

WORLD·WATCH

Volume 23, Number 1


Vision for a Sustainable World

January/February 2010

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Greenwashing Hydropower

- » Climate Change and Security
- » Drawing Carbon Out of the Air
- » More on Transforming Capitalism

LIFE-CYCLE STUDIES

Dry Cleaning

Overview

The dirty business of laundry has long sought improvements over old-fashioned soap and water. The Celts washed their clothing in human urine. The launderers of ancient Rome rubbed a claylike soil known as “fuller’s earth” into their stained togas. During the Renaissance, books of “secrets” circulated through Europe, offering such household stain-removal concoctions as walnuts and turpentine.

Modern dry cleaning is credited to a Frenchman, Jean-Baptiste Jolly, who in the mid-19th century realized the stain-removal potential of kerosene when his maid accidentally spilled a canful onto his soiled tablecloth. Hydrocarbon-based solvents prevailed thereafter until the 1960s, when flammability concerns and the affordability of new synthetic chemicals led to a switch. Tetrachloroethylene, also known as perchloroethylene (“perc”), became the preferred solvent among most of the world’s dry cleaners.

An estimated 180,000 dry cleaners worldwide are believed to use perc. More than 30,000 small- and large-scale operations are based in the United States alone. The rise of service economies in the developing world will likely increase demand for dry cleaning, although many countries are shifting toward more casual office dress codes.

Mitigation and Alternatives

Advances in dry cleaning machinery have led dry cleaners in the United States to cut their solvent use by 80 percent in the past decade, according to the Dry Cleaning and Laundry Institute. Still, the U.S. Environmental Protection Agency estimates that the country’s dry cleaners released some 10,000 tons of perc in 2006.

The European Union, Australia, and Canada have implemented regulations to further limit perc releases and minimize its use. California has passed the only perc phase-out, requiring that dry cleaners transition to alternatives by 2023, but many large dry cleaners have avoided regulation by moving their operations to Mexico.

About half of garments dry-cleaned with perc may instead be cleaned with a process known as “wet cleaning.” The technique combines old methods (biodegradable soap and water) with new technologies such as computer-controlled dryers and stretching machines. Another alternative, immersion in liquid carbon dioxide (CO_2), has been commercially available for the past decade. The Union of Concerned Scientists considers the process beneficial to the climate: The CO_2 is nearly all recaptured, and it requires less energy than traditional dry cleaning.

Consumers seeking alternatives can also remove many stains with household substances such as baking soda, hydrogen peroxide, or cornstarch.

—Ben Block



Kippit

Process

The typical dry cleaner uses a combined washing machine/clothes dryer. A rotating stainless-steel basket holds the laundry while a circulating outer shell sprays solvent throughout the clothing. The machine extracts the solvent, recovering nearly all of it for further use.

Although much of the perc is recycled during dry cleaning, some solvent inevitably evaporates into the surrounding air. The cleaning process also leaves a sludge-like byproduct that contains solvent residue, and only a relatively small portion of this is properly treated; most is mixed with other waste products and burned in incinerators and cement kilns.

The International Agency for Research on Cancer

classifies perc as a probable human carcinogen. Those who work in or live near dry cleaning facilities are exposed to various cancer risks, according to the World Health Organization, including bladder, throat, and lung cancer. Damage to the liver, kidneys, nervous system, and memory is a threat as well, according to the U.S. National Institute of Occupational Safety and Health.

Perc pollution contributes to the formation of smog. The toxin can also accumulate in water resources; U.S. Geological Survey hydrologists have detected perc at measurable concentrations in nearly 1 in 10 tested wells drawing on major aquifers across the country.

Shanghai Cobber Laundry Co., Ltd.



Perc-based dry cleaning machine.

Shanghai Cobber Laundry Co., Ltd.



Same machine from the back.

WORLD·WATCH

Volume 23, Number 1

Vision for a Sustainable World

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FEATURES

8 GREENWASHING HYDROPOWER

Big dams are still being built—and still wreaking havoc.

BY AVIVA IMHOF AND GUY R. LANZA

18 CLIMATE OF RISK

Climate change poses new challenges to security policy.

BY MICHAEL RENNER

24 RECARBONIZING THE EARTH

Shovel-ready ways to draw carbon out of the air.

BY RICHARD J. BLAUSTEIN

29 TRANSFORMING CAPITALISM: WORKER-OWNED BUSINESS, OR EXPANDING THE NON-PROFIT SECTOR?

A rebuttal to David Schweickart.

BY HUNTER LEWIS

COMING UP...

- » URBAN AGRICULTURE POTENTIAL
- » GEOENGINEERING THE CLIMATE
- » TOILET PAPER FUNDAMENTALS
- » WHATEVER HAPPENED TO BIOMIMICRY?

DEPARTMENTS

2 FROM READERS

On stuff, capitalism, and population.

4 EYE ON EARTH

Bike-congested Copenhagen; European offshore wind development slowed; climate change likely to worsen hunger; U.S. public still not convinced about climate change; river deltas sinking worldwide; Madagascar political troubles undermine conservation.

7 UPDATES

15 VITAL SIGNS

Coral Reefs under Threat

16 TALKING PICTURES

Three Gorges Dam

32 MATTERS OF SCALE

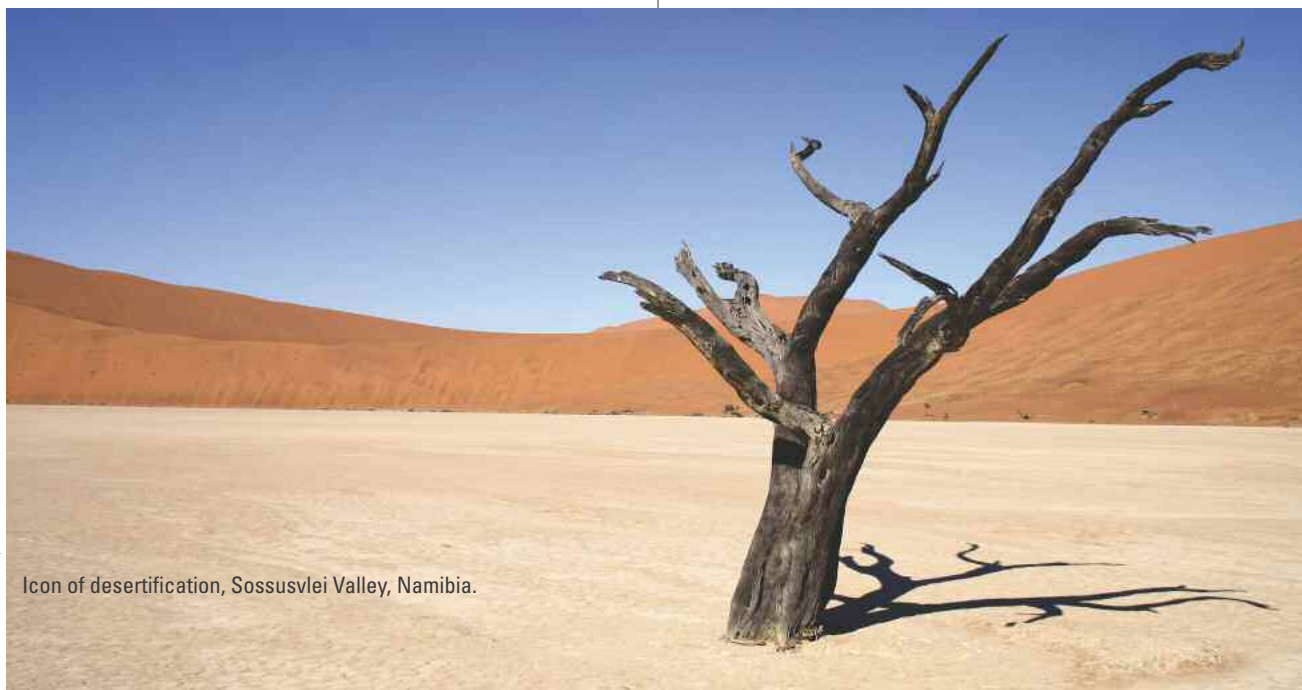
Wasteland

Front cover photograph: Three Gorges Dam under construction, Hubei, China. © Construction Photography/Corbis



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► Stuff, Capitalism, and Population

I really enjoyed the “Less Stuff, or More Blood” article in the September/October issue. I totally agree that eco-efficiency improvements by themselves are not enough to make the math of sustain-

ability work over the next 30–40 years, as Tom Prugh explained so well. Prugh also pointed out that the math at the general scale is a gross generalization of problems at the regional or local level, which will always be much worse in some regions than others. As David Schweickart stated in his article, “A New Capitalism—or a New World?” [same issue], there is more suffering going on today in many parts of the world due to war and starvation than most of us will ever experience in our lifetimes.

Along these lines, I think it is helpful to consider current resource issues and conflicts as well as potential crises in the future. Staying connected to the present helps me to feel less overwhelmed and to be more optimistic. I personally feel much happier when I take a slightly optimistic attitude, and when I feel that I can do something to contribute toward making the world a nicer place.

Getting back to consumption choices and habits, I agree with Prugh that focusing on energy and meat consumption makes a lot of sense. In particular, I think we should focus on reducing our consumption of red meat, which typically requires much more grain inputs and generates much more greenhouse gas emissions per pound than poultry or farm-raised fish. And within the category



Room for more: Bicycle commuting in Portland, Oregon.

of energy consumption, I think it is especially important to focus on oil products (gasoline and diesel). Several wars have already been fought over oil, including the 2003 U.S. invasion of Iraq. Despite other weak justifications provided at the time, oil was definitely a huge driver in the neo-conservative strategic thinking that led to the war. If there are other wars over resources in the future, oil would be the most likely candidate. One need only look at military posturing in the world today. For example, “U.S. interests” in the Middle East are the primary reason why the U.S. “defense” spending is so outrageously high, accounting for 48 percent of the world’s total military spending. (By comparison, U.S. oil consumption is “only” 22 percent of total world consumption.)

Therefore, reducing our personal gasoline or diesel consumption should be the highest priority in terms of reducing future bloodshed over resources, especially for Americans. As we consider our transportation choices, we could think, “Today I will ride my bike or take the bus/train, as a small contribution to world peace.” Or, “as my contribution to world peace, I will adjust my lifestyle to get by with one fuel-efficient car for my family.”

By discussing the connections between consumption and potential

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armed conflicts, many thoughtful/concerned citizens may be motivated to do something about their own habits. (Obviously, many others will not be so easily convinced.) Prugh's article is an excellent start in this direction. Slogans like "less oil consumption, more peace and happiness" could eventually catch on.

NEIL KOLWEY
Boulder, Colorado, U.S.A.

► I applaud your article "Less Stuff, or More Blood," which talks about the need for overturning the consumptive lifestyles and flawed economic thinking pushed forward by developed countries.

I raised exactly all the issues you have raised at the recent World Water Week in Stockholm. There was so much talk there about climate change mitigation and adaptation—how water needs to be factored into the climate talks and so on. But no one came to the crux of the issue, which is a consumptive lifestyle based on a fatally flawed economic system.

The poor fisherman in Bangladesh does not have a car nor an air conditioner. He does not even have an electrical appliance. Yet it is he and his family who will bear the brunt of rising sea levels caused by climate change—a consequence of the consumptive lifestyles of the developed countries (and copycat developing countries).

Are the people in developed countries ready to reduce their resource footprints? Will they move into smaller houses which require less heating, or shift to vegetarian diets which need less water, or adopt simpler/more austere lifestyles?

As long as they continue to consume, the factories of the world will produce the goods they need. Energy, food, water, land—all natural resources of the Earth will continue to be sucked out. Small, incremental lifestyle changes will not help to face the cataclysmic challenges that lie ahead.

I do hope that voices like yours (and mine) will be heard.

SAHANA SINGH
Editor, Asian Water, Singapore

► Just read your very thoughtful article ["Less Stuff"] in the latest *World Watch*.

Seeing the environmental situation as coming down to a choice between sending our children to die for us or getting real about the problem is an apt way of stating things. Blunt but true. Thanks for doing this. The fact of your doing it puts you and the magazine right on the line.

I also liked very much the article on doing away with capitalism ["A New Capitalism—or a New World?"], by David Schweickart, a person of whom I'd not heard previously. His ideas about moving toward cooperative models of economy are very close to my own thinking in this area, on which I spent much time 20 or so years ago. I wish he'd pressed the idea of turning extant corporations into consumer/worker-owned and -controlled cooperatives, since this points to a vision of how people in extant companies can begin to get some leverage both within the companies and via legislation. I'm inclined to agree with Kovel's thesis that it's either get rid of capitalism or the death of the species. If the U.S.A., in its commitment to capital, stays on the path of sending our young to kill to save our way of life, eventually there'll be the nuclear holocaust that will also be the final ecological crisis for our species. We humans keep flirting with this. Added to your piece and the one on capitalism needs to be an emphasis on nonviolent methods for dealing with conflict, not for ideological reasons but out of pragmatic necessity. There's a Chinese proverb to the effect that if we don't change direction we'll end up where we're headed.

LEROY MOORE
Boulder, Colorado, U.S.A.

► David Schweickart's ideas for a democratic economy are interesting, but unlikely to be implemented in the near term. However, he too quickly dismisses the possibility of sustainability within a capitalist system, based on his idea that investors in a capitalist system demand constant growth, and will fail to provide investment capital without that opportunity, leading to contraction and job losses.

In fact, profitable companies can, and often do, provide an adequate return to

investors without growth. A properly structured industry allows participants to earn a sufficient margin on sales to pay labor costs, replace worn equipment, and pay a return to investors in the form of dividends. A company in an industry not subject to dramatic technological change can exist in this way indefinitely, providing jobs but not growth, without requiring additional investment capital. When technology does advance, requiring new enterprises to replace the old, investors will provide the necessary capital for start-up, without the need for constant growth, as long as an adequate cash-on-cash return can be expected.

We will need several adjustments to our economy to achieve this kind of prosperity without growth, but the most fundamental change needed is population stabilization. As long as our population grows, we will need unsustainable economic growth to support it. Unfortunately, a broad alliance against population stabilization remains in control of policy, including business conservatives who want growth to enhance their wealth, religious conservatives who favor human expansion and oppose birth control, and liberals opposed to restrictions on migration or reproduction on human rights grounds. If we can not break this unintended alliance, sustainability cannot happen.

WALTER BRANSON
Newton, Massachusetts, U.S.A.

