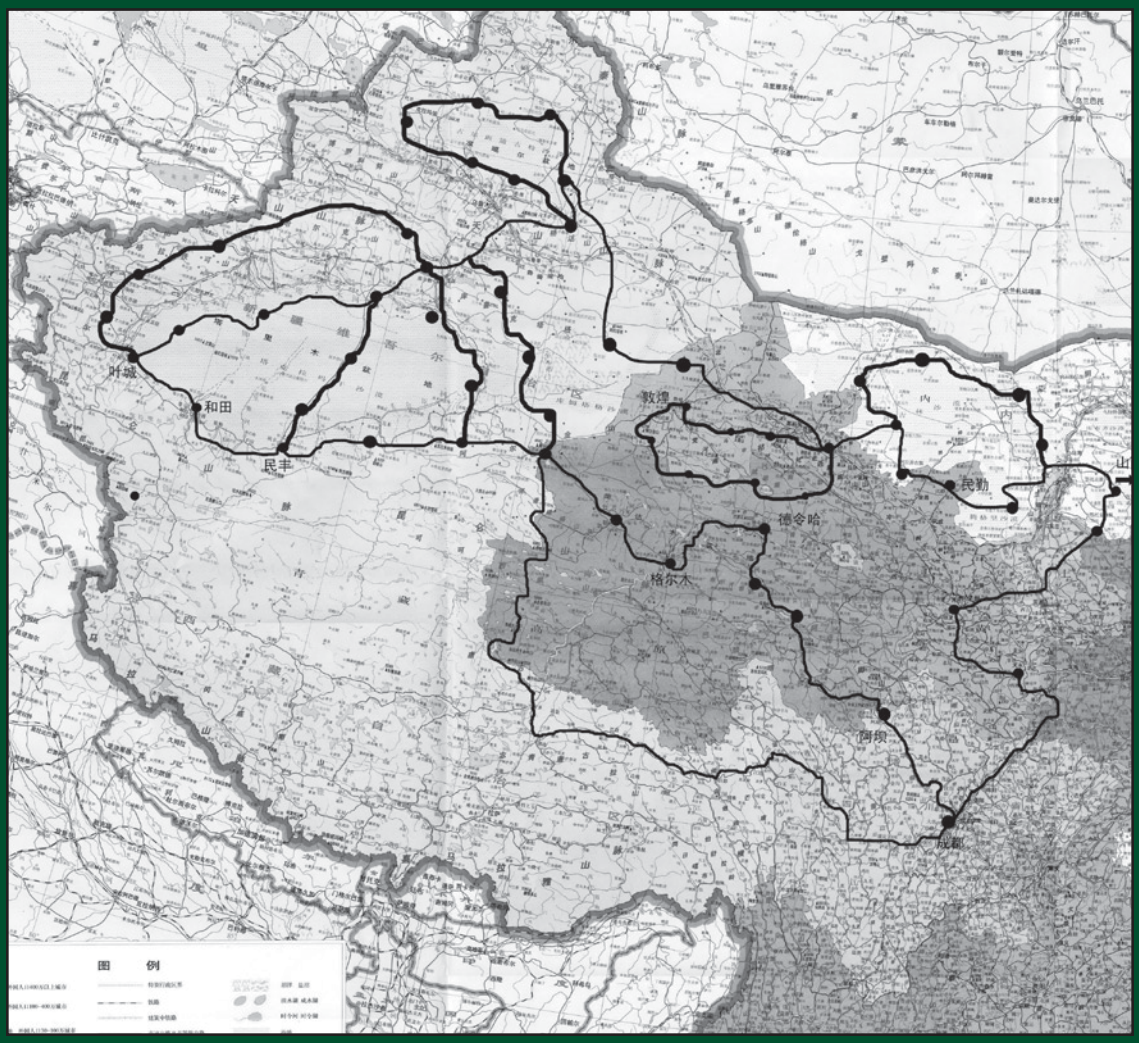
• In the three major sources of the Yangtze River, there are major environmental issues such as melting glaciers, pollution, increasing desertification, and shrinking rivers. Thus, water supply and quality are difficult to guarantee.

