



Dirty Water

BY SHARON GUYNUP

India and China share a grave environmental problem—extreme water pollution



The hazy dawn knits river to sky on the banks of the holy Ganges river in Varanasi. Even at sunrise, the city's 4.5-mile waterfront bustles. Bathers brush their teeth, soap themselves, and scrub their children. Legions wash laundry, gather water, and scour dishes. Men swim and lounge on *ghats* (steps that descend into the Ganges). Black noses and curving horns betray the presence of submerged water buffalo.

Women in bright saris gather in groups or with their families at the water's edge. Up to 60,000 pilgrims journey



Four hundred million people rely on the Ganges watershed for drinking water, including Varanasi's 1.6 million residents. But along its 1,560-mile journey from the Himalayas to the Bay of Bengal, the river absorbs raw sewage from 116 cities. Waste has turned these waters into a highway for viruses and bacteria, including deadly, dysentery-causing microbes like *E. coli* O157 and *Shigella*, and those that cause cholera, hepatitis A, and typhoid fever. Last year, the Indian government pledged \$4 billion for river cleanup to stem the tide of waterborne disease.

But the problem of environmental water pollution extends far beyond the Ganges. Municipal waste, pesticides, and industrial chemicals foul waterways and drinking water across the globe, with the worst pollution concentrated in developing countries. If India's waterways are the dubious poster children for sewage, then China's waters take that role for toxic chemicals. Municipal waste is also a severe problem in China, but three decades of meteoric industrial growth have laced lakes and rivers with a witches' brew of chemicals. Some Chinese waters are now among the most polluted on Earth.

There are few statistics on global health impacts from waterborne chemical exposures, but there is data on fecal contamination. Diarrhea is the second-largest killer of children under five, causing about 1.5 million deaths annually, says Eric Mintz, an epidemiologist at the U.S. Centers for Disease Control and Prevention. India tops that list. Mintz notes that the younger the child, the greater their risk of life-threatening dehydration. Unsafe drinking water, sanitation, and poor hygiene are almost always to blame. In 2006, nearly one billion people lacked access to "improved" drinking water (from a municipal water supply or a deep-dug well), according to the World Health Organization (WHO). Another 2.5 billion lived in homes without a toilet.

PROBLEMS ON A HOLY RIVER

Year round, children stream through the emergency room at Varanasi's Sir Sundar Lal Hospital with illnesses that can be directly attributed to use of contaminated water, says Dr. Ashok Kumar, a pediatrician. They are treated—and quickly re-infected. "As a result, most of these children also have concomitant malnutrition, which further weakens their immunity and makes them vulnerable to more frequent and severe episodes of diarrhea," he says. They also carry waterborne intestinal parasites like cryptosporidium and giardia, which further stunt their growth and development. For many families, costs are prohibitive, so children don't get proper medical care—or come too late. >

to this sacred, 3,000-year-old city from across India each day. They sculpt altars in slick, gray mud, making offerings of flowers and candles. They pour Ganges water, pray, take a sacramental sip and immerse themselves in the turbid river for spiritual healing.

At the "burning ghats," flames consume the bodies of the dead: Hindus believe casting their remains into the Ganges guides their souls to heaven. To them, this river is the mother goddess, Ganga Ma, who washes away humanity's sins.

One of the Ganges's most vocal protectors is Veer Bhadra Mishra, a 70-year-old Brahmin civil engineer and priest of Varanasi's second-largest temple. In 1982, he founded the Sankat Mochan Foundation (SMF; Sankat Mochan means "deliverer from troubles") with colleagues from Banaras Hindu University. Their goal was to foster awareness about the causes of Ganges pollution—and to act as guardians, technical advisers and activists to spark river cleanup.

Varanasi generates over 80 million gallons of sewage daily. "The whole city's nightsoil is coming to the river," says Mishra. Output continues to rise with the burgeoning population and many of the 33 outflows along the city waterfront are adjacent to the busiest ghats. "If public health is the issue, point-source pollution from untreated sewage is over 90 percent of the problem," he says.

