

By George F. Sanderson

# Climate Change

*The Threat to  
Human Health*

*The greenhouse effect could wreak havoc on human health, allowing tropical diseases to affect nontropical populations, causing heat-related stress and illness, and worsening air pollution.*

We have come a long way in recent years toward realizing how extensively global warming will jeopardize both planetary and human health.

Carbon-dioxide buildup—mainly from combustion of fossil fuels such as oil, gas, and coal, and from clearing and burning of forests—is be-



**Left:** Plume of sooty smoke blackens the skyline of Alexandria, Egypt. Air pollution, a human-health hazard in itself, also contributes to global warming. In a "greenhouse future," pollution's impacts on health will worsen, says author Sanderson.

lieved responsible for about half of this worldwide warming, while chlorofluorocarbons (CFCs), methane, ground-level ozone, and nitrous-oxide emissions account for the rest. Together, these gases act like glass in a greenhouse: They allow passage of incoming solar radiation but trap some of the outbound heat radiation from the earth.

One very significant aspect of global warming is the variety of effects it will have on human health—some will be subtle and indirect, others dramatic and direct. Many of the very factors contributing to global warming are themselves harmful to humans, such as the burning of fossil fuels: A typical automobile emits carbon monoxide, sulfur and nitrogen oxides, hydrocarbons, low-level ozone, and lead, all of which are hazardous to health. According to a World Health Organization (WHO) task group on the potential health effects of climate change and the Intergovernmental Panel on Climate Change (IPCC), climate change will likely worsen air pollution—especially in heavily populated urban areas—by altering the composition, concentration, and duration of chemical pollutants in the atmosphere.

Chlorine released by CFCs and bromine released by halons (used in fire extinguishers) both deplete stratospheric ozone. The use of CFCs and halons thus escalates the risk of skin cancer, eye cataracts, snow blindness, and weakened immunity to a host of other illnesses by exposing humans to increased ultraviolet B radiation from the sun. "Skin cancer risks are expected to rise most among fair-skinned Caucasians in high-latitude zones," according to the IPCC. The WHO task group reached a similar conclusion, noting that "the incidence of non-melanoma skin cancer could increase between 6% and 35% after the year 2050. These increases may be larger in the Southern Hemisphere, where total ozone depletions have been larger."

### Health Inside the Greenhouse

On the basis of present trends, scientists predict that greenhouse gases will warm the earth further by about 0.3° C in each decade of the next century. This rise, faster than any experienced over the past 10,000 years, could increase the planet's mean temperature by 3° C before the year 2100, making it warmer on average than it has been for 100,000 years.

This may not sound especially ominous, but left unchecked, global warming could alter rainfall patterns, flood vast areas of low-lying land as warmed seas rise (possibly by as much as a meter), and drive countless species to extinction as fragile ecosystems collapse. A warmed planet will affect human health by disrupting food and fresh water supplies, displacing millions of people, and altering disease patterns in dangerous and unpredictable ways.

The populations most vulnerable to the negative impacts of the greenhouse effect are in developing countries, in the lower-income groups, residents of coastal lowlands and islands, those living in semiarid grasslands, and those in the squatter settlements, slums, and shantytowns of large cities.

Present strategies for immunization, coping with disease vectors or carriers, providing safe drinking water, and improving nutrition are all based on existing climate regimes, ecosystems, and sea and solar-radiation levels. These are all expected to change, but exactly how much cannot be predicted with any

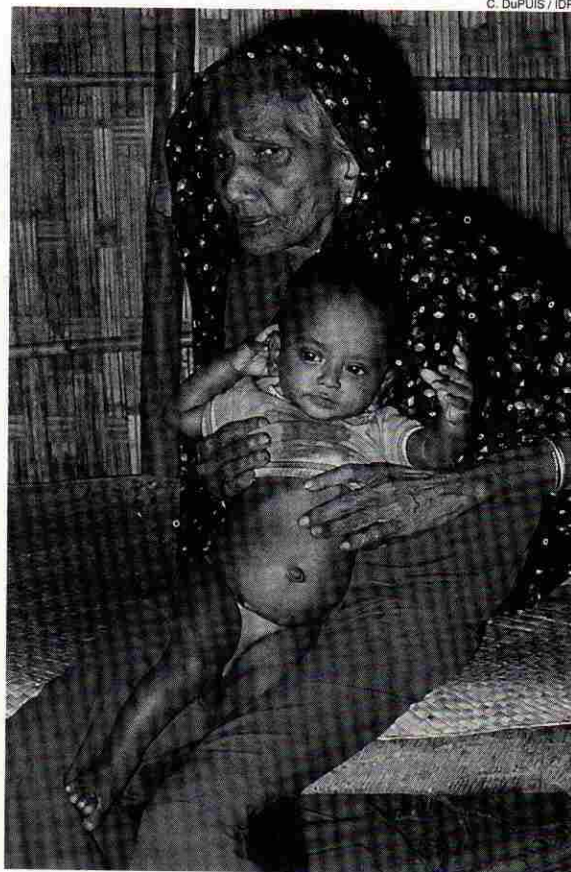
Bangladeshi woman seeks medical attention for sick child. Infants and elderly people—especially in the poverty-stricken areas of the world—are most vulnerable to extreme changes in temperature and the climate.

certainty, making it virtually impossible to adjust health and nutritional strategies now to take possible climate changes into account.