• Considering the mounting number of planned and constructed dams in the upper reaches of the Yangtze River basin, SNWTP will add significant pressure upon the already fierce struggle for water between different interest groups.

THE FUTURE FOR CHINA'S WESTERN WATERS AND HENGDUAN

In 2006, during our studies in the headwaters of the Yangtze River, I revisited the monument erected to the 1986 expedition team. The monument was originally built right next to the water, but today the

Map 1.



Source: Yang Yong

headwater is about 300 meters away. The sources of the Yangtze River have dried to a desperate level and under these circumstances SNWTP can only worsen the situation..

In late September 2008, the Hengduan Mountain Society started a new round of expeditions and investigations into northwestern China. Specifically, the study will investigate the possibility of exploiting glaciers and glacier runoff in the Kunlun and Qilian Mountain regions, and also the five major deserts in northwest China. The goal is to seek an alternative for the western line of SNWTP, which remains stalled, pending further research. Possible strategies include identifying the capacity of water resources in northwest China, changing the wasteful distribution of water to dirty industries in this region, and promoting water-saving lifestyles among households.

Yang Yong is the founder and chief scientist at the Hengduan Mountain Society. He graduated from China University of Mining and Technology with a degree in geology. He can be reached at tibet@public.cd.sc.cn.

Jing Chen was a summer 2008 intern at the China Environment Forum. She is a graduate student at the University of Maryland and can be reached at jichen@gvpt.umd.edu. Zhimin Mao was a fall 2008 intern at the China Environment Forum. She is a graduate student at Carnegie Mellon University. She can be reached at zhimindy@gmail.com.

COMMENTARY

How Far Will the Rising Tide of CSR Go in China?

By Sean Gilbert

Since 2005, interest within China in the concept of "corporate social responsibility" (CSR) has exploded. Influenced by a combination of domestic and international drivers, many leading Chinese companies find themselves at a crossroads where they need to redefine their image and engage in a discussion about their role in society. For the rest of the world, the way in which Chinese industry reacts to this challenge will have a profound impact on how environmental challenges in China and places much further afield play out in the coming decades. Despite the growing enthusiasm for CSR in China, the question remains how the CSR concept can help move Chinese industry to a new paradigm for development.

LAUNCHING A NEW WAVE

Over the last several years, Chinese industry has found its position in the world rapidly changing. Since China launched its economic reforms, the Chinese leadership's prioritization of rapid economic development has transformed the country's industrial economy. The reforms led to an initial social contract in which the key responsibility of business was to generate economic wealth by providing employment opportunities. Chinese officials and citizens initially perceived the environmental degradation and social inequalities of rapid industrialization as necessary evils or an unavoidable transitional stage.

For thirty years China has been a magnet for foreign investment mainly due to a large pool of cheap labor and the need for many suppliers of raw materials to be near labor intensive factories that serve as customers. At the same time, however, since the 1990s overseas buyers have had concerns over certain aspects of labor conditions and poor environmental management (e.g., use of lead or hazardous substances in products). Buyers have been the main source of pressure, however. Consumer protection and environmental activists in the west have usually targeted major North American and European multinationals to seek supply-chain performance standards to ensure safer products, rather than complaints directly at Chinese companies.

In recent years, pressure on Chinese companies has emerged from domestic forces. For example, local communities and workers in China have started to become much more assertive in their relations with industry when their own quality of life is affected. There are plenty of anecdotes about workers starting to demand better working conditions rather than simply accepting any job that pays. Of growing concern to Chinese officials is the increasing number of protests against highly polluting factories. [*Editor's Note: See Ma Tianjie's feature article on environmental mass protests in this issue for more details on protest trends*]. Internationally, Chinese companies also are finding themselves suddenly in the spotlight for the first time with regards to their own operating practices as they rush to develop new resources internationally and begin to enter overseas consumer markets. Deservedly or not, China's business community is finding that it is facing a new set of expectations and a visibility that did not previously exist.