A lab run by SMF has monitored river water quality since 1993. Downriver, concentrations of bacteria that indicate fecal contamination sometimes top 1.5 million in a 100-milliliter test tube of water. In the U.S., beaches are closed when concentrations reach 200.

Sarai Mohana, one of many "unplanned villages" downstream, is ground zero for Varanasi's sewage crisis. It lies at the confluence of the Varuna River, where black, stinking water pours into the Ganges and methane bubbles rise from the sediment. No pilgrims come here: the village is home to some of Varanasi's poorest citizens and the river is utilitarian. Makeshift housing and crop fields dot the shoreline where cows and buffaloes graze or bathe. Fishermen cast their nets nearby, one of them, 35-year-old Nakharu Sahani lives in Sarai Mohana. His family eats fish every day, but they don't drink from the Ganges. "How could we drink this water?" he asks.

He and other residents lack both sewerage and a piped, treated drinking water supply. They draw foul-smelling, discolored water that sometimes squirms with thread-like worms from hand-pumped wells.

Sarai Mohana was included in the only published study on public use of the Ganges and health. Steve Hamner, a microbiologist from Montana State University, interviewed 104 families at four locations along the river in 2004. "Though it was a small sampling, this study demonstrated a very high incidence of waterborne disease," he says.

Socio-economic factors influence infection rates. At more affluent sites upstream where people have indoor plumbing, the waterborne illness rate over the previous year was 38 percent. Sarai Mohana had a 90 percent illness rate.

MOVES TOWARD CLEANUP

Mishra has been trying to bring cheap, algae-based sewage treatment to India since 1994. This "advanced integrated wastewater pond system" (AIWPS), developed by University of California Berkeley engineers William Oswald and Bailey Green, has been used in California for 44 years. Treated water meets stringent state standards for irrigation, discharge into a river, or for processing into clean drinking water.

Over 45 days, sewage cycles through an engineered natural system that mimics how nature deals with waste, says Green. In a series of four ponds, bacteria, algae, and sunlight ferment and break down sludge and purify the water, removing 99.999 percent of fecal coliform bacteria.

In February 2009, Prime Minister Manmohan Singh named Ganges cleanup a nation-wide priority, creating the new National Ganga River Basin Authority. The government committed \$4 billion to stop the flow of waste into the Ganges by 2020, including a \$1 billion World Bank loan. Some of that money will explore alternative technologies. Funding has been approved for a small-scale demonstration AIWPS plant capable of handling 10 million gallons of waste per day. Green's company, California-based GO₂ Water, Inc., and SMF submitted a detailed project design to the government in February. The plant could be up and running by 2011, Green says.

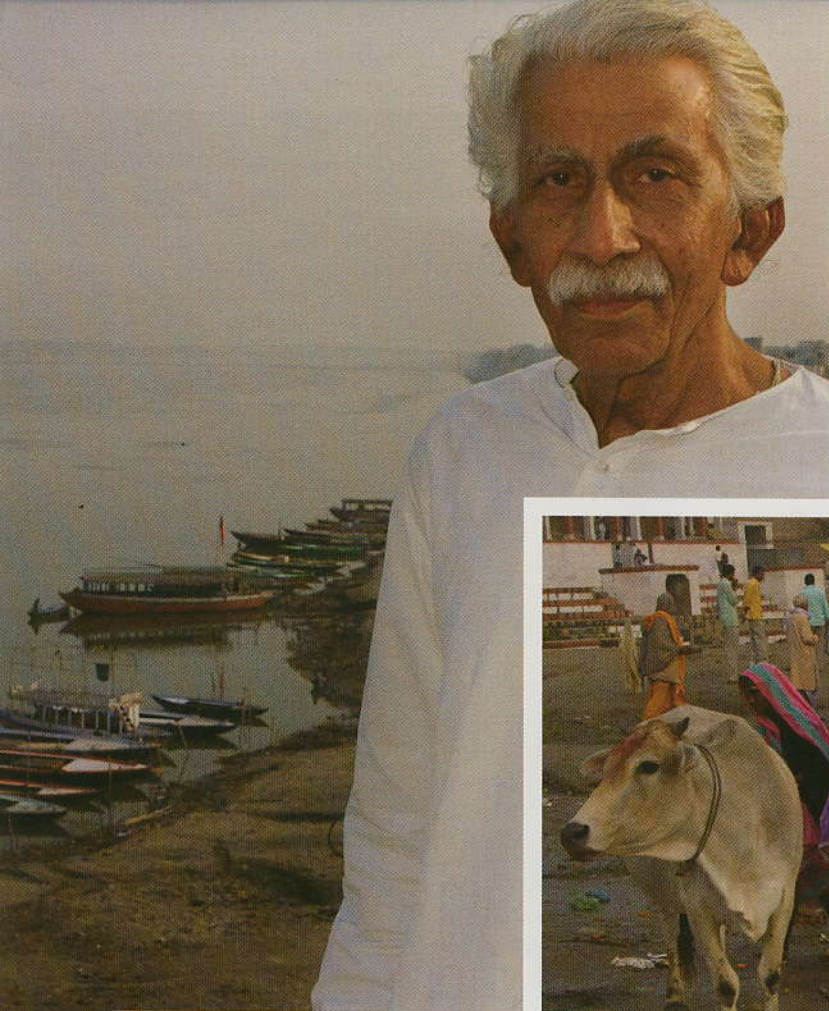
If approved, it would take another five years to design and build a second, larger AIWPS plant just below the city. This energy-efficient plant will be fed by a new sealed,