Editor's Note: *Mr. Branson was not alone in taking exception to David Schweickart's arguments. See page 29 for a rebuttal from Hunter Lewis, an investment banker, active environmentalist, and author of Are the Rich Necessary? and other books.*

TALK TO US!

Please include your home town, country, and phone number (not for publication). Letters may be edited for clarity or brevity. Send them to: tprugh@worldwatch.org

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Editor, *World Watch*
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by Ben Block

Bicycle-Friendly Copenhagen Tries to Ease Crowded Lanes

As Denmark's capital city strives to reach cycling rates of 50 percent, transportation officials face a problem that few urban areas have had to confront: bicycle congestion. In the Copenhagen metropolitan

area, where more than a third of residents pedal to work, more cyclists are complaining that cramped lanes push them closer to cars or buses.

The Danish Transport Research Institute estimates that 47 percent of cyclists feel unsafe riding on Copenhagen streets, up from 40 percent a decade ago. The rising insecurity comes even as serious cycling injuries in the city have plummeted, from 252 in 1996 to only 92 in 2006. Bike-related fatalities have dropped from six in 2006 to five in 2008 and none as of September 2009.

Copenhagen has set a goal that 80 percent of residents should feel safe biking in traffic. To achieve

this target, planners are redesigning intersections and particularly congested bike lanes, as well as adjusting traffic lights on bike-heavy roadways to enable high-speed cyclists to pass unimpeded—a measure known as a “green wave.”

Yet despite cycling's lower emissions, few Copenhagen bike commuters have foregone cars out of a desire to reduce their carbon footprint, according to Lasse Lindholm, a campaign officer with the Department of Traffic's cycle program. “Less than 1 percent of Copenhageners say they bike for the environment,” he said. “They do it because it's easy and it's fast.”

About 20 percent of trips in Denmark and Germany are made by bicycle. Ridership is slightly higher in the Netherlands and China, at an estimated 30 percent and 50 percent, respectively.



Mikael Colville-Andersen

Bicycle rush hour in downtown Copenhagen.

European Offshore Wind Projects Confront Challenging Seas

Offshore wind energy developers in Europe have found that mastering turbulent seas and harsh weather is more difficult than many expected, especially as facilities are built farther from the coast and rely on larger turbines.

Denmark's Horns Rev 2, the world's largest offshore wind project, was inaugurated last September after two months of weather delays. The London Array, an even more ambitious 1 gigawatt project, is still on track but has neared financial ruin on several occasions. Alpha Ventus, Germany's first offshore wind farm, went on line last summer after a year of delays that led the project's budget to balloon.

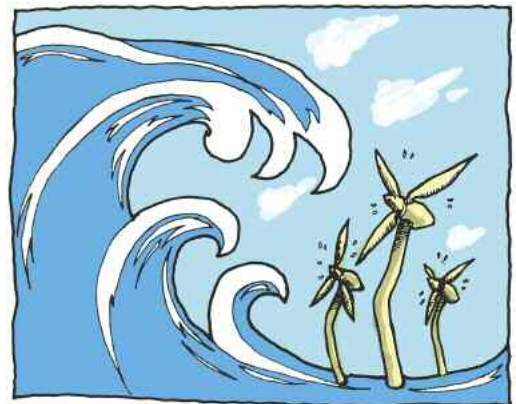
“There should be offshore wind by now, but it isn't there yet,” said Malte Kreutzfeldt, environment editor of the

German newspaper *Die Tageszeitung*. “It turns out it's a lot more expensive than people thought, a lot more complicated.”

Despite the setbacks, several European governments are betting on offshore wind power. Denmark plans to expand its existing 825 megawatts to more than 3 gigawatts by 2025 as part of its push to have wind power supply at least half the country's electricity consumption by then. The United Kingdom has proposed 14 gigawatts of offshore wind by 2020, and Germany has set a goal of 25 gigawatts by 2030.

Seven offshore wind farms were built in Europe in 2008, with a combined capacity of

1.47 gigawatts. The European Wind Energy Association expects offshore wind to reach 2 gigawatts continent-wide this year and projects an additional 1 gigawatt in 2010—to total some 0.3 percent of European Union electricity demand.



Jim Suk

Climate Change Will Worsen Hunger, Study Says

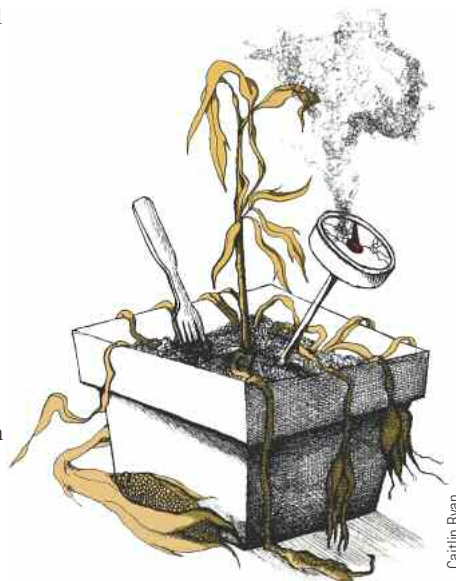
Climate change is expected to lower grain yields and raise crop prices across the developing world, leading to a 20-percent rise in child malnutrition, according to a September study from the International Food Policy Research Institute (IFPRI). The study was the first to combine climate and agricultural models to measure the effects of climate change on the global food supply.

Higher temperatures are expected to reduce some crop yields, allow damaging weeds and insects to spread, and shift precipitation patterns worldwide. While some agricultural regions are expected to benefit from climate change, overall production will decline for the world's rice, wheat, maize, millet, and sorghum harvests, the report said.

Most severely affected will be the wheat-growing regions of South Asia, Europe and Central Asia, and sub-Saharan Africa, where production is projected to decline by 46, 47, and 35 percent, respectively. Also under threat are Middle Eastern rice paddies, where production

is expected to fall by 36 percent.

The regions that would benefit from climate change would experience relatively smaller changes. The analysis estimates that wheat production in Latin America will grow by 13 percent and that millet production will increase in the East Asia and Pacific region and in Latin



America and the Caribbean, by 6 and 8 percent, respectively.

The expected changes vary for irrigated and rain-fed fields. Irrigated rice yields are projected to decline by more than 16 percent in developing countries, whereas rain-fed rice would decline by less than 1 percent. Likewise, irrigated wheat yields are projected to decline by more than 31 percent in developing countries, and rain-fed wheat would increase by more than 1 percent.

Rising concentrations of greenhouse gases may, however, encourage some plants to waste less water and grow more quickly, a process known as carbon dioxide fertilization. If so, the total calories available in developing countries may increase by nearly 6 percent by 2050, the study said.

IFPRI recommends that at least US\$7 billion be set aside annually to help developing countries adapt to the agricultural effects of climate change. The funds would support agricultural research, improve irrigation systems, and expand rural roads.

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U.S. Public Still Unconvinced on Climate Change

Fewer U.S. citizens consider climate change to be a “serious threat” compared to two years ago even as scientific evidence demonstrates that the problem has become increasingly severe, according to a nationwide opinion poll.

The survey, by the Pew Research Center for the People and the Press, polled 1,500 telephone respondents in September and October 2009. It suggests that 65 percent of the U.S. public considers climate change to be a “very serious” or “somewhat serious” problem. This marks a decline from January 2007, when 77 percent of participants said they were seriously concerned about climate change.

The survey suggests that anti-climate-change campaigns are not adequately explaining the latest science. U.S. residents have also been subjected to more sophisticated messages from conservative media, fossil fuel-dependent industries, and



Jin Suk

politicians who question the scientific certainty of climate change, especially as lawmakers consider national cap-and-trade legislation that would restrict emissions.

“In the public mind, the science definitely isn’t settled,” said Riley Dunlap, an environmental sociologist at Oklahoma State University. “Environmental groups and environmental funders need to take note of that and adjust their strategy and tactics accordingly.”

In what is perhaps a silver lining, the Pew results suggest that half of the U.S. public supports a limit on greenhouse gas emissions, even if higher energy prices result. A majority also said that the United States should join other countries in setting standards to address climate change.

Deltas Sink Worldwide, Increasing Flood Risk

Most of the world’s major river deltas are sinking, increasing their vulnerability to severe storms and floods, new satellite studies find. Of the world’s 33 major river deltas, 24 are sinking due to flood-control efforts and other human-caused changes to river systems. The study, published in the September 2009 issue of *Nature Geoscience*, “conservatively” estimates that the area vulnerable to flooding could increase by 50 percent worldwide.

An estimated 500 million people live

on river deltas, which are created as sediments are deposited at the mouths of rivers. Seasonal floods typically expand deltas, but flood-control efforts such as levees and dams have prevented regeneration in many delta systems. Deltas are also being tapped for water and mineral resources, causing the ground to subside faster than new sediments arrive.

In the past decade, 85 percent of the world’s major deltas underwent severe floods, including the U.S. Mississippi River Delta, Myanmar’s Irrawaddy Delta, and the Ganges-Brahmaputra Delta of India and Bangladesh, the study found. But Thailand’s Chao Phraya River, where parts of the delta have sunk 1.5 meters below sea level, may be the worst affected by delta loss.

The scientists used satellite data to compare current delta conditions against historical maps of major low-lying rivers published between 1760 and 1922. They based their estimate of flooding increase on the 2007 Intergovernmental Panel on Climate Change projection of 0.45 meters of sea-level rise by 2100.



Reuters/Sukree Sukplang

Sandbags keep Chao Phraya River floodwaters out of a temple in Bangkok.

About WORLD•WATCH

WORLD WATCH is a bimonthly, nonprofit magazine, written by Worldwatch Institute analysts and guest authors, that tracks key indicators of the Earth’s well-being. We monitor and evaluate changes in climate, forest cover, population, food production, water resources, biological diversity, and other key trends, and identify and analyze the most effective strategies for achieving a sustainable society—including those that come from the advances of science and technology, the rethinking of traditional economics, and the neglected wisdom of now-vanishing indigenous peoples. We are beholden only to our readers, from whom we welcome comments.

WORLD WATCH is also published in Japanese and Spanish, and selections from WORLD WATCH are incorporated into the online French-language magazine, *L’Etat de la Planete* (www.delaplanete.org/).

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Political Unrest Portends Ecological Ruin in Madagascar

Recent political developments in Madagascar have led to a rise in both illegal and sanctioned logging, undermining decades of conservation work, environmental groups say.

After pro-opposition troops ousted President Marc Ravalomanana in March 2009, illegal logging and the trade in wildlife-derived bushmeat escalated in many of the island's protected areas. Although a November deal between political parties provided some stability, conservation groups worry that persistent lawlessness coupled with a decline in foreign aid will lead to increased deforestation in some of the world's richest ecosystems.

Communities and park officials report that armed gangs have entered protected areas, such as the Marojeje and Masoala World Heritage Sites and the Mananara-Nord Biosphere Reserve, and removed endangered rosewood trees, ebony, and other threatened hardwood species. An estimated 7,000 cubic meters of felled rosewood and ebony were shipped each month to Madagascar's ports between January and October 2009, according to Global Witness, an environmental group working with Madagascar's transitional government.

International conservation groups and conservation scientists warn that the increased pressure on protected forests is threatening to push many of the island's rare species toward extinction. In addition, endangered lemurs are being trapped in increasing numbers and sold as food.

The previous government worked closely with conservation groups to expand ecotourism opportunities and keep much of the island's endangered hardwood off the market. But environmental groups accuse the new transitional government of failing to uphold commitments to protect national forests. At the heart of concerns is an order issued in late September that granted 13 operators permission to each export 25 containers of rosewood and ebony.

The World Bank and U.S. Agency for International Development have suspended their funding for environmental programs in Madagascar until at least October 2010. Unless foreign aid resumes in the coming months, Hawkins expects local officials will be unable to stop the conservation losses.

"This illegal logging, the hunting of lemurs, it's something people are getting bolder in doing as they see they are not being constrained from doing so," he said. "The capacity from the community to stop this will not last long."

The illustrations for this Eye on Earth section were created by students in Glenna Lang's illustration class at the School of the Museum of Fine Arts, Boston.

See "Is Local Food Better?" May/June 2009, p. 6

Fat-Fighting MIT researchers are calling for increased local food production to tackle the U.S. obesity epidemic. Local food offers a healthier alternative to the "national-scale system of food production and distribution, which surrounds children...with high-calorie products," they write.

See "Bye, Bye Birdie," July/August 2006, p. 28

Life Losses Eleven more species are either fully extinct or extinct outside of captivity, including a Tanzanian toad and eight tree-snail species, according to the latest *Red List of Threatened Species*. The number of species threatened with extinction now totals 17,291.

See "Living with Climate Change in the Arctic," September/October 2005, p. 18

No See Ice A Canadian scientist reported in October that the multiyear ice covering the Arctic Ocean has effectively vanished, a development that will facilitate polar shipping but that reflects faster-than-projected melting of the northern ice cap.

See "Poisonous Waters," January/February 2003, p. 22

Poisonous Ponds Artificial ponds may be responsible for the arsenic-laced groundwater that has poisoned more than 2 million Bangladeshis, according to a study in *Nature Geoscience*. The ponds have become a dumping ground for debris that releases the toxic metal, the study said.

See "Crimes of (a) Global Nature," September/October 2002, p. 12

Illegal Ivory The illicit trade in ivory, on the rise since 2004, surged dramatically in 2009, according to seizure data in the Elephant Trade Information System. The spike suggests the increased involvement of organized crime networks that link African source countries with Asian markets.

See "Trespass," January/February 2005, p. 24

GMO Blow Rapid U.S. adoption of genetically engineered crops has led to increased pesticide use, a herbicide-resistant weed epidemic, and more chemical residues in foods since 1996, according to new research by health and environmental groups.



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Melissa Ross



Conservation groups have prioritized their efforts in Madagascar, considered a "hotspot" for biological diversity. Most of the island's reptiles, plant life, and land mammals, including lemurs, are found naturally nowhere else on Earth. But conservation programs are in peril following decisions by two major donors, the United States and World Bank, to withdraw non-humanitarian aid following the change of government.

"Park staff and management authorities have been deprived of the resources and mechanisms they need to prevent illegal logging," said Frank Hawkins, vice president of Conservation International's Africa program. "Communities who have been developing mechanisms for generating revenue from intact forests, tourism, or carbon [sequestration]...will have to go back to slash-and-burn agriculture."