This combination of internal and external pressures has now opened the door to what could become a fundamental change in Chinese industries and how they relate to the rest of the world. In 2005, Hu Jintao gave a speech in which he outlined several important policy principles related to China's development, including calling for a new economic

model, scientific development, and the creation of a harmonious society. The speech marked a turning point for many in the business community, sparking a flurry of CSR conferences in Beijing and other locations as companies—especially state-owned companies (SOEs)—tried to interpret what business was supposed to be doing to contribute to a "harmonious society." In January 2008, the State-Owned Assets Supervision and Administration Commission of the State Council followed with a new directive that raised CSR expectations for SOEs. Today, while many companies in China are now beginning to speak the language of CSR, in practice the results have covered a broad range.

PHILANTHROPY OR A NEW WAY OF DOING BUSINESS?

In Europe and the United States, the concept of CSR has evolved over time. Initially, the discussion focused on corporate responsibilities for compliance with environmental and social laws and being a good neighbor to fence line communities.

In the 1990s, this notion changed to exhort concepts such as eco-efficiency, cleaner production, and pollution prevention. Companies were encouraged to begin thinking in terms of production systems and product life cycles to look not just at their own facilities, but across the entire cycle of production from raw material procurement to final disposal (or hopefully reuse and recycling) to maximize environmental and social performance. The emphasis shifted to going beyond compliance, but still focused on operations and improving the associated processes and technologies. Essentially, doing the same types of activities, but more cleanly and safely.

Over the last ten years, the concept has evolved yet again in the west. CSR is now shifting its focus towards the products, services, and business models of companies to ask the question of how the business can gear itself to solve sustainability problems. This has led to the exploration of "bottom-of-the-pyramid" strategies, clean technology funds from the financial sector, and many other new ideas.

For many companies in China, CSR still has a strong overtone of community investment and philanthropy. Companies such as China National Petroleum Corporation (CNPC) with over a million employees operate in many poor areas and CNPC's leaders see investment in community infrastructure as one of their core CSR functions. Many companies highlight their community investment programs as the way to demonstrate their sense of commitment to wider society with the hopes of being seen as a "responsible" company.

Products and services come into play for some companies, but they often walk a fine line between simply extending market reach and being part of a vision of China's development. For example, China Mobile identifies extending the mobile network in China as one of its four pillars of CSR. On the one hand, one would expect a mobile phone company to extend its network as a routine part of its business, and it could be questioned whether this is part of CSR. However, communications access does contribute to opportunities for development, and, in a country where large parts of the population still live in poverty, could offer a legitimate vision of a social contribution. Similarly, Chinese oil companies and electric utilities often refer to providing stable energy supplies as part of their CSR—a message which western oil companies also promote when they talk about their role in society.

The role of legal compliance in CSR is also not clear as some Chinese CSR specialists present compliance with environmental, health, and labor laws as examples of CSR. Many would argue—including those in the business community—that legal compliance is not a matter of responsibility or contribution. Rather it is an obligation, and companies that do not comply deserve punishment under the law. But does this hold true in a situation like China where widespread non-compliance with law is the norm and compliance with law is already an action that represents above-average performance? Over the long term, it is hard to see how a society could function on such a basis. However, in the short term, it could be argued that Chinese companies that comply with laws are worthy of special recognition.

Regardless of the specific definition, the fact that Chinese companies are beginning to embrace dialogues about CSR offers a new opportunity for engagement that did not exist before. For example, some Chinese companies are beginning to warm up to the concept that they have a range of different stakeholders that they need to engage and become partners with in order to be a successful company. The milk contamination scandal provided sobering proof that Chinese companies will increasingly depend on maintaining a level of public trust and credibility in order to be able to operate. Despite this recognition, many Chinese companies struggle to identify with whom they

should engage to build this trust, particularly in an environment that lacks a highly active, membership-based civil society and also lacks active investors with a focus on these issues.