Humans adapt well to moderate changes in temperature and to occasional extremes. But this adaptive capacity—developed over many thousands of years—is relatively low in infants and the elderly; it rises through childhood and adolescence to reach a maximum that can be maintained up to about 30 years of age, then begins to decline.

### When the Temperature Rises

Heat-related illness is one problem that will likely proliferate. Currently, the temperature in Washington, D.C., exceeds 38° C (100° F) on an average of one day per year; it rises above 32° C (90° F) about 35 days every year. "But by the middle of the next century, these figures could rise to 12 and 85 days respectively per year," according to the World Meteorological Organization. "The effect of such temperature rises on human health in Washington and similar cities throughout the world is diffi-



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cult to predict. But there is no question that increased urban heat stress could come to claim many lives."

The same conclusion was reached by IPCC, which warned in June 1990 that the increase in deaths caused by a greater number of summer heat waves "would be likely to exceed the number of deaths avoided by reduced severe cold in winter."

A changing climate will also probably shift the range of conditions favoring certain pests and diseases, according to the final scientific statement issued by the Second World Climate Conference in November 1990.

As temperatures rise, the boundaries of the tropics may extend into the present subtropics, and parts of temperate areas may become subtropical. This will allow the insects and animals that carry or cause many tropical diseases (e.g., mosquitoes, snails, etc.) to move poleward in both the Northern and Southern hemispheres. Some communicable illnesses, including those



transmitted through air, water, and food, could therefore become common in regions that once rarely knew them, with a possible rise in death rates.

Diseases such as malaria, hepatitis, meningitis, polio, yellow fever,

Doctor in Bangladesh examines patient with dysentery. Diseases that already plague people in low-lying countries will spread to other areas of the world as climate patterns shift and sea levels rise, says Sanderson.

## Fighting the Greenhouse Effect

Scientists and policy makers disagree even among themselves on the exact scenario that the greenhouse effect will follow in the years ahead—whether we will see only a mild warming or a major disruption of Earth's climate or something in between.

Because there is no single "silver bullet" that will mitigate the effects of global warming, a variety of options are under evaluation by the Committee on Science, Engineering, and Public Policy, administered by the National Academies of Sciences and Engineering and the Institute of Medicine. A report by the committee's mitigation panel concludes that current knowledge about the pollutants and other factors leading to global warming warrants only the lowest-cost (or no-cost) mitigation options.

The panel analyzed a wide range of options and rated them

on the basis of their cost effectiveness. Those rated "best practice" are those that could reduce U.S. greenhouse-gas-equivalent emissions by 25% from 1990 levels at a relatively low cost or even a savings.

Among the no-cost and low-cost options the panel recommends are:

- Implement conservation and energy-efficiency improvements in residential, commercial, and industrial buildings. Examples of strategies include using fluorescent lamps and superefficient appliances, planting more vegetation around buildings, and painting roofs and road surfaces white.
- Reduce emissions through improved motor-vehicle efficiency by, for instance, reducing vehicle weight, improving aerodynamics, and reducing engine warm-up time.
- Continue aggressive phaseout of chlorofluorocarbons.

- Reduce global deforestation and reforest marginal lands.

- Consider greenhouse warming in design and operation of electricity-generating systems. Existing industrial energy systems could be replaced with cogeneration plants that produce heat and energy simultaneously.

The panel points out that, if global climate change proves to be more severe than now predicted, higher-cost "backstop" options could be implemented, such as increasing phytoplankton growth in the oceans.

Source: *Policy Implications of Greenhouse Warming: Report of the Mitigation Panel*, Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, Institute of Medicine. 1991. 500 pages. Available from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418, for \$35 (plus \$3 shipping) prepaid.



dengue fever, tetanus, cholera, and dysentery, which flourish in hot, humid weather, could increase, while those associated with cold weather would be expected to diminish.

In a warmer climate, malarial mosquitoes and other disease carriers also may migrate vertically, up into formerly inhospitable highlands. This may be particularly hazardous in tropical highland areas where there is no natural resistance to malaria. Researchers in Kenya have already found malaria-carrying mosquitoes in areas where they were previously unknown.

Changes in temperature, rainfall, humidity, and storm patterns may affect insect- and animal-borne diseases in two ways. First, they may directly affect the carrier's range, longevity, reproduction rate, biting rate, and the duration and frequency of human exposure. Second, they may modify agricultural systems or plant species, thus changing the relationship between carrier and host.