Greenwashing Hydropower

Big dams have a serious record of social and environmental destruction, and there are many alternatives. So why are they still being built?

by Aviva Imhof and Guy R. Lanza

On a hot May day, a peasant farmer named Bounsouk looks out across the vast expanse of water before him, the 450-square-kilometer reservoir behind the new Nam Theun 2 dam in Laos. At the bottom of the reservoir is the land where he once lived, grew rice, grazed buffalo, and collected forest fruits, berries, and medicinal plants and spices. Now there is just water, water everywhere.

"Before the flood I could grow enough rice to feed my family and I had 10 buffalo," he says. "I like our new houses and I like having electricity in the new village, but we do not have enough land and the soil quality is very poor. Now I can't grow enough rice to feed my family, and three of my buffalo died because they didn't have enough food."

Bounsouk is one of 6,200 indigenous people whose lands were flooded to make way for the Nam Theun 2 Hydropower Project in this small Southeast Asian country. His story is one that is heard over and over again in the project resettlement area. People are generally happy with their new houses, electricity, and proximity to the road, but are concerned about how they will feed their families in the long term. The poor quality of land and lack of viable income-generating options in this remote area make their prospects bleak.

Big dams have frequently imposed high social and environmental costs and longterm economic tradeoffs, such as lost fisheries and tourism potential and flooded agricultural and forest land. According to the independent World Commission on Dams, most projects have failed to compensate affected people for their losses and adequately mitigate environmental impacts. Local people have rarely had a meaningful say in whether or how a dam is implemented, or received their fair share of project benefits.

But Electricité de France, Nam Theun 2's developer, together

with the Lao government, the World Bank, and other backers, promised that Nam Theun 2 would be different. They called it a "poverty-reduction project." The company committed to restoring the incomes of affected communities, and the World Bank claimed that the cash-strapped Lao government would use the revenues from Nam Theun 2's electricity exports to neighboring Thailand solely to benefit the poor. These promises helped seal the deal, bringing in European development agencies, banks, and export credit agencies with hundreds of millions of dollars in grants, loans, and insurance for the US\$1.45 billion project, the largest foreign investment ever in Laos.

But while Nam Theun 2's engineering deadlines have been met, social and environmental programs have stumbled ever since construction started, making life more difficult for Lao villagers. Legal agreements have been violated and social and environmental commitments have been broken. In a manner typical of hydro projects worldwide, promises were made prior to project approval that were later broken by project developers and governments.

Downstream, more than 120,000 people are waiting to see how their lives will be affected when the project starts operation in early 2010. They are likely to suffer the project's most serious damage, including destruction of fisheries, flooding of riverbank gardens, and water quality problems. Yet the programs to restore livelihoods in this area are badly underfunded and poorly planned.

Rather than being a new model of hydropower development, the experience with Nam Theun 2 to date only reinforces lessons learned from other large hydropower projects around the world. Instead of giving hope for the future, Nam Theun 2 threatens more of the same: broken promises, shattered lives, ruined ecosystems.

Hydro Boom

The dam building industry is greenwashing hydropower with a public relations offensive designed to convince the world that the next generation of dams will provide additional sources of clean energy and help to ease the effects of climate change. In some of the world's last great free-flowing-river basins, such as the Amazon, the Mekong, the Congo, and the rivers of Patagonia, governments and industry are pushing forward with cascades of massive dams, all under the guise of clean energy.

Following a decade-long lull, a major resurgence in dam construction worldwide is now under way, driven by infusions of new capital from China, Brazil, Thailand, India, and other middle-income countries. In particular, Chinese financial institutions have replaced the World Bank as the largest funder of dam projects globally. Chinese banks and companies are involved in constructing some 216 large dams ("large" means at least 15 meters high, or between 5 and 15 meters and with a reservoir capacity of at least 3 million cubic meters) in 49 different countries, particularly in Africa and Southeast Asia, many with poor human rights records. A look at the heavy dam-building activity in China, the Amazon basin, and Africa illustrates the risks involved.

China. China is already home to more than 25,000 large dams, about half of the global total. These projects have forced more than 23 million people from their homes and land, and many are still suffering the impacts of displacement and dislocation. Around 30 percent of China's rivers are severely polluted with sewage, agricultural and mining runoff, and industrial chemicals, and the flows of some (such as the Yellow River) have been so dramatically altered that they no longer reach the sea. Free-flowing rivers with adequate oxygen and natural nutrient balances can remove or reduce the toxicity of river contaminants, but dams compound pollution problems by reducing rivers' ability to flush out pollutants and because the reservoirs accumulate upstream contaminants and submerge vegetation, which then rots. The water then released can be highly toxic and can have significant ecological and human-health effects downstream.

Despite the poor record of dam construction in China, the Chinese government has ambitious plans to expand hydropower generation, more than doubling capacity to 250,000 megawatts by 2020. Huge hydropower cascades have been proposed and are being constructed in some of China's most pristine and diverse river basins in the country's remote southwest.

The Three Gorges Dam, perhaps the world's most notorious dam, generates electricity equivalent to that of about 25 coal-fired power stations. Yet the tradeoffs involved are enor-



International Rivers

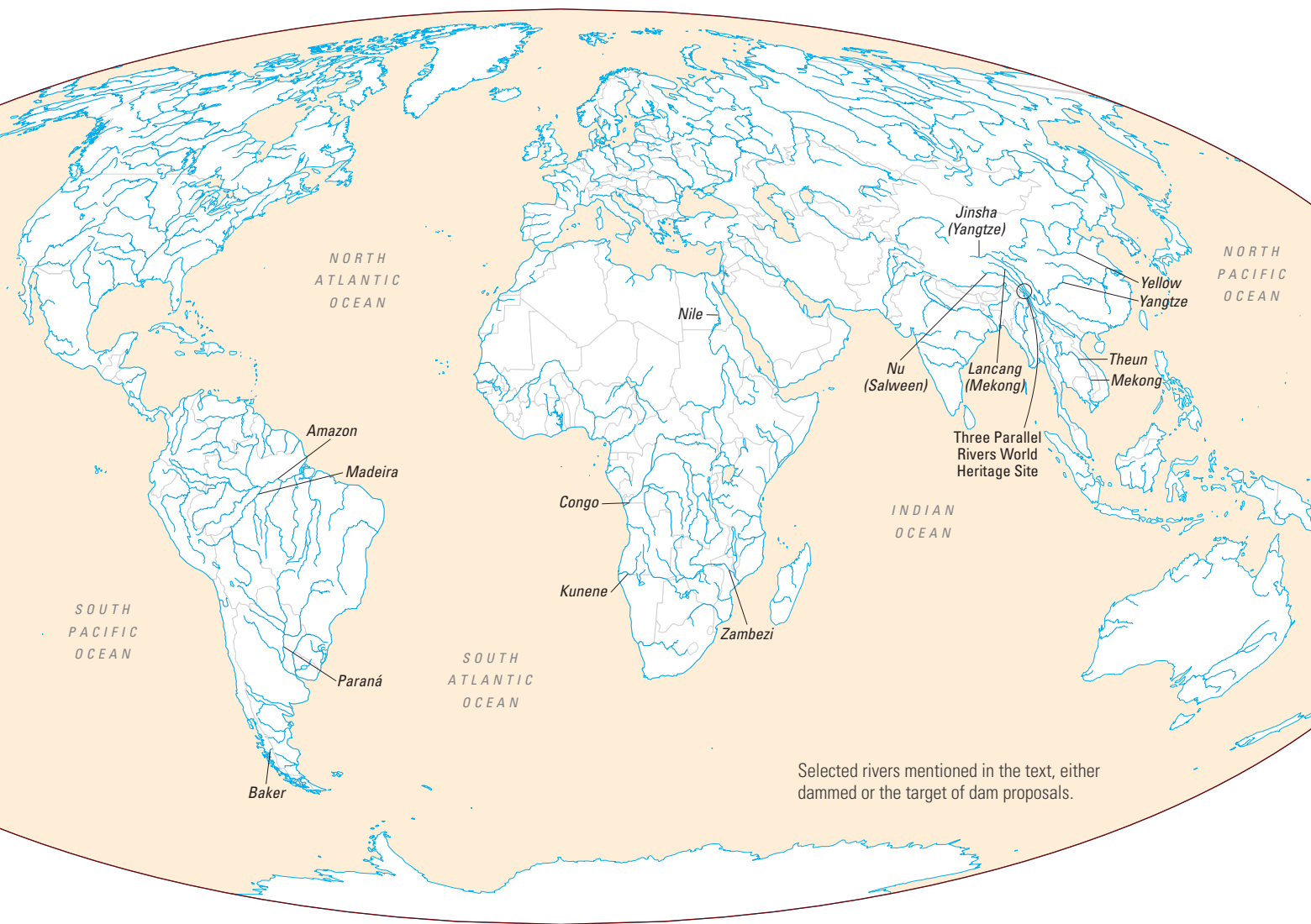


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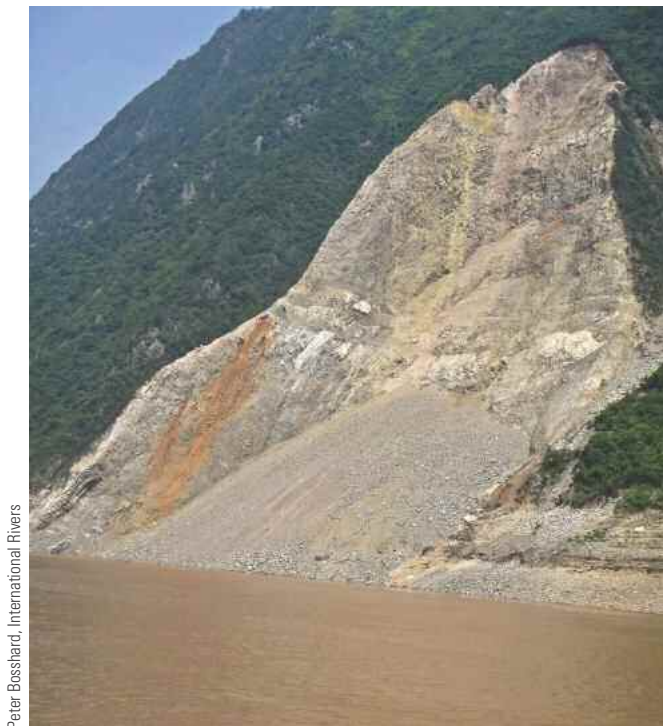


Carl Middleton

Top: Site of the **Nam Theun 2 Dam** on the Theun River, Laos. *Middle:* The dam under construction in 2008. *Bottom:* A woman plants corn and rice on her 0.66-hectare allotment of land in a resettlement village.



Selected rivers mentioned in the text, either dammed or the target of dam proposals.



Peter Bosshard, International Rivers

A landslide on the shore of the reservoir created by the **Three Gorges Dam**.

mous. The project has been plagued by corruption, spiraling costs, environmental catastrophes, human rights violations, and resettlement difficulties. To date, more than 1.3 million people have been moved to make way for the dam. Hundreds of thousands of these people have received tiny, barren plots of land or have been sent to urban slums with limited cash compensation and housing. Those resettled in towns around the edge of the Three Gorges reservoir have seen the shore of the reservoir collapse in as many as 91 places, killing scores of people and forcing whole villages to relocate. Protests have been met with repression, including imprisonment and beatings.

The Three Gorges Dam is, unfortunately, the tip of the iceberg. In southwest China, at least 114 dams on eight rivers in the region are being proposed or are under development on major rivers, such as the Lancang (Upper Mekong), the Nu (Upper Salween), and the Jinsha (Upper Yangtze). Many of these projects are among the largest in the world, with correspondingly serious impacts on river ecology, displacement of hundreds of thousands of ethnic minority people, and concerns about the safety of downstream communities. Several of the projects are in or adjacent to the Three Parallel Rivers World Heritage Site, threatening the ecological integrity of one of the most spectacular and biologically rich areas of the world.

Of increasing concern is the potential for dams in Southwest China to trigger earthquakes. Recent evidence has emerged that the devastating 7.9-magnitude Sichuan earthquake of May 2008, which killed an estimated 90,000 people, may have been caused by the Zipingpu Dam. It is well established that large dams can trigger earthquakes through what is called reservoir-induced seismicity. Scientists believe that there are more than 100 instances of reservoirs causing earthquakes around the world. According to geophysical hazards researcher Christian Klose of Columbia University, “The several hundred million tons of water piled behind the Zipingpu Dam put just the wrong stresses on the adjacent Beichuan fault.”

Many of China’s dam projects are being built on international rivers with no evaluation of the potential transboundary impacts. The cascade of eight dams being built on the Lancang River will drastically change the Mekong River’s natural flood/drought cycle and block the transport of sediment, affecting ecosystems and the livelihoods of millions living downstream in Burma, Thailand, Laos, Cambodia, and Vietnam. Fluctuations in water levels and reduced fisheries caused by the three dams already completed have been recorded along the Thai-Lao border. Despite this, construction has proceeded without consultation with China’s downstream neighbors and without an assessment of the dams’ likely impacts on the river and its people.

Meanwhile, downstream along the Mekong, the governments of Laos, Thailand, and Cambodia are planning their own cascade of 11 dams on the river’s mainstream, and scores of additional dams on its tributaries. The projects are being proposed by Chinese, Vietnamese, Malaysian, and Thai developers, with financing presumably from public and private financial institutions in their home countries. The growth of regional capital has fueled the resurgence of these projects, which have been on the drawing board for decades.

Around 60 million people depend on the Mekong River for fish, irrigation, transportation, and water. Known regionally as the “Mother of Waters,” the Mekong supports one of the world’s most diverse fisheries, second only to the Amazon. Those fisheries are a major source of protein for people living in the Mekong basin, and the annual fisheries harvest has a first-sale value of about \$2 billion. If built, the dams would severely damage the river’s ecology and block the major fish migrations that ensure regional food security and provide income to millions of people.

The Amazon. Under the guise of promoting cheap, clean energy, Brazil’s dam builders are planning more than 100 dams in the Amazon. Already two big dams are under construction on the Amazon’s principal tributary, the Madeira, with several others in the licensing process. Brazil’s

Top: A satellite view of the **Zipingpu Dam** on the Min River, Sichuan, China. *Middle:* The **Xiaowan Dam** under construction on the Lancang (Mekong) River in 2008, Yunnan, China. *Bottom:* Dead trees in the reservoir of the **Balbina Dam**, on the Uatumã River, a tributary of the Amazon, Brazil.