**"IF PUBLIC HEALTH IS THE ISSUE,
POINT-SOURCE POLLUTION FROM
UNTREATED SEWAGE IS OVER
90 PERCENT OF THE PROBLEM."**

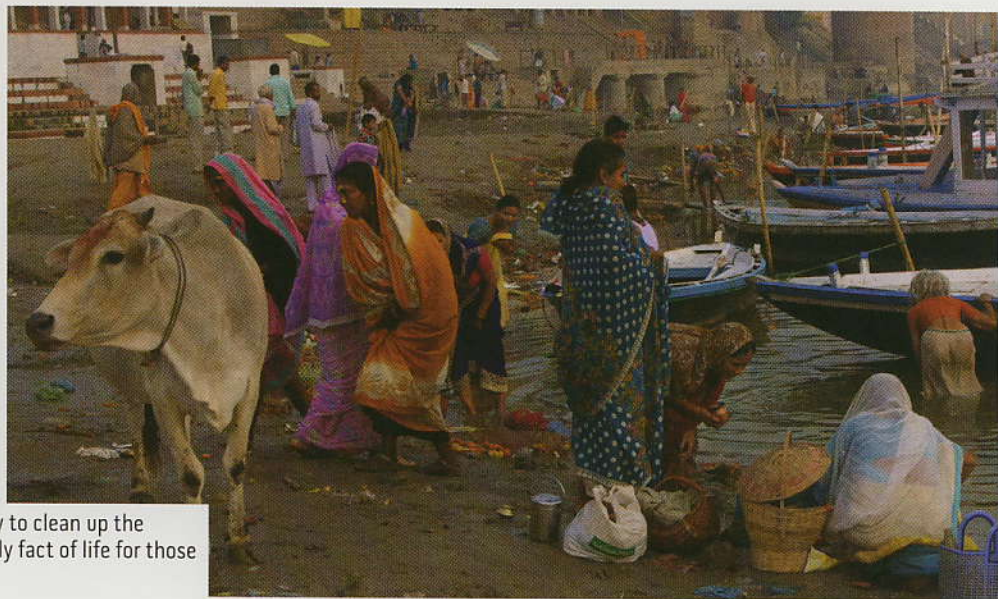
—Veer Bhadra Mishra

gravity-driven interceptor sewer system that flows downhill, requiring less electricity. It could handle the entire city's sewage flow.

In 1985, Mishra's battle to clean up the Ganges helped attract the attention of Rajiv Gandhi, who launched the Ganga Action Plan (GAP). As part of that initiative, the government built a traditional wastewater treatment for Varanasi using what Green considers "conventional, energy-intensive technology developed for cold climates." The system is ill-suited to the tropics: it requires continuous electricity in a country plagued by constant outages—and when monsoon rains overwhelm pumping stations, sewage never reaches the treatment facility and gushes into the Ganges. The plant treats less than a quarter of the current sewage output.



