

[P]eople satisfying their needs by means of a modest use of resources are obviously less likely to be at each other's throats than people depending upon a high rate of use.

E.F. Schumacher
Small Is Beautiful (1973)

INTERNATIONAL HEALTH

Reporting from Bangladesh

Bangladesh is a land of extremes. Home to an estimated 140-plus million people, it is among the most overpopulated and impoverished countries in the world. Its climate produces flooding in the monsoon season and severe droughts in the dry season. Bangladesh is also home to many species of wildlife that are on the verge of extinction. Few countries bespeak such a precarious balance between humans and the natural environment, and despite measures taken by the Bangladeshi government in recent years, the natural resource base continues to deteriorate, concludes the Bangladesh *State of the Environment* report.

The United Nations Environment Programme (UNEP) began preparing this and other national and regional *State of the Environment* reports in 1999, in response to recommendations issued in Agenda 21, an international plan of action that was reaffirmed most recently at Earth Summit 2002 in Johannesburg, South Africa. Produced by the Bangladeshi Department of Environment and the Bangladesh Centre for

Advanced Studies (BCAS), with financial support from UNEP, the report is the most comprehensive environmental checkup to date for this poverty-stricken nation.

"[D]egradation of the natural resource base and of the environment in Bangladesh started with various human and economic development activities, before adequate mitigation measures were considered an integral part of the development process," the report states. "The major thrust of government policy remains towards poverty alleviation through employment generation and economic growth, and little has been achieved in integrating environmental protection."

Five key environmental issues are identified as crucial to the future sustainability of Bangladesh: land degradation, water pollution and scarcity, air pollution, biodiversity loss, and the threat of natural disasters. Recognizing the interrelationships of these issues led the report's authors to adopt a holistic perspective.

Mozaharul Alam, a BCAS research fellow who participated in the project from its earliest inception, cites the example of land degradation, which results in biodiversity losses as well as a heightening of ecosystem vulnerability to the ravages of flooding. "We cannot adequately deal with natural disasters without also addressing land degradation,"

says Alam. "Ongoing wetland losses and deforestation have made us more vulnerable to natural disasters." Deforestation results in topsoil losses and increased siltation; as riverbeds become more silted, the rivers themselves become more swollen and prone to flooding. Approximately 50% of the country's total land surface is wetlands, which have been drastically affected by the burgeoning human population.

Unlike more descriptive methods used in the past, this report uses standardized monitoring and assessment methods developed by the Organisation for Economic Co-operation and Development. "This methodology involves an analytical framework that enables us to effectively prioritize and assess key environmental concerns," says Alam. "It also helps us identify possible remediation and management strategies in a holistic manner." For example, the report proposes an integrated approach to water management that targets policy issues related to agriculture, energy, fisheries, forestry, industry, land use, protection of the drinking water supply, and wetlands preservation.

BCAS executive director Atiq Rahman says that, although the report integrates wide-ranging opinions of institutions and key individuals, a number of dominant inter-related issues were not adequately addressed. These include poverty alleviation, demographic factors, and resource depletion. "The missing link has been the mechanisms of institutional linkages, and [linkages] between different sets of actors," says Rahman.

Feroze Ahmed, a professor of civil and environmental engineering at Bangladesh University of Engineering and Technology, further notes that, although the key issues identified generally reflect the areas of concern in Bangladesh, the report is weak in its lack of up-to-date data and inadequate analysis of available information. Most of the data presented predate 1995, even though more recent environmental studies on water and air pollution and arsenic contamination were available from various sources. These recent studies are important because of the urgency they carry: Ahmed says that arsenic contamination of groundwater in the country is so widespread that 49 million people currently drink tubewell water with arsenic exceeding the World Health Organization guideline value of 10 micrograms per liter. "The possible long-term health risk of ingestion of excessive inorganic arsenic through drinking water is alarming," he says. —M. Nathaniel Mead



Precarious balance. In a land of extremes, an integrated approach to managing resources is critical.

NATURAL RESOURCES

Groundwater Problems Spring to the Surface

Mankind's actions are noticeably harming groundwater resources worldwide, according to a recent report by the United Nations Environment Programme (UNEP). Across the globe, states *Groundwater and Its Susceptibility to Degradation: A Global Assessment of the Problem and Options for Management*, groundwater is being depleted by the demands of megacities and agriculture, while fertilizer runoff and chemical pollution threaten water quality and public health. By 2025, two-thirds of the world's population will live in a nation that is considered water-stressed.