GeoEye satellite image



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Pedro Ivo Simoes

electricity-sector bureaucrats say these will be kinder, gentler dams with smaller reservoirs, designed to lessen social and environmental impacts. Legislation has been introduced that would fast-track the licensing of new dams in Amazonia and allow projects to circumvent Brazil's tough environmental laws, under the pretext that they are of "strategic importance" to Brazil's future.

By flooding large areas of rainforest, opening up new areas to logging, and changing the flow of water, the scores of dams being planned threaten to disturb the fragile water balance of the Amazon and increase the drying of the forest, a process that is already occurring due to climate change and extensive deforestation. New research confirms the critical role the Amazon plays in regulating the climate not only of South America, but also of parts of North America. The transformation of extensive areas of the Amazon into drier savannas would cause havoc with regional weather patterns. Lower precipitation, in turn, would render many of the dams obsolete.

Meanwhile, mocking one of the dams' justifications, the greenhouse gas emissions could be enormous. Amazonian dams are some of the dirtiest on the planet; the Balbina Dam alone emits 10 times more greenhouse gases (from rotting vegetation in the reservoir) than a coal-fired plant of the same capacity. What's more, the planned projects would expel more than 100,000 river-bank dwellers from their lands and seriously degrade extensive indigenous lands and protected areas.

The Santo Antonio and Jirau Dams on the Madeira River, currently under construction, have also raised the possibility that individual dams could affect a huge area of the Amazon Basin. Scientists have pointed out that several valuable migratory fish species could suffer near-extinction as a result of the Madeira dams, depleting fisheries and fauna thousands of kilometers up and downstream. The fertility of the Amazon floodplain, important for agriculture and fish reproduction, would also be impaired because a significant portion of the sediments and nutrients carried by the Madeira would be trapped in the reservoirs.

There is no doubt that meeting Brazil's future energy needs is of crucial importance, but there are alternatives to more dams. A study by WWF—World Wide Fund for Nature showed that Brazil could meet a major part of its future energy needs at lower social, environmental, and economic cost by investing in energy efficiency and renewable energy. Brazil's enormous windpower potential is attracting investors, and the country's potential for generating electricity from biomass, such as sugarcane bagasse, rice husks, and sawmill scraps, has been calculated to exceed the capacity of the massive Itaipu Dam.

Africa. In Africa, dam construction is also on the rise. Africa is the least-electrified place in the world, with just a fraction of its citizens having access to electricity. Solving this huge problem is made more difficult by widespread poverty and poor governance, and because a large majority of the

people live far from the grid, which greatly adds to the cost of bringing electricity to them.

The World Bank and many of the continent's energy planners are pinning their hopes for African electrification on something as ephemeral as the rain, by pushing for a series of large dams across the continent. World Bank energy specialist Reynold Duncan told an energy conference earlier this year that Africa needs to greatly increase its investments in hydropower. "In Zambia, we have the potential of about 6,000 megawatts, in Angola we have 6,000 megawatts, and about 12,000 megawatts in Mozambique," he said. "We have a lot of megawatts down here before we even go up to the Congo."

Duncan said that governments and investors should not hesitate to look at riskier assets such as hydropower, adding that only 5 percent of the continent's hydro potential had been tapped. But "risky" is right. New African dams are being built with no examination of how climate change will affect them, even though many existing dams are already plagued by drought-caused power shortages.

Climate change is expected to dramatically alter the dynamics of many African rivers, worsening both droughts and floods. In this climate, the proposed frenzy of African dam building could be literally disastrous. Unprecedented flooding will cause more dams to collapse and hasten the rate at which their reservoirs fill with sediment. Meanwhile, worsening droughts will mean dams will fail to meet their power production targets.

Dams are not inexpensive investments: Just developing one of these dams, the Mphanda Nkuwa in Mozambique, is expected to cost at least \$2 billion (not including the necessary transmission lines). Yet these huge projects are doing little to bridge the electricity divide in Africa. With the majority of the continent's population living far from existing electricity grids, what is needed is a major decentralized-power rollout of renewables and small power plants to build local economies from the ground up, not the top down. But that's not where the money is right now.

Corruption

These examples from three areas of heavy dam-building activity hint at the spectrum of major problems they present. Big dams can contribute to development, but that progress often comes at staggering cost, in displaced and impoverished refugees, ecologically fragmented and damaged rivers, and downstream victims of destroyed fisheries and impounded sediments. Big dams also expand the habitat of waterborne disease vectors such as malaria, dengue fever, schistosomiasis, and liver fluke, and can trigger devastating earthquakes by increasing seismic stresses. Dams frequently fail to deliver their projected benefits and usually wind up costing more than predicted. And although hydropower is touted as a solution to climate change, many dams actually emit huge quantities of greenhouse gases. As Indian writer and activist Arundhati Roy has put it, "Big dams are to a nation's development what

nuclear bombs are to its military arsenal. They're both weapons of mass destruction."

If dams continue to wreak havoc with people's lives and ecosystems, and are increasingly risky in a warming world, why do they continue to be built and promoted? And why are they now being hailed as a source of green, renewable energy?

One of the main reasons is vested interests: There are substantial profits to be had, for the hydropower industry, their network of consultants, and host-country bureaucracies, from planning, building, and operating massive infrastructure projects. These attractions often trump the impacts on people and ecosystems and the need to develop sustainable economies in the midst of a growing water and food crisis.

Industry consultants and engineering companies that undertake feasibility studies and environmental impact assessments know that they need to portray a project in a favorable light if they want to get future contracts. In case after case, and without comprehensively assessing the alternatives, they consistently claim that the impacts can be mitigated and that the project in question represents the best option for meeting the country's needs.

Environmental impact assessments (EIAs) that should anticipate problems have served as a rubber-stamping device rather than a real planning tool. Jiang Gaoming of the Chinese Academy of Sciences reports that construction on many projects in southwest China is under way in violation of key aspects of Chinese law. Many projects lack an EIA and have not been approved by the government. According to Jiang, even basic safety checks have not been performed and government regulators are uninvolved. "EIAs have become a marginalized and decorative process, seen as just a part of the cost of doing business," says Jiang. "Both the builders and local government know that, to date, an EIA has never managed to halt a dam project."

Needless to say, corruption also plays a key role. A dam involves a huge upfront investment of resources, making it easy for government officials and politicians to skim some off the top. One of the most egregious examples of corruption involving a dam project is the Yacyretá Dam on the Paraná River, between Argentina and Paraguay. In the 1980s, the cost of this "monument to corruption" (in the words of former Argentine president Carlos Menem) ballooned from an original estimate of \$1.6 billion to more than \$8 billion. In 2002 and 2003, several of the biggest dam-building companies in the world were convicted of bribing the former director of the Lesotho Highlands Development Authority to win contracts on Lesotho's Katse Dam. Masupha Sole accepted around \$2 million in bribes from major dam-building firms such as Acres International of Canada and Lahmeyer International of Germany. In China, corrupt local officials stole millions of dol-



Wilson Dias, Agência Brasil



Eric Gaba



International Rivers



Lori Pottinger

Top two: Both the Teotônio Rapids and the Giant Otter are threatened by the proposed **Madeira Dams** in Brazil. *Third:* The partially functioning **Inga Dam** on the Congo River in the Democratic Republic of Congo—only half of the turbines work because they have never been maintained. *Bottom:* Site of the proposed **Mphanda Nkuwa Dam** on the Zambezi River in Mozambique.

lars intended for people displaced by the Three Gorges Dam. At least 349 people have been found guilty of embezzling a total of about 12 percent of the project's resettlement budget.

The Way Forward

Needless to say, these are not easy problems to address. The most ambitious and systematic attempt to date has been undertaken by the World Commission on Dams (WCD), a multi-stakeholder independent body established by the World Bank and the World Conservation Union (IUCN) in 1998. After a comprehensive evaluation of the performance of large dams, the Commission issued its final report, *Dams and Development: A New Framework for Decision-Making*, in 2000.

Briefly, the WCD recommends conducting an open and participatory process to identify the real needs for water and energy services, followed by a careful assessment of all options for meeting those needs, giving social and environmental aspects the same significance as technical, economic, and financial factors. If a new dam is truly needed, outstanding social and environmental issues from existing dams should be addressed, and the benefits from existing projects should be maximized. Public acceptance of all key decisions should be demonstrated and decisions affecting indigenous peoples should be guided by their free, prior, and informed consent. Legally binding agreements should be negotiated with affected people to ensure the implementation of mitigation, resettlement, and development entitlements. Impact assessments should follow European Union and other global EIA standards. By definition, an effective EIA "ensures that environmental consequences of projects are identified and assessed *before* authorization is given"—something that almost never occurs in today's world. Dam projects built on international rivers should also evaluate the potential transboundary impacts or cumulative impacts from multi-dam projects in regional watersheds.

The dam industry has rejected the WCD guidelines and in 2007 established its own process, hoping to develop a sustainability protocol that will replace the WCD framework as the most legitimate benchmark for dam projects. But the industry approach is clearly an attempt to circumnavigate the more robust requirements of the WCD while paying lipservice to sustainability.

In fact, the industry's attempt to repackage hydropower as a green, renewable technology is both misleading and unsupported by the facts, and alternatives are often preferable. In general, the cheapest, cleanest, and fastest solution is to invest in energy efficiency. Up to three-quarters of the electricity used in the United States, for instance, could be saved with efficiency measures that would cost less than the electricity itself. Developing countries, which will account for 80 percent of global energy demand growth up to 2020, could cut that growth by more than half using existing efficiency technologies, according to McKinsey Global Institute. "Technology transfer" programs can be an effective way to help poorer nations avoid having to reinvent the wheel; for

example, California's remarkable energy efficiency program has been sharing knowledge with Chinese energy agencies and government officials to jump-start strong efficiency programs there.

Even with investment in efficiency, however, many developing countries will require new generation sources. Developing countries often have vast, unexploited renewable energy potential, such as wind, solar, geothermal, and modern biomass energy, as well as low-impact, non-dam hydropower. Such technologies are much more suited to meeting the energy needs of the rural poor, as they can be developed where people need the power and do not require the construction of transmission lines. Examples include the installation, supported by Global Environment Facility incentives, of hundreds of thousands of solar home systems in Bangladesh, China, Sri Lanka, and Uganda.

Large-scale true renewables can also be an attractive and affordable solution to many countries' energy problems. The cost of windpower in good locations is now comparable to or lower than that of conventional sources. Both solar photovoltaic and concentrating solar power are rapidly coming down in price. A 2008 report from a U.S. National Academy of Engineering panel predicts that solar power will be cost-competitive with conventional energy sources in five years.

As for systemic corruption, it must be openly challenged by governments, funding agencies, and other proponents of dam projects. Regulations must be written to identify, define, and eliminate corruption at all levels of the planning process. And the regulations must be openly supported and enforced by the World Bank, the dam industry, the hydropower companies, and the governments supporting dam construction. The dam industry itself, together with its biggest government allies, such as China, Brazil and India, must take steps toward internal reform. Adopting the WCD guidelines would be a good first step, together with instituting such practices as integrity pacts, anti-corruption legislation, and performance bonds that require developers to comply with commitments.

A vigorous assault on corruption, plus technology transfer and financial assistance: these are the keys to allowing developing countries to leapfrog to a sustainable, twenty-first-century energy regime. The stakes are high, because healthy rivers, like all intact ecosystems, are priceless. The alternative, quite simply, is a persistent legacy of human and environmental destruction.

Aviva Imhof is the campaigns director for *International Rivers*, an environmental and human rights organization based in Berkeley, California. Guy R. Lanza is a professor of microbiology and director of the Environmental Science Program at the University of Massachusetts, Amherst.



For more information about issues raised in this story, visit
www.worldwatch.org/ww/hydropower.

VITAL SIGNS

Coral Reefs under Threat

Alice McKeown

About one-fifth of the world's coral reefs have already been lost or severely damaged, while another 35 percent could be lost within 10–40 years, according to the latest review by the Global Coral Reef Monitoring Network. The number of coral reefs considered at low risk stood at 46 percent, up from 30 percent only four years ago, but the number of effectively lost reefs remained constant during the period—although this figure was double the 10 percent lost or severely damaged in the first global estimate in 1992. However, the recent estimates do not take into account risks from climate change; when these are included, all coral reefs are in danger and widespread mortality is predicted.

Coral reefs in Asia and the Indian Ocean are most at risk, with 54 percent either lost or critically threatened and another 25 percent moderately threatened. Southeast Asia, which contains the highest biodiversity of all coral reefs as well some of the world's highest human population densities, has already lost 40 percent of its reefs (36,680 square kilometers).

In the Caribbean region, 38 percent of coral reefs are either lost or critically threatened and 24 percent are moderately threatened. The Middle East region contains one of the areas with the lowest-risk reefs (in the Red Sea), as well as the area with the largest percentage of lost reefs, the Persian Gulf, Arabian Sea, and Gulf of Oman.

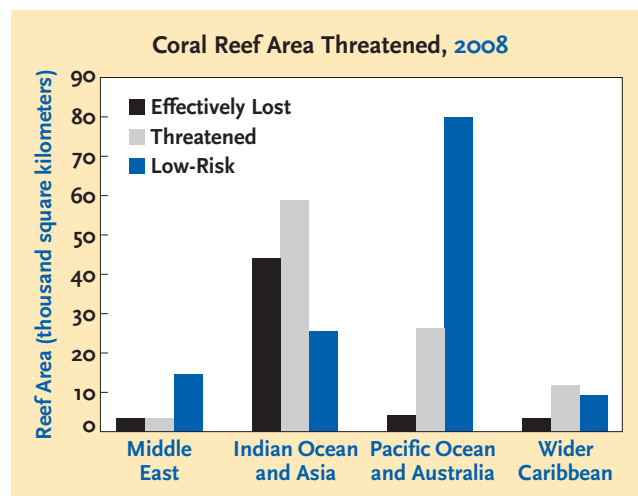
Coral reefs in the Pacific Ocean are by far in the best shape, with only 11 percent lost or critically threatened, 16 percent moderately threatened, and 72 percent considered at low risk.