Development rates of mosquitoes, for example, would increase with warmer temperatures, provided these pests have wet areas in which to breed, and snail-borne diseases are likely to spread if global warming forces increased irrigation or causes people to migrate toward irrigation projects. Changed human migration patterns, along with increased temperature and rainfall, may extend the geographic range of hookworms, too.

Moreover, "warmer, humid conditions may enhance the growth of bacteria and molds and their toxic products, such as aflatoxins," cautioned the WHO task group. "This would probably result in increased amounts of contaminated and spoiled food."

Such changes would not be limited to developing countries. For example, in the United States, tick-borne diseases such as Rocky Mountain spotted fever and Lyme disease could spread northward. Americans could face the risk of five separate mosquito-borne diseases that have at present been virtually eradicated, according to Andrew Haines, a professor at University College and Middlesex School of Medicine in London.

## Malaria on the Rise

Malaria is raging at unprecedented levels and will continue to do so unless governments support research to prevent the disease, according to an Institute of Medicine committee. Malaria is a tropical disease caused by mosquito-borne parasites; it kills some 1.5 million people and infects as many as 300 million worldwide each year.

The mosquitoes carrying the parasites that cause malaria have become resistant to insecticides, and the disease itself has become

resistant to the drugs traditionally used to treat it. Thus, vaccination offers the greatest hope. A malaria vaccine is still years away but could offer enormous benefits, according to committee chairman Charles C.J. Carpenter, professor of medicine at Brown University.

Source: *Malaria: Obstacles and Opportunities*, Institute of Medicine, National Academy of Sciences. 1991. Available for \$42.95 (postpaid) from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

## Higher, Warmer Waters

As ocean temperatures rise and nutrients from agricultural fertilizers leach into rivers and coastal waters, toxic "red tides" may become more frequent, disrupting marine food stocks. This proliferation of minute marine organisms called dinoflagellates sets off a toxic chain reaction up the food chain: Incidences of food poisoning would increase when people eat tropical fish or shellfish that have eaten organisms that have eaten dinoflagellates.

Sea-level rise could spread infectious disease by flooding sewerage and sanitation systems in coastal cities, and increase the incidence of diarrhea in children. The flooding of hazardous waste dumps and sanitation

systems could result in long-term contamination of croplands.

Rising, warmer seas may also disrupt marine habitats and aquatic food chains. Since fish constitute 40% of all animal protein consumed by the people of Asia, such a disruption of the marine ecosystem would affect the food supplies of many mil-



Thai youngster climbs the steps to house along one of Bangkok's *klongs*—networks of irrigation canals. Droughts caused by shifting rainfall patterns will increase irrigation and force many people to migrate toward irrigation projects, where disease-carrying mosquitoes, snails, and other pests proliferate.



lions of people and dramatically increase protein deficiency and malnutrition.

Food shortages, reaching "famine proportions in some regions," could also follow the inundation of fertile coastal land by rising seas, the WHO task group noted. And the potential scarcity in some developing countries of food, cooking fuel, and safe drinking water because of drought may further increase the extent of malnutrition, with "enormous consequences for human health and survival," according to the IPCC. The most-serious implications are for Indonesia, Pakistan, Thailand, the Ganges Delta in Bangladesh, and the Nile Delta in Egypt, all low lying and densely populated.

### Human Disruptions

Finally, changes in the availability of food and water as well as radical shifts in disease patterns could initiate large migrations of people. An increased number of "environmental refugees" would lead to overcrowding, social stress, and instability, all of which may impair human health and increase health inequality between peoples of developed and de-

Fishing port in the Philippines. Warmer oceans could disrupt food supplies by causing food poisoning in people who eat fish contaminated by toxic organisms that multiply in warmer oceans. Many millions of people around the world rely on fish as their primary source of protein.



C. DuPUIS / IDRC

In Upper Volta, two migrants pause to rest. Droughts exacerbated by global warming will force more people to become "environmental refugees," says Sanderson, resulting in overcrowded cities, increased social instability, and greater stresses on human health.

veloping countries.

Much more emphasis must be placed on research into how people contribute to and cope with climate change and on public awareness and education programs. "Not only do we need more information about environmental conditions . . . we also need information about health conditions if we are to target our efforts and use our ever-limited resources to best serve health needs," notes Wilfried Kreisel, director of WHO's Division of Environmental Health. "Sad to say, environmental health globally suffers from informational malnutrition."

Equally important in Kreisel's view is the global need to generate more and better human resources for environmental health, to develop

more-coherent environmental health policies, and to influence not only the leaders of business and industry but also people in all walks of life to be more sensitive to the health implications of their choices and decisions.

"Day by day, the image of the world as the 'global village' becomes more of a reality," Kreisel points out. And as all people are affected by environmental degradation, including that caused by global warming, "communication and sharing of resources among peoples is essential for the survival of the planet and our species." □



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