▲ Veer Bhadra Mishra has worked tirelessly to clean up the Ganges yet waterborne disease remains a daily fact of life for those washing in and drinking from the great river



Most importantly, the process fails to remove pathogenic organisms that end up back in the river. Local farmers also use “treated” effluent to irrigate crop fields, contaminating nearby shallow tube wells.

According to a government audit report, GAP spent an estimated \$200 million (901 crore rupees) between 1991 and 2000. For years, officials argued they had met GAP objectives despite empirical evidence that the Ganges grows ever-more polluted. “To put it simply, the plan failed,” Mishra says. “The river has never been close to healthy.”

In 1997, SMF’s proposal for construction of an algae pond system and gravity interceptor sewers was unanimously approved by the city. After the state government scuttled the plan, a subsequent lawsuit languished in the highest court for over a decade.

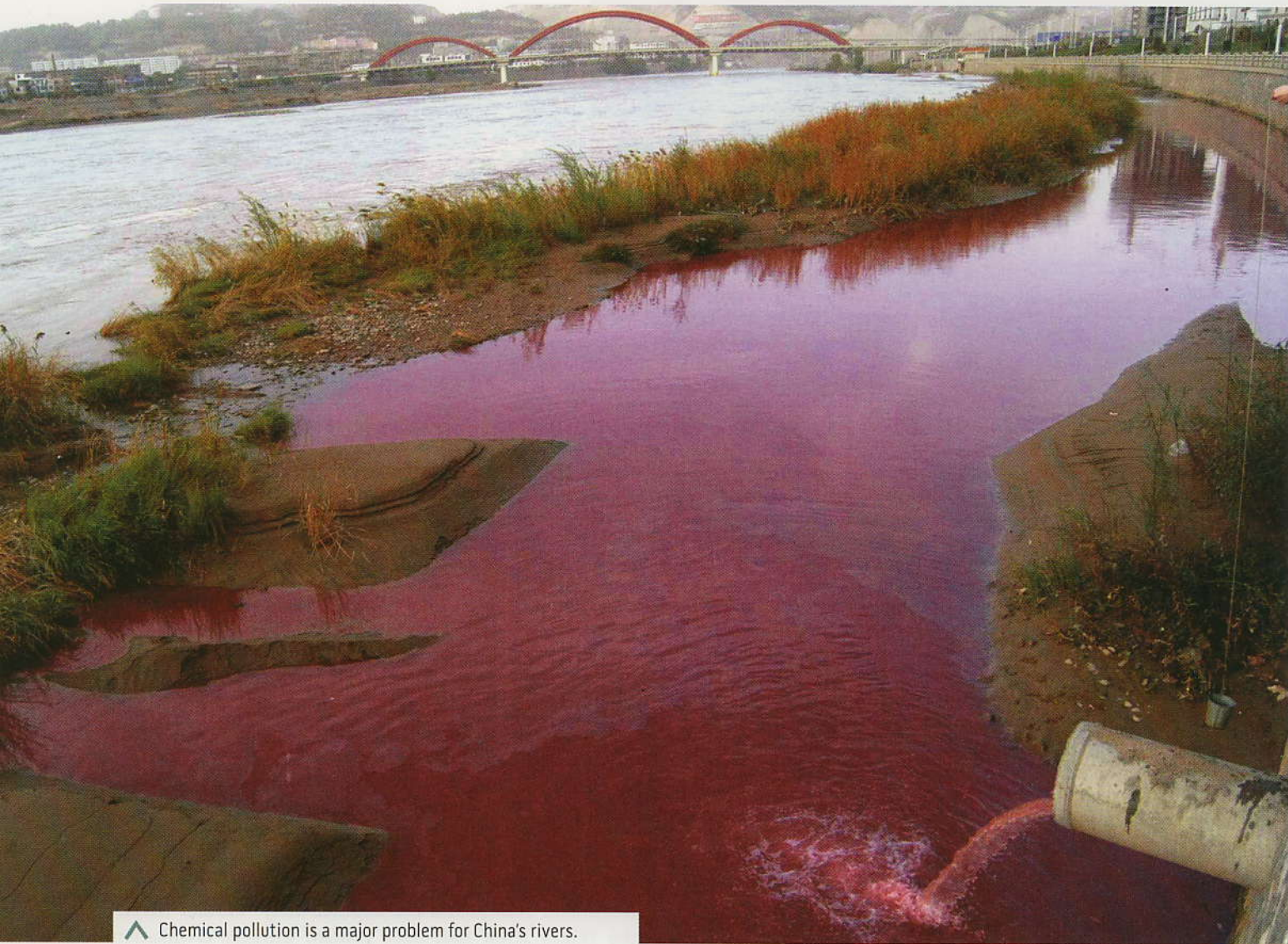
Until new infrastructure is built, the 40 percent of India’s population that lives in the Ganges river basin will be exposed to waterborne pathogens. Many will get sick; some will die. In-home solutions like water filters, single-dose chlorination and UV disinfection could act as temporary band-aids to purify drinking water. But the only way to curb the transmission of waterborne disease is through effective sewage treatment and access to clean drinking water, says Mishra. “We have landed on the moon and cannot do this?” he asks. -