There are roughly 284,000 square kilometers of coral reefs in the world, covering less than 0.1 percent of the world's oceans—equal to about 0.6 percent of the world's agricultural lands. But, though relatively rare, coral reefs support more than a quarter of all known fish species and more species per unit area than any other ecosystem. Coral reefs directly supply about 2–5 percent of the global fisheries harvest and are an important protein and income source, especially in developing countries. They provide resources and food for about 500 million people across the globe, including 30 million people who are almost completely dependent on reefs and associated coral resources. The associated goods and services are worth an estimated US\$30 billion per year.

Many of the ongoing threats to coral reefs can be linked to human activities, including overfishing and destructive fishing practices such as using explosives and cyanide poison. Another threat is coastal development, which leads to lower

water quality, increased sedimentation, and more pollution. These threats are expected to worsen: At least 39 percent of the world lives within 100 kilometers of an ocean, and projections indicate that population density will continue to grow in these coastal areas.

Climate change is arguably the most important factor for the future of coral reefs. Coral reefs are particularly susceptible to warming sea-surface temperatures, which over the last few decades have raised the frequency and intensity of coral bleaching events that can reduce coral growth and reproductive capacity, change reef fish species composition, and make the reefs vulnerable to disease and mortality. In 1998 (the second warmest year on record), the largest documented bleaching event killed 16 percent of the world's corals.



Another worrying climate change factor for coral reefs is increasing ocean acidity due to higher atmospheric carbon dioxide concentrations, which can decrease coral calcification and growth and lead to weaker structures and slowed reproduction. Ocean acidity has already increased by 30 percent.

Most approaches to coral reef protection rely on some degree of improved management. For example, socioeconomic modeling looks at how local peoples perceive threats to coral reefs as a way to help inform local management approaches. A revision to the monumental *Reefs at Risk* survey coordinated by the World Resources Institute is under way—relying on improved modeling and data and looking specifically at climate change threats—to offer a new look at coral reef threats that can be used in management decisions.



Vital Signs are adapted from Vital Signs Online, which contain additional data and more in-depth analyses. Visit <http://vitalsigns.worldwatch.org> to view and read the complete collection of trends.



"Friends," Fuling

THREE GORGES DAM

The largest concrete object on Earth inundated over 600 kilometers of the Yangtze River valley and forced more than 1.2 million people from their ancestral homes. Steven Benson, the photographer, took these photos in 1999 in order to "create a lasting document of an extraordinary part of the planet before it disappeared—a valley that had inspired artists, poets, and philosophers for centuries."

The photos come from Benson's book, *The Cost of Power in China: The Three Gorges Dam and the Yangtze River Valley*, available at www.stevenbensonphoto.com. Steven Benson is an associate professor at the Southeast Center for Photographic Studies at Daytona State College, Florida.



"Chair Maker," Fengdu



"Farmer," Wanxian

P I C T U R E S



"Construction Site," Three Gorges Dam



"Welder's Assistant,"
Li Dou

CLIMATE OF RISK

CLIMATE WARMING DEMANDS FRESH THINKING ABOUT SECURITY POLICY.

BY MICHAEL RENNER

Climate change may very well be the biggest challenge our civilization has ever faced. Left unaddressed, the effects on natural systems, biodiversity, food security, and habitability will likely be calamitous and the economic penalties severe.

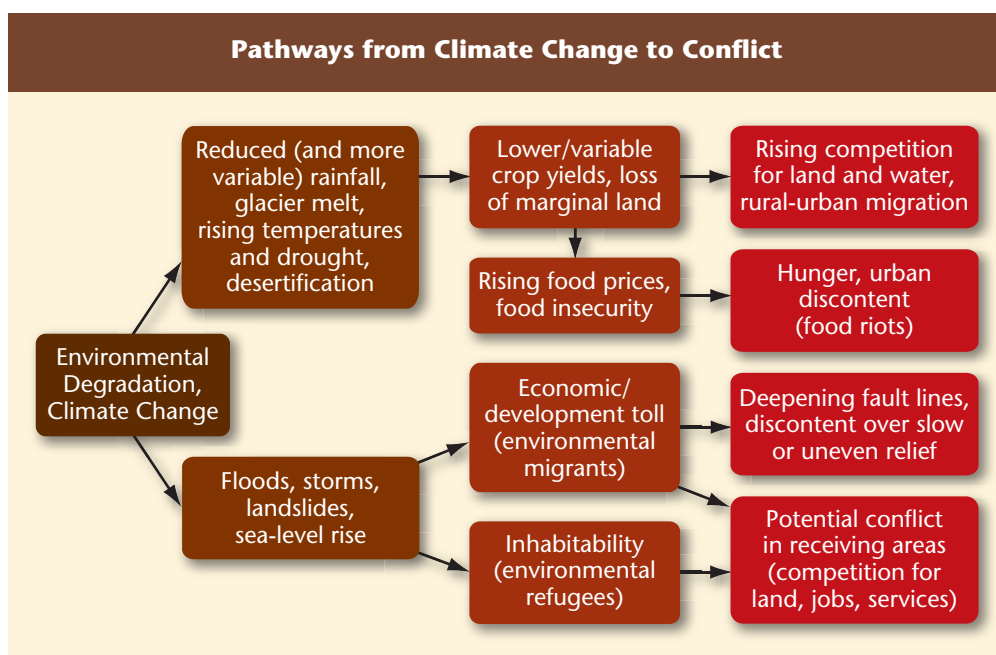
And in the absence of increased cooperation, runaway climate change may well trigger a whole new age of conflict. We live, after all, in a world marked by profound inequalities, unresolved grievances, and tremendous disparities of power. Ruled by competitive nation-states and rootless global corporations, our planet bristles with arms of all calibers. Under such circumstances, the additional stress imposed by climate change could have tremendous repercussions for human well-being, safety, and security.

Nations around the world, but particularly the weakest countries and communities, confront a multitude of pressures. Many face a debilitating combination of rising competition for resources, severe environmental breakdown, the resurgence of infectious diseases, poverty and growing wealth disparities, demographic pressures, and joblessness and livelihood insecurity. Climate change is certain to intensify many, if not all, of these challenges. More frequent and intense droughts, floods, and storms will play havoc with harvests and weaken food security. Extreme weather events, sea-level rise, and spreading disease vectors could conceivably undermine the long-term habitability of some areas. Together with reduced economic viability, the result could be escalating social discontent and

large-scale involuntary population movements, severely testing national and international institutions. Possible conflict constellations revolve around resource access, natural disaster impacts, and refugee and migrant flows (see figure below).

RESOURCE ACCESS

Growing depletion and scarcity of fresh water, arable land, and forests could lead to conflicts over access and distribution. Almost one-third of the world's population—estimates vary between 1.4 and 2 billion people—already lives in water-scarce regions (defined as less than 1,000 cubic meters per capita per year). Most affected are swathes of North Africa, the Middle East, and Central and South Asia; parts of China, southeastern Australia, southern Africa, southwestern Latin America; and parts of the U.S. West. Population growth alone will increase the affected number of people. And depending on the climate scenario that comes to pass, an additional 60 million



to 1 billion people could be affected by 2050 (while 700 million to 2.8 billion people already affected by water stress now would see their situation worsen).

The repercussions of climate change for food production—reduced water availability, higher temperatures, greater drought, etc.—will vary enormously from region to region, and some populations may indeed benefit. But a study by scientists at the Uni-

versity of Washington and Stanford University found that half of the world's population could face severe food shortages by the end of this century. In the tropics and subtropics, harvests of rice, corn, and other staples could fall by 20 to 40 percent as a result of higher temperatures alone. And a heightened risk of drought could cause even greater crop losses.

In what is perhaps a preview of a growing scramble for resources, a number of wealthy but food-insecure nations (including Saudi Arabia, Qatar, the UAE, China, Japan, and South Korea), as well as private investors, have purchased or leased substantial tracts of land abroad, mostly in poor African and Asian countries, in order to produce crops for export. There have been at least 180 such transactions, which have come to be known as “land grabbing,” involving somewhere between 15 million and 20 million hectares of farmland. But as the moniker suggests, these deals have also triggered intense fears that they will promote export-oriented monocultures that exploit poor countries, jeopardize food security, and ultimately undermine political stability in “host” countries.

Whether and how rising resource stress translates into conflict is not easy to predict. Different population groups experience the effects of resource depletion and environmental degradation unevenly. These divergences can reinforce existing social and economic inequities or deepen ethnic and political fault lines. Growing hardships may reinforce the perception of a “zero-sum” game. This is especially the case where economies are heavily geared toward agriculture, where large portions of the population are directly dependent on the health of the natural resource base, and where land distribution is highly unequal or otherwise contested.

Farmers and nomadic herders in the Sahel region of Africa, for instance, increasingly clash as droughts and desertification processes intensify, magnifying contradictory needs



Hartmut Scharzbach/Peter Arnold, Inc.

This family was among the 60,000 internally displaced people living in camps near El Geneina in West Darfur, Sudan, in 2004.

and interests. The influx of arms has made such strife more deadly in a number of cases. But nowhere has the situation been more severe than in Sudan's Darfur province, where the government has deliberately stoked hostilities among different communities in a cold-blooded strategy designed to suppress a regional insurgency. Darfur suggests that it is not resource and environmental trends in isolation, but their interplay with political dynamics, that may be most worrisome in terms of potential conflict.

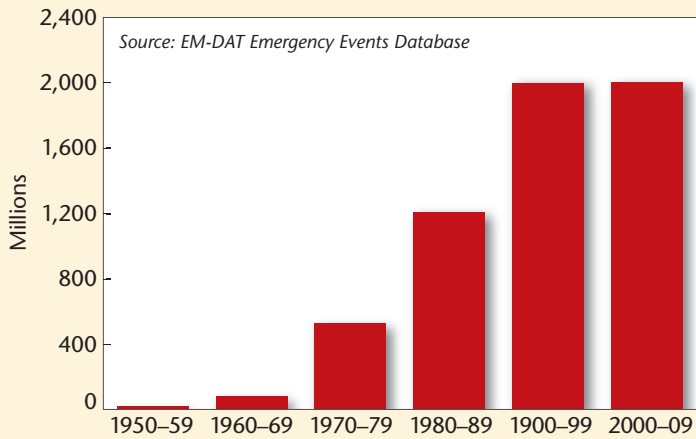
Conflicting claims over water resources have been cited as a possible cause of violent clashes in regions like the Middle East and in Central and South Asia. But water cooperation, rather than conflict, has so far been the norm in international river basins. Water agreements have been about benefit-sharing (that is, shared exploitation of water resources). As climate change heightens water scarcity, the question is whether countries will still be able to reconcile competing interests. Will water diplomacy be able to shift from benefit-sharing to burden-sharing? This is also an important question within national boundaries. Already, internal disputes revolve around water allocation among different communities and regions, and between local sustenance needs and export crops.

AFTERMATH OF DISASTERS

A second pathway toward conflict is found in the context of disasters. A combination of resource depletion, ecosystem destruction, population growth, and economic marginalization of poor people (who often have no choice but to settle in marginal, vulnerable locations or in poorly constructed housing) has already led to more frequent and more devastating disaster events.

The number of natural disasters (excluding geological

Number of People Affected by Natural Disasters, 1950–2009



events such as earthquakes and volcanic eruptions) has risen from 233 per decade in the 1950s to more than 3,800 in the decade 2000–2009. Though there are considerable variations year-to-year, the number of people affected by such disasters has grown from less than 20 million to 2 billion during the same time frame.

The pace is likely to accelerate as climate change translates into more intense storms, flooding, and heat waves. In addition to sudden disasters, there is also the “slow-onset” degradation of ecosystems through drought and desertification processes, which in some cases is sufficiently extreme to compromise habitability.

Disasters undermine human security by exacerbating poverty, deepening inequalities, and straining the social and economic fabric of affected communities. Disasters often widen existing fault lines within societies—between rich and poor, urban and rural communities, and different ethnic groups. In divided societies, conflict may arise if the provision of relief and reconstruction aid is inadequate or uneven among different groups and communities. Slow or incompetent disaster response can also lead to growing opposition to the government and unrest, particularly where popular dissatisfaction is already widespread.

One analysis found that out of 171 storm and flood disasters with at least 1,000 victims, in at least a dozen cases a clear connection existed between a disaster event and an intensification of conflict, violent unrest, and/or political crisis. Among these were hurricanes in Haiti (1954 and 2004), several flooding events in India and China, and typhoon and flooding events in Bangladesh (1970, 1974, and 1988).

POPULATION DISPLACEMENT

Disasters, along with environmental and resource pressures, are increasingly a contributing factor to displacement. But it is not always easy to categorize the displaced by single, sepa-

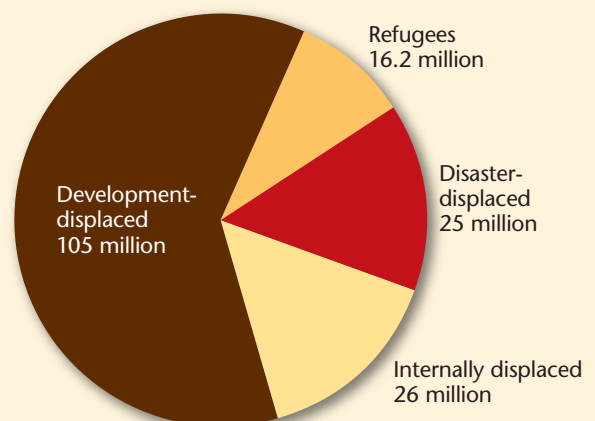
rate causes. Warfare, human rights violations, poverty, inequality of land ownership, as well as resource disputes and environmental problems, can be closely intertwined.

Some 42 million people were officially recognized as either international refugees or internally displaced persons (IDPs) in 2008, having fled war or persecution. In addition to the narrow reasons recognized in international law, there are additional reasons why people decide to seek refuge elsewhere. Some 25 million people are thought to have been uprooted by natural disasters. And London-based NGO Christian Aid estimates that as many as 105 million people have been made homeless by a variety of so-called development projects—which typically inflict substantial environmental damage—including dams, mines, roads, factories, plantations, and wildlife reserves.

Environmental degradation is already leading to sizable population movements (see table). In the mid-1980s, Essam El-Hinnawi of the UN Environment Programme coined the term “environmental refugees” and offered the following definition: “People who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption...that jeopardized their existence and/or seriously affected the quality of their life.”