INDUSTRIES OF THE FUTURE

Alongside evaluating the operating practices of the existing industry base, there are also those who advocate for China to focus its energies on playing a leading role in developing the new technologies and industries of the future. Reports such as CCIED-WWF study on China's Ecological Footprint underline that China is at a crossroads in its development and the investments that the government makes in core infrastructure such as transport, power generation, urban design, and other areas will drive the country's consumption patterns for the next several decades.[1] In effect, China (and the world around it) will become locked into a mode of living and resource consumption patterns from which it will be almost impossible to escape for an extended period without massive reinvestment—quite similar to the position in which the United States finds itself in its reliance on personal transport. More focus should be put on developing new technologies in China—such as solar panels—for home and abroad that will lead to more sustainable consumption patterns. Initiatives such as the New Ventures program under the World Resources Institute embrace this type of ethos in helping Chinese small and medium enterprises develop business plans to secure capital.

TRANSPARENCY EMERGES

Parallel to this growth of CSR, Chinese businesses are increasingly finding themselves required to operate with more transparency. The Ministry of Environmental Protection (MEP) has been passing a series of laws that help increase public access to information and seek to link access to capital to environmental performance through a series of policies aimed at establishing "green" finance. So far, high-level government policies have been released that relate to banking, insurance, and equities (including new requirements for initial public offerings to disclose environmental risks), but these have not been elaborated in any detail (i.e., most lack implementing regulations). The initial focus has been on banking and measures such as translating the Equator Principles into Chinese. Depending on how these initiatives continue to unfold, they could become a powerful driver for CSR. Already major market regulators and institutions including the People's Bank of China, MEP, and the China Banking Regulatory Commission are actively thinking about these issues.

> **"The milk contamination scandal provided sobering proof that Chinese companies will increasingly depend on maintaining a level of public trust and credibility in order to be able to operate."**

At the same time as the regulations are evolving, voluntary disclosure is also growing. The directive from SASAC encourages SOEs to begin issuing voluntary reports on their sustainability performance, and the practice has been spreading rapidly. According to the Beijing-based CSR consulting company SynTao, 121 reports were issued in 2008, which represents a sudden and significant growth of activity. Many of these reports have drawn on or directly applied the *Sustainability Reporting Guidelines* of the Global Reporting Initiative.[2] In China there also has been growth in disclosure in relation to greenhouse gas (GHG) emissions, primarily in connection with the Carbon Disclosure Project and also with the GHG Protocol that was created by the World Resources Institute and the World Business Council for Sustainable Development.[3]

In many ways, the move towards transparency by Chinese regulators and businesses is following global trends. Promoting such transparency represents progress in CSR globally in two ways. First, many of the early adopters in China are using reporting as a means to begin building internal policies, procedures, and performance monitoring. Currently many companies lack the ability to adequately track and review their environmental and social impacts at the group level. Many current sustainability reports in China are light in quantitative detail because the data gathering systems simply do not exist for most Chinese companies. However, the process of reporting has stimulated significant internal initiatives to

develop data tracking systems, which could begin to deliver better information in the coming 2 to 3 years from Chinese companies. For example, China Ocean Shipping Company (COSCO) has built a new internal monitoring system over the last few years that they claim enables the company to track several hundred data points on environmental and social performance indicators.

Even more important than just publishing the numbers, the process of starting to measure performance opens new routes for these companies to begin managing performance more systematically. Further, many of the leading companies are also using international guidelines and standards as an opportunity to learn about the range of sustainability issues that are shaping markets around the world—including markets that they hope to enter.