The report is important because it demonstrates that groundwater issues, although often specific to a particular watershed, affect people worldwide, says Susan Seacrest, president and founder of the Groundwater Foundation. Besides those resources that are locked in glaciers and ice caps, groundwater accounts for about 95% of the earth's fresh water. According to the report, groundwater supplies drinking water for up to 2 billion people and 40% of the irrigation water used in agriculture; still more is used for industrial and other uses.

One major issue affecting groundwater is salinization, according to the report. Salinization often occurs as a result of poor irrigation (in which natural salts are forced through waterlogged soil into the aquifer) or the encroachment of seawater into aquifers (which can be exacerbated by overextraction of groundwater). Just a small amount of intrusion—around 6% salinity—renders water unfit for any purpose except cooling and flushing, the report notes, and remediation technologies are expensive and often beyond the reach of many developing countries.

In the introduction to the report, UNEP executive director Klaus Töpfer calls for the establishment of a global surveillance network to monitor the extent and level of aquifer pollution: "Regional observatories of aquifer vulnerability and degradation could gain valuable knowledge through the comparison of water quality conditions, and the results would be a powerful public awareness tool."

But Bill Alley, chief of the Office of Groundwater for the U.S. Geological Survey, notes that even in a developed

country such as the United States, monitoring can be difficult to sell to legislators and managers as a budgetary priority because it yields long-term, rather than immediate, benefits. The report itself says groundwater monitoring is often "inadequate and poorly focused," and that when environmental programs are scaled back, monitoring is often one of the first things to be cut.

Furthermore, once monitoring is in place in one location, it may not be adjusted as the ecologic dynamics within the watershed change. This ultimately results in less reliable data. Finally, water management is usually highly fragmented. For example, most municipalities have separate drinking water and wastewater departments, even though it all comes from and goes back to the same source. In the United States, both the U.S. Geological Survey and the Environmental Protection Agency have separate offices for groundwater and surface water management.

Options for rejuvenating groundwater resources include artificial recharge (such as replenishing groundwater with rainfall collected during wet periods) and desalinization, which Alley says is decreasing in cost although it is still expensive. However, the science and technology to support these approaches generally is available only in developed countries. Stephen Ragone, director of science and technology for the National Ground Water Association, notes that science should be shared with workers in less-developed countries so that they can gain more understanding of how to protect limited water resources.

It is important to study the quantity of groundwater and how it is used, not just the threats to the aquifer, Alley says. Groundwater and surface water needs to be looked at basin by basin in terms of how pollutants enter the system, and basic hydrogeologic principles to maintain water balance in natural systems need to be applied, according to Ragone. Alley and Seacrest say that groundwater should be included in water quality planning that is done in each watershed.

The final link in the chain of protection involves educating the public about the connection between unseen groundwater and the water that comes out of the kitchen tap, Seacrest says. This way, the public can make the connection between everyday activities and the potential that water pollution has to affect their daily lives. Contamination is hard to address once it occurs, she says: "Pollution prevention is the only viable strategy for groundwater." —Tara Hun-Dorris

Lead-Laden Snack Alert

Chapulines (grasshoppers) seasoned with chili powder and lime are a popular snack with many Mexicans. Now state and federal health departments have issued warnings against eating *chapulines* from the Mexican state of Oaxaca because many, for reasons yet unknown, contain dangerously high concentrations of the neurotoxicant lead—as high as 2,300 µg/g in some samples, or nearly six times the tolerable daily intake for a young child. The FDA recommends that parents of children who have eaten *chapulines* contact their health care provider to see if testing for lead poisoning is warranted.



Global Forum Targets Pesticide Poisonings

More than 600 delegates at the November 2003 Intergovernmental Forum on Chemical Safety agreed to implement internationally binding measures to reduce the incidence of accidental poisonings by household and agricultural pesticides. Each year, such incidents account for 3 million acute poisonings worldwide, with more than 200,000 fatalities. The new measures include potential prohibitions and restrictions on the marketing, sale, and use of pesticides that have been classified by health agencies as highly hazardous. Delegates also noted inequities between developing and developed countries in the implementation of chemical safeguards, and agreed to establish a free, publicly available international repository for pesticide hazard information. This information will also aid governments in standardizing chemical labels by 2008.

The World's Dumping Ground?

Less-affluent nations may be bearing the brunt as developed nations including the United States crack down on mercury pollution. India's Centre for Science and Environment reports that India—already known to have some of the worst rural and urban soil, air, and water pollution in the world—is rapidly becoming the site of choice for those looking to offload large stores of mercury. India is among the world's largest importers of substances for recycling purposes, and many of those imports, such as ships to be broken down, are contributing to a mercury pollution crisis. Imports of mercury/mercury compounds have increased almost sixfold over the past seven years. Methylmercury, the most commonly found form of mercury in the environment, can permanently damage the central nervous system, lungs, and kidneys, and can cause fetal brain damage with no symptoms in the expecting mother.