Forecasts of the number of people that may have to move due to climate change and environmental degradation vary enormously. Projections for 2050 range from a low of 25 million to a high of 1 billion. Because no one knows how severe climate disruptions will be and how resilient governments and communities are, these numbers must be understood as no more than educated guesses. For instance, how many of the more than 630 million people living in low-lying coastal zones

People Forcibly Displaced, 2008



Sources: See www.worldwatch.org/ww/climaterisk

Examples of Environmentally Induced Population Movements

Country	Observation
Mexico	Desertification affecting drylands is leading some 600,000 to 700,000 people to migrate annually.
Brazil	Between 1970 and 2005, repeated drought has led some 60 million people to migrate from rural to urban areas, mostly from the northeastern Sertão region.
Senegal	In the Tambacounda area, badly affected by soil erosion, 90 percent of all men aged 30 to 60 have migrated (temporarily) at least once in their lifetimes.
Africa	Over the last two decades, an estimated 10 million people have moved due to the effects of environmental degradation and climate change.
Burkina Faso	Before the outbreak of instability and violent conflict in Côte d'Ivoire in 1999, farmers from drought-plagued Burkina Faso had regularly and in large numbers migrated there. Their remittances helped to finance schools, hospitals, and irrigation systems back home.
Papua New Guinea	The country's Carteret Islands may be completely submerged by 2015 as a result of sea-level rise. In 2005, the population of 2,600 was resettled to Bougainville.
United States	Of the 1.5 million people displaced by Hurricane Katrina in 2005, some 300,000 may never return.

Source: International Organization for Migration (IOM), "Migration, Climate Change, and the Environment," *IOM Policy Brief* (Geneva: May 2009), pp. 2–4.

worldwide might one day be displaced by sea-level rise, storm surges, and rising salinity of coastal aquifers?

Further complicating assessments is the possibility that some people will be displaced temporarily, rather than permanently. And people do not move only because they are pushed out, but also because they sense opportunities elsewhere. (There are an estimated 200 million longterm migrants worldwide.) Hence, some people may depart well before habitability and economic viability are too compromised. Others may migrate seasonally to supplement local incomes made more meager or precarious by climate impacts. It may be more meaningful to speak of climate migrants than of climate refugees.

Environmental refugees and migrants may be seen as unwelcome competitors for land, water, jobs, and social services. In the poorer states of northeast India, for instance, Bangladeshi migrants have been met by violence. North African cities (either as destinations or as stops on the way to Europe) are increasingly magnets for migrants from the Sahel region, but in some cases the influx has led to social unrest and attacks on migrants.

Whether violent conflict ensues depends on the scale and speed of population movements, as well as the mix of social and economic conditions and the presence of unresolved grievances in host areas. Likewise, governance capacities and

political stability play a critical role. Some political leaders (or would-be leaders) may find they can capitalize on stirring up resentments against migrants and refugees.

CONNECTING THE DOTS

Environment–conflict linkages have for some years worked their way onto the agendas of various national government ministries, including the environment, development cooperation, foreign, and military portfolios. Intergovernmental bodies like the World Bank, a range of UN agencies, the OECD, OSCE, European Union, and NATO have developed policy guidelines, commissioned research and strategy papers, and convened meetings to assess the consequences for conflict prevention and post-conflict peace-building efforts.

On April 17, 2007, the United Nations Security Council discussed, for the first time ever, the security implications of climate change, including border disputes, migration, societal stress, humanitarian crises, and shortages of energy, water, arable land, and fish stocks. The discussion covered such potential consequences as increased competition for food, water, and energy in the face of widespread drought and crop failures; an unprecedented rise in the number of people seeking to escape flooding, disease, and famine; and the possibility of climate-related economic disruptions on a scale not seen since World War II.

Recognition of such linkages and repercussions is welcome and overdue. But much of this discussion remains solidly within the national security mindset, steeped in traditional perceptions of "threats" (as opposed to common vulnerabilities) and is thus likely to cement the power of military institutions. There is, for instance, frequent reference to climate change acting as a "threat multiplier for instability in some of the most volatile regions of the world," as a much-cited 2007 report commissioned by the Center for Naval Analyses, a U.S. Navy-financed group, put it. The report expressed concern that climate change will make military operations and preparedness more difficult, and that chaos in climate-destabilized states may complicate Western access to oil and mineral resources.

The result could be a militarization of environmental and

humanitarian challenges, rather than a fundamental re-evaluation of a suitable security policy in a climate-disrupted era. An August 2009 front-page *New York Times* article argues that climate change raises “the prospect of military intervention to deal with the effects of violent storms, drought, mass migration and pandemics.” Reflecting the views of U.S. military and intelligence agencies, the article warns: “Such climate-induced crises could topple governments, feed terrorist movements, or destabilize entire regions.”

Clearly, two very different paths emerge from the intersection of climate and security. One is primarily concerned with preserving the status quo of international relations. Thus, rich and powerful nations may focus on unwanted instability to the extent that it threatens their own privileges. At times, this may find expression in policies to shut borders in the face of an “onslaught” of migrants and refugees from countries collapsing due to environmental calamity. At other times, it may lead to military intervention to shore up their own interests—such as the preservation of access to resources.

The other path emerges from a recognition that adopting greener economic and technological policies not only reduces the likelihood of catastrophic climate disruptions but also represents smart security policy. It entails dramatically different foreign and security policies, flowing from a concern for human rights, equity, and justice. Transformative in nature, it requires strengthening the civilian institutions that can address the roots of insecurity and promote cooperative rather than adversarial thinking. This path is ultimately about a profound transformation of culture—moving away from the warrior culture that always sees new enemies lurking, and toward an understanding that different nations and communities need to make peace not only with each other but also with nature.

MILITARY VERSUS CLIMATE BUDGETS

Government budgets are a good indicator of where priorities lie and how much progress is being made in this regard. Although change is in the air, traditional security perspectives continue to be well represented in most national budgets.

Driven largely by wars in Iraq and Afghanistan, military spending by the United States is now at the highest level since the end of World War II. Although the Obama Administration has adopted a far more positive attitude toward climate policy than its predecessor, it still proposes to spend US\$65 on the military for each dollar devoted to climate programs. Just the nuclear weapons budget for 2010, at \$9.9 billion, is almost as large as the entire climate budget, and almost three times as much as the \$2.3 billion requested for renewable energy and energy efficiency programs. Only if

one includes spending under the American Recovery and Reinvestment Act—the one-time stimulus measure passed in early 2009—does the gap temporarily shrink to less extreme proportions.

Though the United States is a far bigger military spender than any other nation on Earth, lopsided though less extreme priorities are found elsewhere as well. In FY 2008, the German government provided €3.3 billion (\$4.7 billion) for climate policy. While that was more than double the €1.5 billion provided in 2005, it is still a small sum compared with the €29.5 billion (\$42 billion) allocated to the Ministry of Defense. The military-to-climate-budget ratio thus came to

U.S. Federal Government Allocations for Climate Change and Military Programs

	2008	2010	2010 plus ARRA
	(billions of U.S. dollars)		
Climate Budget	7.37	10.6	79.47
Military Budget	647.1	687.2	690.5
Military to Climate Ratio	88 : 1	65 : 1	9 : 1
Of which: R&D spending	20 : 1	16 : 1	4 : 1

Source: Miriam Pemberton, *Military vs. Climate Security. Mapping the Shift from the Bush Years to the Obama Era* (Washington, D.C.: Institute for Policy Studies, July 2009).

about 9 to 1. In the fiscal year starting April 2009, Japan planned to spend about ¥432 billion (\$4.6 billion) on climate-related programs. While this expands FY 2008 spending by about ¥100 billion, it is dwarfed (11 to 1) by the ¥4,774 billion (\$50 billion) military budget.

Funds to assist developing countries with climate mitigation and adaptation also involve rather limited resources, compared both to the need at hand and to other governmental priorities. Announced bilateral funds, as of late 2009, tallied about \$13 billion and pledged multilateral funds add another \$7 billion. Most of these funds will likely be spent over five years or so, thus averaging roughly \$4 billion per year. This is about a third of what the United States alone spends on military aid to other countries, or less than a quarter of the value of world arms transfers to developing countries.

Available data are too incomplete to permit anything near a complete tally of military and climate budgets worldwide. It is especially difficult to tally climate funds, which are either in flux or still at an early stage of being established. But there is no doubt that funding priorities are severely slanted in favor of military programs. In 2008, the world spent almost \$1.5 trillion for military purposes. Even generously assuming that worldwide climate budgets run to \$50 billion a year, that would imply a 30 to 1 gap.

Bilateral and Multilateral Climate Funds

Fund	Amount
	(millions of U.S. dollars)
Cool Earth Partnership (Japan)	10,000*
International Window of the Environmental Transformation Fund (UK)	1,593
NORAD Rainforest Fund (Norway)	560
MDG Fund (Spain)	143
Global Climate Change Alliance (European Commission)	79
International Climate Initiative (Germany)	634
Global Initiative on Forest and Climate (Australia)	188
Total, Bilateral Funds	13,197
UNFCCC Funds under the Kyoto Protocol	320†
Forest Carbon Partnership Fund (World Bank)	165
Tropical Forest Account (Global Environment Facility, GEF)	60
Earth Fund (GEF/International Finance Corporation)	200
Clean Technology Fund and Strategic Climate Fund (World Bank)	6,141‡
Total, Multilateral Funds	6,985
Grand Total	20,182[◇]

*The bulk of this fund—\$8 billion—will be in the form of concessional loans; only \$2 billion will be in grant form.

†Amounts pledged as of 2008.

‡Pledged as of mid-2008. Amount actually received by then was \$201.7 million.

◇Rough figure, premised on a five-year period.

Sources: Gareth Porter, Neil Bird, Nanki Kaur, and Leo Peskett, *New Finance for Climate Change and the Environment* (Washington, DC: WWF and Heinrich Böll Stiftung, July 2008), pp. 24–25; United Nations, UNFCCC, *Investment and Financial Flows to Address Climate Change* (Bonn: 2007); Manish Bapna and Heather McGray, *Financing Adaptation: Opportunities for Innovation and Experimentation*, (Washington, D.C.: World Resources Institute, 2008); World Bank, "Climate Investment Funds (CIF)," www.worldbank.org/cif/.

RESILIENCE TO THE RESCUE

If the term "security" is to have any meaning in the twenty-first century, governments will need to accord far higher priority to climate stabilization. Massive climate disruptions threaten to make a mockery of food security, expose hundreds of millions to dangerous storms and other weather extremes, cause havoc to the economy and jobs, and trigger a whole new range of conflicts.

Mitigation measures—reining in future greenhouse gas emissions—are critical, whether they result from a grand bargain at the December 2009 Copenhagen UN climate conference or from cumulative national measures. But too much carbon has already been put into the atmosphere to avoid adaptation measures. Helping communities and nations strengthen their resilience in the face of an inevitable degree of climate change is thus essential—so that they are less prone to resource conflicts, less exposed to the disasters and other repercussions, and less likely to confront massive population displacements.

Resilience has at least four major dimensions. Ecological resilience is about protecting or resurrecting natural buffers such as healthy forests or coastal wetlands, promoting drought-resistant farming, and so on. Social resilience is about reinforcing community coherence, reducing social inequality, and shoring up livelihood rights. Economic resilience is concerned with diversifying the economy and sources of income to limit the impacts of climate disruptions. Finally, good governance, and capable and inclusive institutions, create political resilience.

Instead of preparing for future climate wars or the type of interventions presaged in the *New York Times* article mentioned above, it is time to get serious about what Geoffrey Dabelko of the Woodrow Wilson Center and Ken Conca of the University of Maryland call "environmental peace-making." The concept is simple (though translating it into real-world policies is often not): Identify shared environmental vulnerabilities and interests among different

countries, and undertake joint projects to manage cross-boundary environmental resources that provide mutually recognized rights and tangible benefits, enhance mutual trust, and establish cooperative habits (on both the governmental and civil society levels). Among the existing initiatives are transborder peace parks, shared river basin management plans, and joint environmental monitoring programs. But such initiatives will have to multiply. And in addition to cross-border initiatives, similar efforts can be beneficial among different communities and regions within given countries. These are the sorts of initiatives the new climate of the twenty-first century requires.

Michael Renner is a senior researcher at Worldwatch Institute and director of the Institute's Global Security Project.



For more information about issues raised in this story, visit www.worldwatch.org/www/climaterisk.

Recarbonizing the Earth

The case for reducing emissions of greenhouse gases is more compelling than ever.

But it's also past time to begin drawing carbon out of the air.

by Richard J. Blaustein

About the time this article is published, the nations of the world will be gathered in Copenhagen to discuss ways to reduce emissions of carbon dioxide and other greenhouse gases (GHGs). In the run-up to Copenhagen, the general expectation had been that this meeting would at last chart an effective international climate-change policy to succeed the Kyoto Protocol. But expectations have moderated as 2009 progressed, and the common wisdom now is that the most likely outcome is a framework understanding with an extended working-out period to follow.

In many ways, this is all too familiar: year after year of presentations and negotiations while GHG emissions continue to rise and the scientific evidence paints an ever-more dire picture. Severe changes in the biosphere, such as the dramatic retreat of Alpine glaciers, are already occurring with atmospheric GHG concentrations at the current level of about 388 parts per million (ppm); they continue to rise about 2 ppm per year. The momentum built into the processes driving climate change virtually guarantees worse to come, even with significant cuts in emissions. To prevent the severest outcomes, it looks like we'll have to augment whatever progress on energy emissions and forest incentives comes out of Copenhagen with new ecosystem-based initiatives to pull carbon out of the atmosphere—an effort that, in effect, will amount to recarbonizing the Earth.

What GHG level should we aim for? The science is still evolving, but many important policy positions and discussions peg the acceptable upper bound at about 450 ppm, which



Forests: Clearcuts, slash piles, and logging roads, British Columbia, Canada.

Brian Burger

would theoretically limit further temperature increases to an additional 1.25 degrees Centigrade above current levels (and about 2 degrees C above pre-Industrial temperatures). However, NASA's top climate scientist, James Hansen, has been outspoken in advocating a maximum of about 350 ppm. "Humanity's task of moderating human-caused global climate change is urgent," Hansen and several colleagues wrote in a widely cited 2008 paper. "[T]here is a danger that human-made forcings could drive the climate system beyond tipping points such that change proceeds out of our control." Most critically, the Antarctic and Greenland ice sheets could melt and northern permafrost zones might warm and release their methane, triggering cascading ecological catastrophes.