Second, reporting is placing many aspects of Chinese company performance into a format where they can be discussed for the first time. In the past it was impossible to engage Chinese companies on their performance simply because stakeholders did not know where to start and how to gauge what was and was not happening. Transparency will create the opportunity to create routes of engagement and feedback between companies, communities, and other groups. For example, some international socially responsible investment (SRI) investors have now begun to directly engage Chinese companies on their sustainability performance.

WHERE IS IT GOING?

The key question, of course, is where CSR in China is headed and what impact it will have on how companies approach doing business. The answer to this question will play out over the next ten years. China clearly has reached a tipping point in its development path where there is now a growing consensus among policymakers and some of the more progressive Chinese businesses that environmental impacts associated with development must be addressed. There does not appear yet to be consensus on how to do this, but the visible shifts in policy statements and the business community show that the process is starting.

As Chinese business grapples with its role in this equation, it will be important to engage them in a constructive manner and bring them into a wider international debate. Environmental problems cross national boundaries and, in some cases, know no national boundaries. Solving challenges like biodiversity loss and global warming will require coordination across regions, production chains, and stakeholder groups.

"As Chinese business grapples with its role… it will be important to engage them in a constructive manner and bring them into a wider international debate."

Chinese enterprises are becoming increasingly active in the international networks, which is an encouraging sign and essential step. Over the last 18 months, more than 100 Chinese companies have signed the Global Compact and at least a dozen report according to the Global Reporting Initiative (GRI). For CSR tools and standards to be truly global, they do need to be both applicable and used in China and to have active involvement from Chinese companies in their governance and development. The alternative of a patchwork of national standards won't result in the coordinated efforts that are needed to meet the sustainability challenge.

Supply chain engagement will continue in any scenario. Several nongovernmental organizations (e.g., World Environment Center, Business for Social Responsibility, and Institute for Sustainable Communities) are working on greening supply chain projects with some Chinese companies that not only aim to help build better capacity to adopt cleaner production processes, but also hope to promote better transparency of companies vis-à-vis local communities. Similarly, NGOs such as Forestry Stewardship Council, Forest Trends, and WWF-China are working with various government, timber companies, paper industries, and NGO stakeholders in China to promote sustainable forestry certification. However, the question is what else will happen in the space alongside these supply chain initiatives as Chinese companies begin to take more of a leadership role in the area of CSR?

FINAL THOUGHTS

While there are positive signs that the Chinese government and business sectors are taking CSR

more seriously, it also should not be taken for granted that a wave of corporate environmental and social responsibility will sweep across China and transform business practices and production chains. There are positive steps from leaders, but there are also a staggering number of companies in China (and other countries) that are not interested in a sustainability agenda. However, the opportunity is emerging to engage with Chinese industry domestically and internationally in a manner that has not existed before. The interest exists and now it is up to all parties interested to make the most of it.

Sean Gilbert is a Director at the Global Reporting Initiative, which is the most widely used global guideline for sustainability reporting. In addition to his current involvement with China at GRI, he previously did environmental consulting based out of Taiwan for seven years. He can be reached at gilbert@globalreporting.org or gilbert.sean@gmail.com. This article reflects his personal views and experience.

NOTES

1. Report on Ecological Footprint in China, CCICED-WWF can be downloaded here: http://www.footprintnetwork.org/en/index.php/blog/af/new_report_examines_chinas_fast_growing_footprint.

2. The Global Reporting Initiative (GRI) is a large multi-stakeholder network of thousands of experts, in dozens of countries worldwide that has developed the world's most widely used sustainability reporting framework. The principles and indicators set out in this framework enables organizations to measure and report their economic, environmental, and social performance. For more information see: http://www.globalreporting.org.

3. The Carbon Disclosure Project is a nonprofit organization that encourages private and public sector organisations to measure, manage, and reduce CO_2 emissions. The GHG Protocol is is an online accounting tool for businesses to quantify, and manage greenhouse gas emissions.