THE RED-BROWN YELLOW RIVER

Northwest across Asia lies another dirty “Mother River,” the Yellow River that once cradled Chinese civilization and remains the country’s spiritual home today. It snakes through 3,000 miles of mountains, plains, and farmland, past dams, factories and cities before emptying into the Bohai Sea. Some years, the mouth of the river runs dry. Though 140 million rely on it for water, certain sections run brown or red, and three-fifths of the river is too toxic for human contact. And no wonder: as of four years ago, over half of China’s 21,000 chemical plants sat on the banks of the Yellow and Yangtze rivers.

In Liangjiawan, a small, blue-collar and farming community, residents unknowingly drank untreated Yellow River water for a few years. Their water treatment plant had malfunctioned and pollutants concentrated when a new dam was built nearby. Villagers were dying of myriad cancers: pancreatic, brain, stomach, and liver. Public outcry led by Green Camel Bell, a local NGO, has sparked construction of new treatment facilities.

Across the country, three decades of double-digit economic growth have drained rivers at the same time flooding them with noxious chemicals. Unbridled rapid industrial development often has serious environmental consequenc- >



▲ Chemical pollution is a major problem for China's rivers.

es, including carcinogens in the water, said Hisashi Ogawa, the WHO's Western Pacific regional adviser on environmental health. Despite billions of dollars spent on cleanup, lax enforcement has left 40 percent of China's rivers undrinkable, according to a 2006 State Environmental Protection Agency (SEPA) report.

But last February, the government unveiled new data. With long-ignored agricultural chemicals factored in, water quality was twice as bad as previously reported.

Some 90 million Chinese—one in 14—must drink, bathe in, or cook with water so noxious that the World Bank warns of potential “catastrophic consequences for future generations.” Hundreds of so-called “cancer villages” cluster on polluted shorelines. Some communities suffer staggering rates of spontaneous abortion, birth defects, diminished IQs, and other maladies, says Elizabeth Economy, director of Asia Studies at the U.S. Council on Foreign Relations.

The statistics make grim reading. The WHO estimates that 22 percent of deaths in China stem from environmental

causes. A 2007 government report blamed alarming jumps in cancer incidence on air and water pollution: 19 percent in cities and 23 percent in the industrialized countryside. Last year, a Fudan University study noted a serious public health risk from lead, mercury, chromium, cadmium, and arsenic. However, there is little hard data on health impacts. “No systematic epidemiological studies have been conducted proving links between industrial pollution and disease,” says Yok-shiu Lee, a University of Hong Kong urban planning professor.

FIGHTING BACK

With high medical costs and few practitioners in rural areas, many patients don't get care or are buried in debt. The government is currently in the midst of health reform.

Citizens are becoming acutely aware of the growing health crisis. Headlines chronicle frequent industrial accidents, new cancer villages, hundreds of lead poisoning cases, and more. Beginning in 1997 the State Council pushed the mostly-state-

© CHINA DAILY/REUTERS/CORBIS

owned media to report on environmental issues. But information-gathering is often hampered by local officials with entrenched economic interests, and there is very little oversight and massive corruption, says a health researcher who requested anonymity.