Other assessments broadly support Hansen's target. For instance, climate activist and biologist Tim Flannery of Australia's Macquarie University points out that the findings of the Intergovernmental Panel on Climate Change (IPCC) support the essence of the Hansen et al. 2008 paper: "We are tracking the worse-case scenario of the IPCC's Third Assessment Report.... This indicates that catastrophic climate change will be unavoidable if emissions continue to grow.... Key indicators of this include...the rate of warming...and the rate of sea-level rise...."

"We are seeing abrupt changes, [such as] coral bleaching in the oceans and the pine bark beetle conifer mortality on the land," says biologist and Heinz Center Biodiversity Chair Thomas Lovejoy. "That is with only three-quarter degree of warming. At 450 ppm it is two degrees of warming.... [I]t



Saturated lands: Wetland plants in a bog in Karelia, northwestern Russia.

seems a real mistake to go beyond 350 ppm.” Flannery, Lovejoy, and United Nations Environment Programme (UNEP) Executive Director Achim Steiner called last year for bolstering ecosystems to lower GHG concentrations. Alongside “the imperative to redesign the energy base of human societies,” they write that “the potential to remove CO₂ from the atmosphere by restoring biodiversity and carbon is clearly of major consequence.” In short, this is a call for planetary engineering, and Lovejoy believes the only guaranteed safe way to do this is “biological...because all life is built of carbon.”

Potential

Soil scientist Rattan Lal, director of Ohio State University’s Carbon Management and Sequestration Center, has written extensively on natural ecosystem responses that would lower greenhouse gas levels. According to Lal, about 478 gigatons (1 gigaton equals 1 billion tons) of carbon have been released from land uses since the beginning of agriculture, while fossil fuels have released around 292 gigatons of carbon from 1750 to the present. Therefore, Lal argues, “recarbonization of the planet has a technical maximum potential of sequestering 478 gigatons of carbon. Even if 40 percent to 50 percent of this can be sequestered in trees, soils, and wetlands, an average of 200 gigatons is equivalent to an atmospheric drawdown of about 50 ppm over the next 40 to 50 years, or more by the end of the twenty-first century.”

Lal looks to the 120-gigaton annual global photosynthesis cycle for opportunities to extract atmospheric carbon and

convert it into some form of biomass. “It’s low-hanging fruit” with enormous potential, he says. Lal estimates that with the right land management practices the annual sequestration potentials for cropland would be 0.6 to 1.2 gigatons, for grazing lands 0.5 to 1.7 gigatons, and for degraded lands 0.6 to 1.7 gigatons—a huge sequestration total over the course of a few decades. Similarly, Hansen and his colleagues argue that an end to deforestation by 2030, matched with substantial reforestation, would “achieve a maximum potential sequestration rate of 1.6 gigatons [of carbon] per year.”

A key attraction of these practices is their co-benefits. Among these, Lal cites higher agricultural yields, improved water quality, richer and more dependable grazing lands, decreased pollution (including reduction of coastal dead zones), protection of biodiversity, and new income streams for farmers through carbon credits or ecosystem services payments. However, instigating these changes turns on political will, effective outreach, altering habits, and new policies. For example, for developing-country agriculture, “[u]nder the prevailing socioeconomic and policy environments,” Lal writes, carbon-enriching practices such as “no-till farming, agroforestry, diversified mixed farming systems, [and] precision farming...do not meet social and economic needs that determine farmer behavior. Therefore, there is a need for a radical change in mindset at all levels of the societal hierarchy.”

With all ecosystem focuses, policymakers, scientists, and advocates will need to work together to create outreach efforts and policies that maximize economic and multiple environmental benefits, not just carbon drawdown. However, on a large scale, payments for ecosystem services, carbon markets, and other ideas will only succeed if they insure the rights and livelihoods of local and indigenous peoples who live in forests and on agricultural and other lands. Without attending to equity considerations, polarization and resentment will surely ensue and undercut diverse ecosystem-based efforts to lower GHG levels (see “Vision Quest: Who Will Control the Future of the Amazon” and “Seeing REDD,” both in the November/December 2009 *World Watch*).

Possibilities

Several different land categories, including forests, saturated lands, rangelands, and croplands, are considered candidates for carbon enhancement and show varying degrees of promise and activity:

Forests. Forest options include afforestation (establishing forests in previously unforested areas), reforestation, and avoiding deforestation. A noticeable shift is under way both in terms of major programs—such as large-scale forestry projects in China and UNEP’s “Billion Tree Campaign”—and in international discussions.

This year there has been intense focus on deforestation, which accounts for the largest portion of the approximately 20 percent of greenhouse gas emissions related to land uses. (In 2005 the UN Food and Agriculture Organization reported

that the globe was losing about 13 million hectares—an area roughly the size of Greece or Nicaragua—of forest every year.) While afforestation and reforestation are currently included in the system created under the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, avoided deforestation is not. Kyoto Protocol discussions debated (but did not resolve) how addressing deforestation, primarily in developing countries, would be linked to wealthy countries' commitments on fossil fuel emissions.

However, advocacy and discussion have continued on avoiding deforestation, now mostly in the context of a program called Reducing Deforestation and Forest Degradation (REDD). In what many consider a breakthrough, at the UNFCCC's December 2007 discussions in Bali, Indonesia, the conference's deforestation decision called for "urgent action" on REDD. In fact, since Bali a consensus has emerged that tentatively favors an eventual incentives approach, which might eventually include REDD in a carbon market, promote a global program of direct foreign assistance, or both. At the same time, in pre-Copenhagen 2009 UNFCCC discussions, the advocates for greater equity and rights have voiced strong concerns about the adequacy of expected REDD provisions.

However, other developments point to an advancing discourse on how to match co-benefits and rights with forest carbon policies and investments. For example, a new effort was launched in 2009 to produce a set of guidelines called "REDD + Social and Environmental Standards" (REDD + SE), which aims to help governments formulate equitable REDD programs. Moreover, even with a desultory Copenhagen outcome, the discourse and the change in politics have been substantial enough to suggest that a forest program—afforestation, reforestation, and avoided deforestation—will loom large in the climate change agenda these next few years.

Saturated lands. Receiving less attention, but critical to mitigating land-use emissions, are peatlands, wetlands, and other saturated lands replete with stable organic carbon. According to biologist Hans Joosten of Greifswald University in Germany, continuing drainage of peatlands releases around 2 gigatons of CO₂ per year, or about 25 percent of all land-use emissions. Peatland conversion occurs often in the tropics, but also in Eastern Europe and the former Soviet Union.

Joosten points out that the way to mitigate peatland emissions is to stop ongoing drainage and "re-wet" already drained peatlands. He believes that restoring peatlands will produce many co-benefits, including improvements in regional hydrology, reductions in nutrient runoff, revitalization of rural economies with new livelihood opportunities, ecotourism, and the prevention of dangerous peatland fires, which in the Chernobyl region of Belarus, for example, "lead to re-emission of radioactive substances." Joosten also hopes for some international incentives to support peatland conservation, similar to those talked about for REDD.

Rangelands and grasslands. A different type of carbon man-



Grasslands: This permanent grass cover established under a conservation reserve program in northern Minnesota sequesters large amounts of carbon throughout the dark soil layer.

USDA ARS

agement, rather than capturing carbon in vegetation or avoiding its release, involves modifying or enhancing soils themselves with carbon amendments. Ranchers, farmers, and land managers all over the world look to carbon in the soil for productive lands. Justin Derner, a rangeland scientist with the U.S. Department of Agriculture's Agricultural Research Service (ARS), explains that "carbon is the fundamental building block for healthy rangeland soils." According to ARS pastureland expert Alan Franzleubbers, "soil organic matter is typically composed of 58 percent carbon and 5 percent nitrogen.... Soil organic matter is a sink for carbon, derived from plant uptake of CO₂ from the atmosphere and decomposition and transformation of plant residues into soil organic matter." Grassland and cropland soils can quickly take up considerable amounts of carbon.

The world's 3.3 billion hectares of grazing lands offer enormous potential for sequestration. For example, according to Derner it is estimated that in the United States 90 percent of privately managed rangelands can be significantly better managed and attain much higher levels of soil carbon, by such means as increased plant cover, light-to-moderate livestock loads, and low-disturbance addition of legumes. Ron Follett, who leads the Soil Plant Nutrient Research Unit at ARS, says these plantings and other measures are low-cost technology that land managers already know how to use.



Croplands: This Iowa farm incorporates terraces, conservation tillage, and green buffers around riparian areas.

Soil carbon enhancement outreach and policy linkages are starting to come into view. For example, Follett points to the Environmental Service Markets Program initiated by the U.S. 2008 Farm Bill as key to preparing American farmers and ranchers for future carbon and ecosystem service markets. There are uncertainties to be worked out—“The question remains about how such benefits of environmental services might best be measured,” he says—but the energized scientific and policy scrutiny of soil carbon in the American heartland raises possibilities within and beyond America’s borders.

Similarly, in the developing world there is a strengthening focus on the benefits of increasing soil carbon. Recarbonizing developing-world rangelands and grasslands will lead to healthier livestock, less erosion, cleaner water, and better nutrient cycles, among other benefits, as well as better livelihoods. Moreover, for rangelands and pasturelands in the developing world, climate-change adaptation strongly overlaps with mitigation. “For example, if we are assisting pastoralists in the Horn of Africa to be prepared for potentially more arid climatic conditions,” explains Namibia-based environmental scientist and UN consultant Julianne Zeidler, “a more directed utilization of limited range resources...will diminish potential degradation or desertification and will limit carbon releases.”

Croplands. For croplands worldwide, there are also many opportunities to increase carbon content and yield co-benefits. High-carbon crop systems, livestock management that

produces less greenhouse gases, and restoring vegetation in degraded areas are among the strategies on tap. Soil scientist and World Bank advisor Erich Fernandez adds that “[i]n the tropics, the use of a variety of conservation tillage, mulching, agroforestry systems, and improved manure management and composting with crop residues is resulting in significant carbon replenishment of carbon depleted soils.” However, Fernandez also warns against neglecting the local picture: “Farmers don’t farm to produce carbon—they strive to produce food and fuel crops and building materials for household consumption and for sale.” For Fernandez, future agriculture policies must focus on developing farmers’ production goals, which will turn on better environmental practices.

Sarah Scherr, an economist and president of the nonprofit group Ecoagriculture Partners, also calls for new focuses, such as expanding agricultural research beyond the traditional concentration on seeds and yields. “[I]n this century, the production of ecosystem services like carbon sequestration, watershed protection, and wildlife habitat will have to be just as important,” says Scherr. “We haven’t invested very much in research on how to achieve production and livelihood goals, while at the same time producing ecosystem services—particularly how to develop carbon-rich, low-emissions agricultural systems.”

Fire management. Then there is managing wildfires, responsible for emissions of perhaps 1 or 2 gigatons per year of carbon, depending on climate patterns and the estimation methods. This area will be difficult to address, as fire policy is often a primary responsibility of local governments. However, with growing dissemination of best practices, such as scheduling prescribed fires in cool seasons instead of hot ones, a real difference could be made in this area too. For example, a 2008 study of Australian indigenous lands and climate mitigation measures by Australia’s Commonwealth Scientific and Industrial Research Organization concluded that with better fire management GHG emissions from fires on Australian indigenous lands would decrease from an estimate 7.6 million tons of CO_{2eq} (carbon dioxide equivalent) per year to 5 million tons CO_{2eq} per year. The paper points out that this reduction could be incentivized by linkage to the offset market. Thus, even with fire management, it may be possible to link practices at the local level with national or global carbon programs.

Biochar. Lastly—and getting a lot of attention in 2009—there is biochar, the soil amendment famous for its association with fertile indigenous lands (*terra preta*, or “black earth” in Portuguese) in the Amazon. Biochar is charred organic matter from low-oxygen heating and has an extremely slow rate of carbon decomposition. It is therefore a “recalcitrant” that increases the terrestrial carbon balance in a durable way. As a soil amendment biochar tends to increase growth of photosynthesizing biomass, thereby facilitating sequestration.

Biochar is usually formed for more than one reason, as the biochar heating process (pyrolysis, for example) can also produce gas usable for energy. Biochar expert and Cornell University soil scientist Johannes Lehmann points out that

“biochar will create the greatest sustainability value where a waste biomass stream is co-located with energy needs and the need for soil improvement.” This could be where biomass is “an environmental liability, such as with some green wastes or animal manure” at agricultural sites, or “where soils are severely degraded,” including in unproductive dry lands.

There has been some backlash against biochar. For example, a March 2009 *Guardian* column by British journalist and activist George Monbiot was particularly harsh in questioning biochar’s effectiveness and its impact on health and landscapes. And a 2009 UNEP paper, “The Natural Fix? The Role of Ecosystems in Climate Mitigation,” was cautious about biochar. Until environmental, agricultural, and economic questions are worked out, it said, “large-scale biochar deployment is inadvisable.”

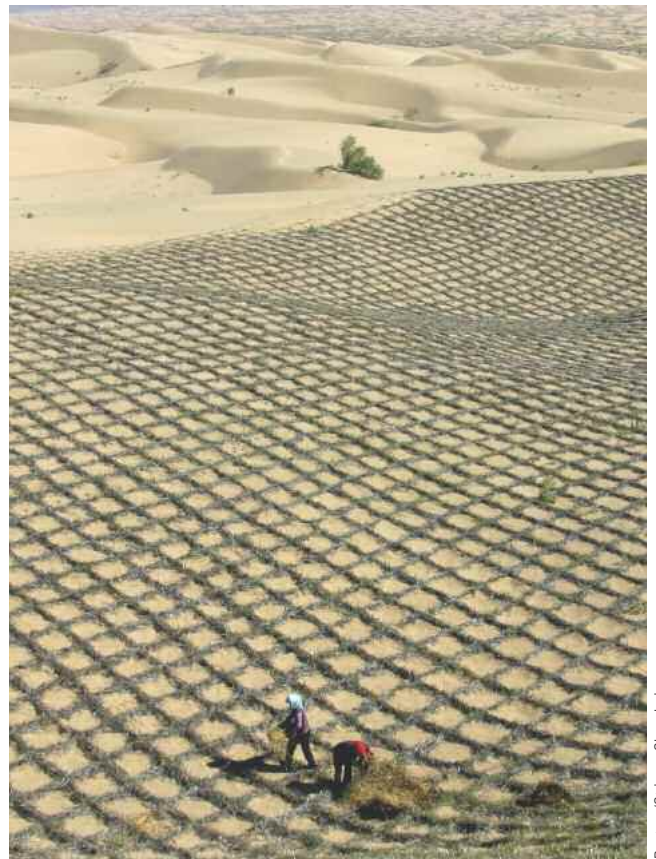
Nonetheless, in recarbonization scenarios biochar is typically included. “There is no single technology which can be applied to all soils, climate land uses, and social and environmental conditions,” Rattan Lal contends. “Biochar, similar to no-till and agro-forestry, has some niches where it may be applicable. These niches are those which have sources of biomass which is not used for other purposes.” Johannes Lehmann adds that “biochar systems should be seen as another tool in our tool box to mitigate climate change and global soil degradation. It may well turn out to be an important one. We can not afford to overlook any sustainable option for climate change mitigation.”