CLIMATE CHANGE

Global Warming Kills

We're all going to die, but climate change may increase the risk of death, according to a new report by the World Health Organization (WHO). Many important diseases that affect developing countries are sensitive to climate variations, according to the report, and even a proportionally small change in the global incidence of some diseases could result in significant public health impacts far into the future.

The authors of *Climate Change and Human Health: Risks and Responses* quantified the relative risk of death in 2030 from diarrhea, malaria, cardiovascular disease related to heat and cold, malnutrition, and flooding in several developed and developing regions. They used a WHO-developed methodology that quantifies the disease burden in 2030 based on 26 environmental, occupational, behavioral, and lifestyle risk factors. They also consulted models that forecast climatic variations over long periods in response to likely changes in the composition of atmospheric gases. Calculating from 1990 conditions, they constructed three scenarios for estimating the relative risk of disease burden from climate change: one of unmitigated greenhouse gas emissions, a second of modest emission reductions, and a third representing more rapid emission reductions.

Africa and Southeast Asia bore much of the estimated increased disease burden. The increased risk of diarrhea was as much as 10% higher in some regions than if no climate change occurred. Large increases were estimated for malaria in regions adjacent to areas already significantly affected by the disease. Under the unmitigated

emissions scenario, the western Pacific region could expect malaria to increase by as much as 83%. Temperate climates appeared to spare most of Europe from increased risk, and socioeconomic conditions protected most of the southern United States.

The greatest uncertainty in the authors' estimates stems from the lack of long-term data sets on disease rates in most regions of the world. "There are too many other influences acting over the time scale in which climate change operates," notes coauthor D.H. Campbell-Lendrum, a lecturer at the London School of Hygiene and Tropical Medicine. Still, he adds, the indication that climate change may worsen several important diseases makes it even more important to control these diseases now. "For example," he says, "provision of clean water and sanitation not only cuts overall diarrhea rates, but also decreases the importance of the bacterial pathogens that respond positively to temperature, and decreases risks of diarrhea outbreaks following floods."

The study did not include mortality estimates for many waterborne diseases affected by climate variation, broader categories of heat-related deaths, or dengue, notes Jonathan Patz, director of the Program on Health Effects of Global Environmental Change at The Johns Hopkins University. "[The report is] a great start, but I have concerns that it could be an underestimate," he says.

The authors acknowledge that their estimates are conservative. "We have left out many diseases which we would expect to be affected by climate change, usually because there are no quantitative models available," says Campbell-Lendrum. "We would expect that all diseases that show climate-associated patterns in either space or time would be affected." —Jan Gilbreath

AGRICULTURE

Anti-Insect Ozone

In attempts to control insects and the diseases they bring, farmers have relied on a variety of pesticides, many of which are highly toxic to humans. Meanwhile, insect resistance is growing. Replacement technologies are critical. Now associate entomology professor Linda Mason and colleagues at Purdue University are investigating ozone as one possible replacement.

According to the U.S. Department of Agriculture, insect damage to the nation's stored wheat crop costs some \$500 million annually; Purdue's agriculture department estimates that about 5–10% of the world's food production is lost during storage each year because of insects, with some countries losing as much as 50%. Insects such as the lesser grain borer, the red flour beetle, and the rusty grain beetle not only devour vast amounts of stored grain, but add insult to injury by defecating on the kernels, triggering the growth of fungi and molds such as *Fusarium* and *Aspergillus*. *Fusarium* infection can cause illnesses from esophageal cancer to alimentary toxic aleukia, and the aflatoxins produced by *Aspergillus* can

cause cancer and damage the brain, liver, and kidneys.

Ozone has been used to purify water, and the agricultural industry has used it to decontaminate perishable foods and disinfect manufacturing equipment, water, and packaging materials. Neither the volume nor the concentration used are high enough to contribute to environmental problems. The only breakdown product of ozone is oxygen.

Mason and colleagues filled three containers with wheat, then applied ozone at a

concentration of 50 parts per million for 30 days. The result was 92–100% mortality of a number of typical grain pests as well as fungi on the kernel surface. The study also showed that current commercial aeration systems used in grain storage are adequate to distribute the ozone freely throughout the grain mass. Subsequent studies showed similar results for other grains such as maize, popcorn, rice, and soybeans, with no degradation of flavor or nutritional value. This research was published last year in the *Journal of Stored Products Research*.