Information now spreads over the Internet, on blogs and in chat rooms, though many people are still hesitant to speak openly. In 2006, former journalist Ma Jun built an online water pollution map now consisting of 58,000 records

OVER TWO AND A HALF YEARS, 53 PEOPLE FROM QUIGANG— A VILLAGE OF 2,000 PEOPLE— DIED OF CANCER, INCLUDING A TODDLER.

on more than 30,000 domestic and foreign companies. His Beijing-based Institute of Public and Environmental Affairs compiles official statistics and grassroots monitoring into a searchable database. This data has shamed a few multinationals into leaning on their polluting Chinese suppliers.

About 3,000 registered environmental organizations have sprung up since the first was formed over a decade ago. Today, NGOs are activist groups that bring government and public attention to environmental issues, though they still must operate carefully within political constraints. Some educate the public about their rights. Some press for government action. Others file lawsuits against polluting industries. Without media attention or support, most pollution victims, many of whom are poor and uneducated, have little recourse.

Green Anhui is one of these activist groups. They fight for the Huai River Basin, which ranks with the Yellow, Ao, and the Yangtze as among China's most polluted. The "ugly river" and its tributaries are riddled with factories—and health problems. Over two and a half years, 53 people from Quigang—a village of 2,000 people—died of cancer, including a toddler. Children who attended a riverside school were vomiting and suffered from nosebleeds, dizziness and diarrhea. Water quality tests were sabotaged and villagers who spoke out were beaten, according to a Woodrow Wilson Center China Environment Forum (CEF) report.

Green Anhui stepped in, focusing press and government attention on three chemical plants in nearby Bengbu. The plants were dumping benzene and other toxics into the Huai's Baojiagou tributary in alarming quantities. It took two years to shut them down. This model is now being used in other locations, says Xiu Min Li, co-director of Pacific

Environment's China Program, Green Anhui's California-based partner.

Even skin contact with benzene can trigger anemia, nervous system or reproductive damage, leukemia and other ills. Over a hundred tons of benzene, aniline and nitrobenzene spilled into the Songhua River when a petrochemical plant exploded in Jilin Province in November 2005. Since the river straddles the Russian border, the ensuing government cover-up caused international embarrassment and internal scandal. Xie Zhenhua, then-head of China's environmental protection agency stepped down and a vice-mayor, Wang Wei, committed suicide.

The disaster focused public attention on the magnitude of the nation's water pollution crisis. "The Chinese government now sees water as their most important environmental issue," says CEF director Jennifer Turner. Laws have become more progressive, she says. She ticks off a list of gains: stronger environmental impact assessment laws, mandatory reporting of industrial pollution levels, greater public access to environmental information, and growing citizen protests. *China Daily* reported that roughly 50,000 environmental protests broke out in 2005; uprisings have continued.

Companies and government officials can now be brought up on criminal charges for water pollution violations. Fines and penalties are higher. "People are being told they have the right to complain, to take cases to court, and the laws are making it easier to do so," says Turner.

Although more cases are being tried, there are few victories for pollution victims. But last year, in a landmark ruling, the head of Biaoxin Chemical Co. Ltd. was sentenced to 11 years in prison for "spreading poison."

Implementation remains scarce. A Greenpeace China report found that few large companies were disclosing pollution data and government agencies fail to enforce the disclosure requirement.

Great distance remains between the laws on the books and enforcement on the ground, says Vermont Law School professor Jingjing Liu. Turner agrees, but she's optimistic. She believes that the health impacts from deadly pollutants, water scarcity and growing public pressure will catalyze stronger environmental governance.

With rising populations in China, India, and the developing world, the old adage that "the solution to pollution is dilution" no longer holds true. "When you combine multi-point pollution, chemical industrial runoff, lack of infrastructure to clean the water at all, and poverty, you have a recipe for a health crisis as great as any pandemic in our history," says Maude Barlow, U.N. senior adviser on water.

Mishra couches it differently. "The Mother is sick and needs our help," he says. ❧