SPOTLIGHT

Securing Land Rights for China's Poor Farmers: The Rural Development Institute

By Zhu Keliang, Ping Li, and Radha Friedman

INSECURE LAND AND PEOPLE

Cao Fenping and his wife have spent their lives farming turnips by hand in Tangzhuang Village, Anhui Province. At 65, they yearn for security. But for decades, Cao and his wife have been subjected to the government's periodic "land readjustments." Every 3 to 5 years, the land they farmed was "readjusted" amongst other villagers. They never knew where or how far away from home the new land would be, or in what condition the land would be in when they got there. Without any assurance in keeping the same plots of land, Cao and his family did not want to invest the little money they had in irrigation or organic fertilizers to more sustainably farm their land.

PROPERTY RIGHTS IN CHINA

China's 210 million agricultural households represent one out of every three farm families on the planet, and comprise nearly two-thirds of China's population. For these 700 million people who depend on the land for their livelihoods, secure rights to the land are crucial.

Unfortunately, China's rapid urbanization, economic growth, and population migration are causing millions of farmers to face overwhelming threats to their land rights and livelihoods. Whether through state expropriation or so-called "land readjustments," these land grabs weaken the land rights of farmers, inhibiting them from making long-term investments in their land.

Faced with the constant threat of losing their land, farmers are more likely to plant short-term cash crops and to use pesticides, decreasing the long-term productivity of the soil and the nutritional benefits of the crops. Others may choose to migrate to cities, adding to the demand for converting agricultural land into urban development. Weak land rights turn properties into sitting ducks for local governments, which are increasingly seizing land for nonagricultural purposes and lucrative resale as the industrial economy expands. Land is now the primary source of unrest in China, leading to over 87,000 "massive rural incidents" in 2005, predominantly related to land seizures.

SECURE LAND RIGHTS PROVIDE INCENTIVE TO INVEST IN THE LAND

It is easy to understand why only a minority of Chinese farmers have made long-term productivity-enhancing investments—such as installing irrigation, planting trees or constructing greenhouses—all of which promote environmental stewardship and improve agricultural productivity, income, and wealth. Guaranteeing China's rural poor with secure land rights has a variety of important benefits:

- Providing incentives to invest in the land;
- Increasing the value of farmers' land assets;
- Increasing agricultural production;
- Encouraging organic farming;
- Promoting economic freedom and independence;
- Reducing urban migration; and,
- Promoting better stewardship of the land.

STRENGTHENING LAND RIGHTS FOR 700 MILLION CHINESE

Since 1987, the Rural Development Institute (RDI)—an international nonprofit organization working to secure land rights for the world's poorest—has been working closely with China's central government to strengthen the land rights of rural families and protect them from land seizures. In

For China's rural farmers, secure land rights are crucial. Photo Credit: Rural Development Institute

China, RDI has patiently worked to develop secure, 30-year renewable rights for farmers like Cao and his wife through laws such as China's newly-adopted *Property Rights Law*. With this law, farmers like Cao have meaningful "property rights" for the first time in China's modern history—rights that are long term, sustainable, and marketable. In addition to securing legally recognized private property rights, the law also improves the compensation standards for affected farmers whose land is taken or expropriated by the government for non-agricultural purposes.

THE PERFECT TURNIP

Since receiving these 30-year land rights, Cao and his family have greatly improved their income and security by making investments in their land including:

- Digging three wells;
- Converting 2 *mu* of the household's land into a vegetable garden for the family;
- Installing an electric pump for irrigation;
- Building an organic fertilizer tank for their vegetables; and,
- Switching to organic fertilizer (chicken and goat waste, and sesame oil).

Cao is now able to grow turnips, which sell extremely well. "The demand for my turnips is far greater than my supply!" says Cao. His turnips are highly soil-selective; any artificially-manufactured chemical in the soil would damage the taste of the turnip, and therefore, he only uses organic fertilizer. Though switching to organic fertilizers was a costly investment, it has more than paid off in returns on the sales of his turnips. Today, Cao harvests 5,000 kilos of turnips each year. During non-turnip seasons, he grows other vegetables for local markets. "You have to spend a lot of time and money to nurture the soil before getting into the business," says Cao, "but if the land were reallocated to someone else, your investments would be gone like water."