Dennis Avery, director of the research group Center for Global Food Issues, says that, while any environmentally benign approach to protecting grain is welcome, there are some potential issues. "The problem with any sort of gaseous fumigation is that storage facilities in countries that really need the protection are not designed to hold in the ozone," he says (a charge Mason counters by noting that the system does not require airtight storage). "That being said," Avery adds, "I think anything that allows us to keep insects from infesting grain with minimal risk to humans and a lower risk of pesticide resistance is very much to be welcomed." —Lance Frazer



Good news for silos. Ozone treatment could spell the end of grain pests like these rusty grain beetles.

ehpnet

TOXMAP

As more information makes its way into the popular media on the potentially toxic chemicals that are released into the nation's soil, water, and air, consumers want to find out how news reports and feature stories about chemical releases relate to their own neighborhoods and workplaces. Now they have a new tool to help them understand the data: the National Library of Medicine (NLM) TOXMAP pilot program, located online at <http://toxmap.aquilent.com/toxmap/index.jsp>.

TOXMAP uses geographic information system (GIS) technology to allow users to build maps that show in as much detail as desired the toxic chemicals released in a specific area. One primary source of the data used to create the maps is the U.S. Environmental Protection Agency's annual Toxics Release Inventory (TRI), which at last count included information on nearly 650 chemicals released by industrial facilities around the nation. TOXMAP also draws data from the NLM Hazardous Substances Data Bank and TOXLINE bibliographic database.

One of the site's newest features is Tour TOXMAP, which provides a guided overview of the site and the tools it has to offer. This section of the website also seeks to inform the NLM's plans for improving the site—for example, by asking questions about whether users would find specific types of presentations helpful—and lets users provide feedback on their visit to the site.

Getting Started With TOXMAP provides a more detailed guide to navigating the site and describes the various types of maps that users can create: releases of a single chemical within a single year; releases of a single chemical over a range of years; customized application of a combination of TRI criteria; and all facilities that have reported releases of any type. This page also elaborates on the specific steps for creating customized maps.

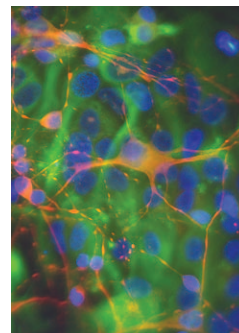
The mapping actually begins with a press of the Start TOXMAP button on the homepage. Searching by chemical name results in releases identified by volume released. A list of links to the side of the map takes users to information including human health effects, manufacturing statistics and uses, environmental fate, and pertinent public health statements. Users can also choose to identify facilities on the map by name. This produces a list of pop-up records of all the chemical releases reported by that facility. Release maps can then be overlaid with selected demographic characteristics (which have been extracted from the 1990 U.S. Census) to a county-level resolution.

Finally, the homepage offers detailed information, through About The Beta, about the statistical and technological inputs that TOXMAP is based on. The beta program has been designed to help TOXMAP developers learn about how and whether the availability of GIS capabilities helps users make better use of the data. Users are invited to critique the site as well as participate in a more formal feedback group. —Erin E. Dooley



Lead Shows Differential Effects on Stem Cells

Unpublished new findings by neuroscientists from Philadelphia's Jefferson Medical College reveal that prenatal exposure to low lead concentrations may affect brain cell differentiation. In studies presented at the 2003 Society for Neuroscience annual meeting, the team exposed rat neural stem cells to lead concentrations correlating to levels lower than those deemed safe for human exposure by the CDC. The exposure significantly inhibited neural stem cells from differentiating into neurons or oligodendrocytes, but enhanced their ability to become astrocytes. Thus, lead may differentially affect development of stem cells from different brain regions. Says team member Jay Schneider, "We think our results could indicate that early in development, the presence of lead could significantly affect the development and organization of the fetal brain."



New CDC Center for Public Health Law

The CDC recently announced funding to establish a second Center for Public Health Law at the University of Louisville. The new center will work collaboratively with the Georgetown University/Johns Hopkins Center for Public Health Law to develop educational programs for public health officials, law enforcement personnel, attorneys, and judges.

Center director Mark Rothstein notes, "Most of the legal work involving public health is performed by professionals who do not specialize in public health law." Center staff hope to help legal practitioners meet the changing face of health law with innovative legal strategies for protecting public health.

Green-e for Savvy Shoppers

The nonprofit Center for Resource Solutions has launched its new Green-e logo as a way to help energy-conscious U.S. consumers make informed purchasing choices. Under the voluntary certification program, manufacturers may use the logo on any product created using a portion of certified renewable electricity, among other requirements. Currently, 98% of U.S. electricity comes from nonrenewable sources. A number of companies, including food and beverage producers and textile makers, are already taking steps to use the new logo in the marketing and packaging of their products.