Paradigms

An adequate climate change response with a big natural sequestration component poses a huge challenge in terms of choices, rights, and flexibility of measures. “It is, of course, a big land issue,” Thomas Lovejoy says, “the biggest of all time—as the same land base has to supply food, biofuels, biodiversity conservation, and carbon sequestration.”

Nonetheless, there are paradigms of large-scale land management which offer guidance. For example, Sarah Scherr gives the example of the United States’ response to the Dust Bowl of the 1930s: “Millions of hectares were restored and protected with soil conservation measures and planting of windbreaks.” Scherr also highlights current undertakings in India and China that are rehabilitating millions of hectares of degraded lands. “These programs could be scaled up ten-fold if carbon finance for local organizations, technical assistance, and planting materials were available to communities.”

Incentives, too, are key. For example, Alan Franzleubbers maintains that farmers, with the right incentives, would adopt carbon sequestering approaches, “not only in response to financial interest but also based on a stewardship ethic and the desire to improve the world. Farmers...are drawn in different directions due to various social and economic policies and incentives.” If science, government, and industry would forge a clear framework for agriculture, he says, “enormous potential exists to improve conservation practices in the U.S.A.”



Reuters/Stinger Shanghai

Degraded lands: Farmers plant grass to stabilize sand dunes at the edge of the Mu Us Desert in Lingwu, China.

In addition to incentives, the notion of a public-service benefit might appeal to many. According to independent geologist Allison Burchell, who examines geological-based linkages for sequestration, such as with restored mines, “an enhanced natural terrestrial sequestration program may buy us time in the race against climate change. It offers hope and opportunity for both research and public participation—green jobs, green education, AmeriCorps, volunteers for America—to engage collaboratively to determine the combination of applications that may enhance the [carbon] baseline of a restoration area.”

Time is critical. “This is the ultimate moment of reconciliation between humanity and the living planet,” Lovejoy asserts. “We can either recognize the need to manage the planet as a biophysical system and reap the benefits, or we can continue to degrade the biological underpinnings of the planet.” Perhaps what is most encouraging is that what we need to do is clear and has many co-benefits. “We are talking about strengthening Earth’s life force,” Tim Flannery explains. “What we have done is weaken the life force, and we need to strengthen the capacity of the Earth to take care of us.”

Rich Blaustein is an environment writer based in Washington, D.C.



For more information about issues raised in this story, visit www.worldwatch.org/ww/recarbonize.

Transforming Capitalism:

Worker-Owned Business, or Expanding the Non-Profit Sector?

by Hunter Lewis

Editor's Note: In the September/October issue of World Watch, philosopher David Schweickart wrote about the dynamics and environmental advantages of economic democracy, a noncapitalist system in which most firms and corporations would be owned and run by their workers. In this essay, author and investment banker Hunter Lewis critiques economic democracy and argues for expanding the nonprofit sector instead.

Who would not agree that today's capitalism needs reform? But reform in what direction? That is the critical question.

In the September/October 2009 issue of *World Watch*, David Schweickart, philosophy professor at Loyola University Chicago, offered an intriguing proposal: a move to worker-owned businesses. He cited the Mondragón Corporación Cooperativa (MCC), an alliance of worker-owned and shareholder-owned businesses based in Spain, as an imperfect but serviceable model to follow.

Worker-owned businesses are not just an idea. They are also an ideal, an ideal which cannot help but appeal to all of us on some level. But we live in a world of competing ideals. For example, if we want economic democracy, as Schweickart says he does, are worker-owned cooperatives or buyer-owned cooperatives the right model to follow? In making this choice, we must remember that all workers are also buyers (consumers), but not all consumers are workers. Might it not be more democratic for consumers to own the economy rather than workers?

Schweickart also accepts the idea that workers in worker-owned businesses may be paid at different levels, just as they are in MCC's worker-owned businesses. The fundamental concept of democracy is one vote per person. If workers receive different numbers of dollars or Euros for their labor, can this really be described as democratic? Or is it enough that workers will be able to vote in or out management teams and review management compensation on a one-person, one-vote basis?

Another issue: If all workers ultimately have an equal say about compensation, will they agree to keep the labor share of expenses under control? Will there be enough money left over to save, to build up needed financial reserves, and to make the investments necessary to compete and produce better and better, and cheaper and cheaper, products? All of us as consumers ultimately benefit from being able to choose better and cheaper products brought to us by competition, and it takes a great deal of investment to produce them. Does this perhaps explain why MCC is not entirely worker-owned but also operates shareholder-owned businesses? Certainly there are examples of worker-owned businesses (e.g., United Airlines) in which workers did not put the future of the firm ahead of their own paycheck.

When I co-founded my own financial business in the 1970s, I gave a great deal of thought to how it would be structured. A worker or employee cooperative was one of the options I considered. But I eventually rejected the idea for a number of reasons. An important one is that worker-owners change. People may come to work at the firm for a few years and then move on. Others may stay but eventually retire. Some may work hard and make a great contribution and others not. If I work hard for 30 years building a business, is it fair to turn over my full ownership share to a brand new employee who has not yet contributed anything?

Can we also be sure that employee ownership will last? When I was deciding about my own business, there were a number of financial firms fully committed to forms of the worker cooperative idea. The first or even the second generation turned the business over to a succeeding generation at either no or low cost. But in many cases, the succeeding generation then decided to change the rules. They decided not to continue the hand-down through the generations but instead sold the business at a high price to outside shareholders. In effect, they took the equity built up by earlier generations and claimed it all for themselves. It is possible to

set up some legal barriers to prevent this happening, but such legal barriers can usually be circumvented.

These are not, of course, new issues. Some of them were discussed by Karl Marx. Marx said in different passages that people should be paid according to need and also that workers should receive the full fruit of their labor, two contradictory ideas. He also argued that the fruits of capital as well as labor should go to labor, because capital was just embodied labor, but did not explain why today's laborers should get all the profits from the capital that retired laborers have left behind. Marx also said nothing about how to divide the profits among today's workers.

Schweickart is more specific than Marx, which helps us think through his proposal. He says that owners will not be paid salaries, but "specified shares...of the firm's profit." This could have many advantages, because the firm's costs would automatically fall as profits fall, thereby reducing the risk of bankruptcy. But profits by their nature can be extremely variable. Is it realistic for workers with rents or mortgages and often families to support to see their take-home pay go up or down by large amounts?

In some instances, Schweickart could explain his logic more fully. For example, he says that worker-owned firms in a worker-owned economy "don't have to worry about being driven out of business by a more innovative...rival" and can also "choose leisure" over increased income. It is not clear why this is true. In thinking about innovation, we also need to remember that without it we would all still be farmers or even hunter-gatherers, and of course there would be far fewer of us alive. Many innovations have very negative consequences (we each have our own list), but change cannot be bad in itself.

Schweickart says that "we must move beyond capitalism if humanity is to flourish." In order to know whether this is true or false, we must first define capitalism. Schweickart's own view of the capitalist system is thoroughly Keynesian. For example, he agrees with Keynes that consumption drives



the economy. We dare not stop borrowing and spending or the economy as presently structured will implode. This is a complicated question, one which I explore in my books *Where Keynes Went Wrong* (2009) and *Are the Rich Necessary?* (2007). But I believe Keynes to be completely wrong about this. I do not agree that capitalism depends primarily on consumption, much less limitless consumption. On the contrary, I think that frenzied consumerism of the kind that we have had destroys the market system.

Where has this frenzied consumerism come from? The usual view is that it comes from private markets and that we should look to government for a solution. This is also part of the Keynesian worldview. Keynes held that private market participants are gripped by "animal spirits," but that government officials are not. He even suggested that government officials decide matters based on "long views and collective wisdom." I do not think Schweickart would go that far, since he



Consumer temple: the Galerías
Pacífico Mall in Buenos Aires.

Luis Argerich

acknowledges government's large responsibility for creating what might be called today's car economy. But he does propose putting government in charge of the allocation of capital to a new world of worker-owned businesses. He also proposes government as an "employer of last resort."

I take a very different view of government. I attribute much of the frenzied consumerism of recent years to poor government decisions, especially decisions by the U.S. Federal Reserve to print too much new money. All this newly printed money flowing directly into Wall Street created the casino atmosphere which Keynes ironically deplored. It has also led to the corruption of government as more and more of the new money flowed back from Wall Street into government campaign contributions and lobbying budgets.

Did the Crash of 2008 create the merger of Wall Street and Washington that we see today? No. The Crash was the result, not the cause, of this merger. The more government gets

involved in the financial economy, the more opportunity there is for present political corruption to grow. If government or its agents were to allocate all capital in the economy, I fear not only that allocation decisions would be unwise, but that corruption would exceed all bounds and we would end up with a system that looks like Russia today under Putin.

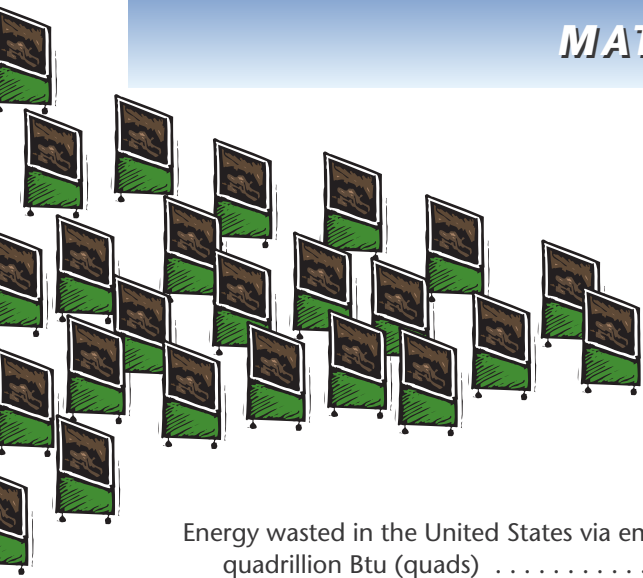
Let's put aside for a moment today's crisis in our economy and our democracy and return to the initial question that opened this piece. Is there a way to transform capitalism, in particular to put a more human face on it? I think there is. At the present time, government represents about a third of our economy, and nonprofits about 10 percent; the rest is privately owned. What I would personally like to see is a much bigger nonprofit sector. Two changes would be needed to accomplish this. First, tax deductions for charitable gifts could be turned into tax credits (which directly reduce taxes dollar for dollar). Second, nonprofits should be allowed to

control private businesses, something which they are not allowed to do today. If we went in this direction, we could have the efficiency and innovation of the private sector, but with more and more charitable funds available to alleviate poverty, to help those in need, to safeguard the environment, and to achieve other important social ends.

One of the anomalies of the present political discussion is that President Obama has come out in favor of limiting charitable deductions. I believe that we need to go in precisely the opposite direction. We need to give the charitable sector of the economy a full place at the table along with government and private enterprise.

Hunter Lewis is co-founder of a global investment firm, author of Where Keynes Went Wrong, Are the Rich Necessary?, and other books. He is a former Worldwatch Institute board member and an active environmentalist.

MATTERS OF SCALE



Wasteland



Energy wasted in the United States via embodied energy in trash and other solid waste each year, quadrillion Btu (quads)	1.6
Energy wasted via industrial waste, quads	11.4
Energy wasted in transportation losses, quads	20.0
Energy wasted via power generation losses, quads	26.4
Total energy wasted, quads	59.4
Wasted energy share of total U.S. primary energy consumed, percent	60



Share of energy consumed by an ordinary car that actually moves the driver, percent	<1
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Amount of food waste generated yearly in the United States, tons	30 million
Share of total U.S. waste stream, percent	12



Share of industrial inputs to products lost within six months of product manufacture, percent	>99
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Estimated water lost via leaks in city water systems, percent:	
Boston	36
London	50
Manila	55
Seoul	35



Estimated person-hours lost in traffic jams, United States (2005)	4.2 billion
Associated fuel waste, liters	11 billion



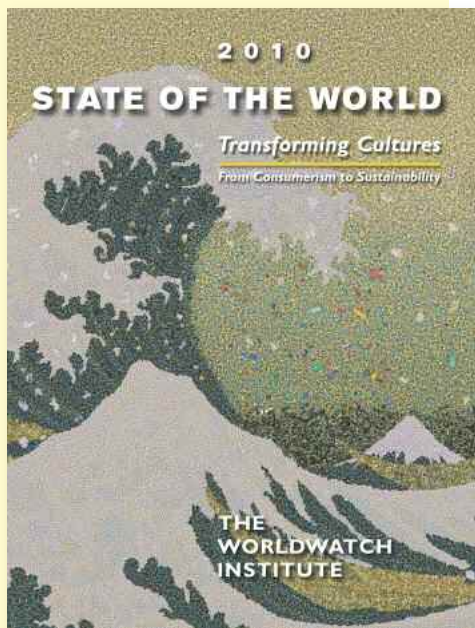
Rate of global topsoil loss, tons per year	24 billion
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SOURCES: Energy: Sean Casten, *Grist*, Sept. 11, 2009. Car energy efficiency: Amory Lovins, *Encyclopedia of Energy*. Food waste: U.S. Environmental Protection Agency. Industrial inputs: L. Hunter Lovins, *State of the World 2008*. Water: www.corrosion-club.com/waterfigures.htm. Traffic jams: Texas Traffic Institute. Topsoil: David Montgomery, *Dirt: The Erosion of Civilizations*.



To view other archived Matters of Scale visit www.worldwatch.org/ww/.

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Birds and Bags

Festive holiday decorations? No, plastic bags and other plastic debris snagged by thorny trees at a dump site in Changzhi, Shanxi province, China, in March 2009. Apparently China's plastic bag ban has not yet fully taken hold.