Today, Cao makes 20,000 Yuan (~$2900) from vegetable farming, and he and his wife and children now feel secure. They are saving for the future and dreaming of their next opportunity. "Perhaps I could pool my money with other farmers in the village to build a larger storage facility, or even a turnip juice processing line!" Cao muses.

LOOKING AHEAD

Partially attributable to gradual reforms to land laws over the last 25 years, the number of Chinese living in poverty fell by 400 million—over 70 percent of

the poverty reduction in the entire world.[1] Yet, although we have seen immense progress, research data from RDI's most recent nationwide surveys (conducted in 1999, 2001, and 2005 in cooperation with Renmin University and Michigan State University) show that only 40 percent of China's rural citizens are actually receiving their full rights. RDI is now working with several levels of the Chinese government in implementing the recent pro-farmer laws including the issuance of land rights certificates and contracts to farmers, grassroots publicity of land laws and policies, establishment of a formal rural land rights registration system, as well as free legal aid and education to farmers.

Secure land rights for farmers like Cao are more relevant than ever. Competition from foreign agricultural producers has intensified as barriers to agricultural imports have dropped with China's entry into the World Trade Organization. After World War II, Japan, South Korea, and Taiwan instituted "land-to-tiller" programs that provided secure land rights to hundreds of millions of farmers, which eventually led to broad-based economic successes in the countryside and drastically reduced rural-urban income gaps. If the government protects the land rights of Chinese farmers as its law requires, China has the opportunity to replicate the amazing economic and social transformations that occurred in rural Japan, South Korea, and Taiwan.

This year marks the 40th anniversary of RDI's work in over 40 countries, helping to secure land rights for over 400 million people. Over those 40 years, RDI has demonstrated that land rights provide global security, as well as, leveraged, sustainable, and generational poverty alleviation. RDI is currently seeking funding to undertake another 17-province survey in the coming months, providing new data from nearly 2,000 rural households in China. For more information about RDI's work, visit www.rdiland.org.

Zhu Keliang is director of the East Asia Program (keliangz@rdiland.org); Ping Li directs RDI's Beijing office (pingl@rdiland.org); and Radha Friedman is the director of Global Communications at RDI (radhaf@rdiland.org).

NOTE

1. Martin Ravallion & Shaohua Chen. (2004). *Understanding China's (Uneven) Progress Against Poverty* (World Bank Policy Research Working Paper 3408).

The Woodrow Wilson International Center for Scholars, established by Congress in 1968 and headquartered in Washington, D.C., is a living national memorial to President Wilson. The Center's mission is to commemorate the ideals and concerns of Woodrow Wilson by providing a link between the worlds of ideas and policy, while fostering research, study, discussion, and collaboration among a broad spectrum of individuals concerned with policy and scholarship in national and international affairs. Supported by public and private funds, the Center is a nonpartisan institution engaged in the study of national and world affairs. It establishes and maintains a neutral forum for free, open, and informed dialogue. Conclusions or opinions expressed in Center publications and programs are those of the authors and speakers and do not necessarily reflect the views of the Center staff, fellows, trustees, advisory groups, or any individuals or organizations that provide financial support to the Center.

The Center is the publisher of *The Wilson Quarterly* and home of the Woodrow Wilson Center Press, *dialogue* radio and television, and the monthly newsletter *Centerpoint*. For more information about the Center's activities and publications, please visit us on the web at www.wilsoncenter.org.

CHINA ENVIRONMENT FORUM

The Woodrow Wilson International Center for Scholars
One Woodrow Wilson Plaza • 1300 Pennsylvania Avenue, NW
Washington, DC 20004-3027
Tel: 202-691-4233 • Fax: 202-691-4001
E-mail: cef@wilsoncenter.org

ISBN: 1-933549-50-5