

Global Environmental Change: The Threat to Human Health

Executive Summary

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*This is an executive summary of the report Global Environmental Change:
The Threat to Human Health, released jointly by the Worldwatch Institute
and the United Nations Foundation in November 2009.*

Over the past two-to-three hundred years, humanity's ecological footprint has ballooned to such an extent that we are now fundamentally altering the planet. We have transformed the Earth's land surface and altered the function of its ecosystems, and we are triggering the rapid loss of both terrestrial and marine life. We are also profoundly changing our planet's climate. It is increasingly apparent that the breadth and depth of the changes we are wreaking are imperiling not only many other species, but the health and wellbeing of our own species as well.

As humans convert more land, water, and ecosystem services for their own use, the environmental changes resulting from these activities are combining to magnify several serious public health threats, including: exposure to infectious disease, food scarcity, water scarcity, air pollution, natural disasters, and population displacement. Taken together, these represent the greatest public health challenge of the 21st century. We need to act with urgency to reduce ecological disruption while simultaneously strengthening the resilience of populations to withstand the impacts of unavoidable environmental change.



Food distribution at a refugee camp in Angola.

Courtesy USAID

Global climate change in particular threatens human health in numerous and profound ways. Large segments of the population will experience more heat waves, altered exposure to infectious disease, and more-frequent natural disasters. Most significantly, climatic disruption threatens the adequacy of the core “building blocks” of health for large populations around the globe: sufficient food and nutrition, safe water for drinking and sanitation, fresh air to breathe, and secure homes to live in. As climate change dismantles these

central elements of healthy societies, people with fewer resources will be forced to migrate in large numbers to lands where they may not be welcome, likely leading to increased civil instability and strife.

Environmental Change and Infectious Disease

Ample evidence suggests that human disruption of ecological systems is changing the distribution of infectious disease, leading in many instances to increased transmission. Global land use and climate change drive new patterns of disease exposure through five main mechanisms:

- *Changes in the density or presence of disease-related organisms.* Changes in temperature, precipitation, nutrient concentrations, and other parameters are often fundamental in defining the range and breeding habitat of vectors, hosts, and pathogens;
- *Changes in exposure pathways.* Direct human incursions into wildlife habitat (e.g., to establish new settlements or for bushmeat hunting), rural-to-urban migration, and the movement of non-immune workers into disease-endemic areas can all lead to new exposure pathways.
- *Change in the genetics of pathogens.* Intensified livestock management can allow pathogens to proliferate and develop genetic modifications more rapidly, affecting both the infectiousness and virulence of disease organisms.
- *Changes in the life cycles of pathogens and vectors.* Higher air temperatures, for example, are associated with shorter egg-laying cycles, faster development, and increased survivorship among *Anopheles* mosquitoes, increasing their capacity to spread malaria.
- *Changes in species composition.* Complex changes in the types of organisms that make up ecological communities can have dramatic impacts on disease exposure by creating conditions and relationships that favor certain pathogens over others.

Infectious diseases that are transmitted by a vector or that have a non-human host or reservoir, such as malaria, dengue fever, schistosomiasis, and Chagas disease, are particularly sensitive to these types of changes. Given that such diseases affect more than half the human population, alterations in their transmission can have significant impacts on global public health.

Environmental Change, Food, and Nutrition

Although altered exposure to infectious disease receives much of our attention, the most important impacts of global change on human health are likely to result from

reduced access to food and safe water. Already, an estimated 1.02 billion people worldwide—nearly one-sixth of the global population—are undernourished (see Figure), and malnutrition is responsible for at least a third of the disease burden in poor countries.

As the human population expands and as more people eat meat, world agricultural production will need to roughly double over the next 50 years to keep up with projected demand. But food production is already facing significant ecological constraints—including limits to arable land, water scarcity, soil nutrient depletion, and biological limits to increasing crop yields. Climate change will further challenge food production through myriad mechanisms and is expected to reduce yields significantly in many regions of the world—particularly those where food scarcity is already endemic.

Other Health Outcomes

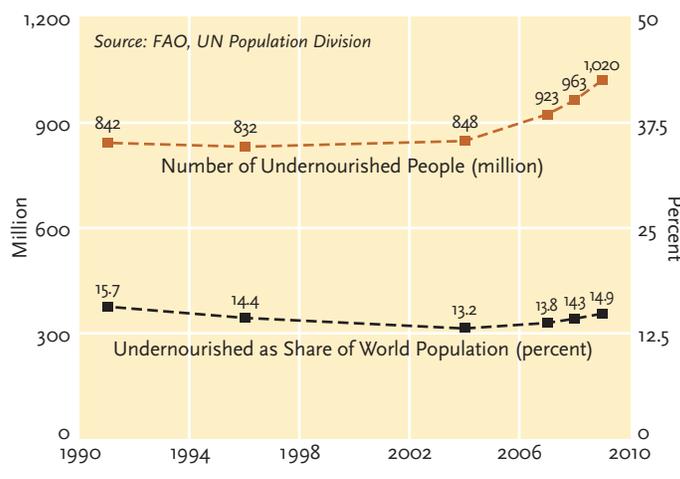
Human-caused environmental change adversely affects health through other pathways as well. These include:

Water and sanitation. Inadequate access to drinking water, sanitation, and hygiene causes an estimated 1.7 million deaths annually. As with food, our ability to meet future water needs faces serious constraints, from reduced access to fresh water as a result of climate change, to declining water quality, to rising demand as a result of population growth and economic development. Poorer populations are especially vulnerable to the health consequences of water scarcity because they are less capable of insulating themselves with technology and other infrastructure and lack the ability to purchase water on the international market.

Natural disasters. Since 1980, the number of Category 5 (devastating) natural disasters worldwide has more than doubled, with a record 40 such disasters registered in 2008. As both the number of events and human vulnerabilities to them have increased, so too have the associated impacts, ranging from death or illness as a result of heat stress, acute injuries, or drowning; to air and water contamination and mental health effects. In addition, sea-level rise, more-intense storms, and the rapid destruction of coastal barriers as a result of climate change represent a “triple threat” that is likely to cause significant human morbidity and mortality.

Air pollution. Air pollution as a result of changing environmental conditions has numerous effects on human health. Atmospheric brown clouds (ABCs), composed primarily of the combustion products of fossil fuels and biomass, trigger deaths from heart and respiratory disease and also block out the sun’s rays,

Undernourished Population, Total and as Share of World Population, 1990–2009



thereby reducing agricultural yields. Higher temperatures increase the formation of ground-level ozone, which causes sickness and death from heart and lung disease. And warmer temperatures and higher CO₂ concentrations are associated with longer pollen seasons and increased pollen production for many allergenic plants, contributing to allergic respiratory disease, particularly asthma.

Population displacement. Population displacement and conflict could become common outcomes as large, vulnerable populations suffer amplified exposure to water scarcity, hunger, and natural disasters. In 2008, an estimated 42 million people worldwide were considered refugees or displaced persons, and the United Nations estimates that climate change alone will displace an additional 250 million to 1 billion people by 2050. Health consequences of increased migration include malnutrition, greater susceptibility to infectious disease, and higher than normal death rates. Displaced peoples also suffer high levels of violence, sexual abuse, and mental illness.

Adapting to the Health Impacts of Climate Change

Because climate change is a rapidly accelerating source of human-induced environmental change, there is a special urgency to address it. Climate change will magnify water scarcity in areas that already face unsustainable water use, and create new scarcities elsewhere. It will affect crop yields and generate obstacles to meeting global nutritional needs. It is also likely to cause more-frequent and severe natural disasters, alter the distribution of infectious diseases, and reduce air quality across large parts of the globe. And, it is likely to cause large-

scale population displacement and migration to a degree not before witnessed.

But the fact that climate change is a threat magnifier (and not, primarily, a source of entirely new public health challenges) may represent an opportunity as well as a challenge. If the international community accepts the moral imperative to help lower-income countries reduce their vulnerability to the health threats from climate change, it will also be helping these countries take strides toward addressing entrenched threats that have been a longstanding scourge to their economies and people.



Mukesh Jain

In the aftermath of torrential flooding in Assam, India, people are reduced to foot travel on the remains of a washed-out road.

To be most effective, efforts to adapt to the health impacts of climate change must include the following measures:

1. *Adaptation assistance.* Wealthy countries (responsible for most of the carbon emissions driving climate change) have a moral imperative to assist lower-income countries with adaptation, given the size of the health threats, their preventability, and the disproportionate vulnerability of lower-income countries to them;
2. *“No-regrets” solutions.* The chosen interventions should yield benefits regardless of the timing and location of specific climate-related events. Examples include improving public health infrastructure, developing more-tolerant crop strains, increasing freshwater storage capacity, creating early-warning systems, and bolstering disease surveillance;
3. *Insurance strategies.* Because it is impossible to

predict the precise impacts of climate change in a specific location, it makes sense to pool risk and develop insurance strategies whereby countries agree to help whichever populations absorb the greatest impacts;

4. *Surveillance.* Because even the most sophisticated models are unable to predict exact climate-related changes in specific locations, it will be important to monitor key factors such as crop productivity, in-stream flow rates and water tables, food consumption and malnutrition rates, and population movements, as well as changing distributions of infectious diseases. This will help countries target the resources to address emerging threats before they become humanitarian crises.
5. *Demographics.* Population growth in the face of limited land and resources exacerbates such threats as food and water scarcity, vulnerability to disasters, and human displacement. Meeting the unmet need for family planning services is a central way to both reduce greenhouse gas emissions and reduce vulnerability to the health impacts of climate change, while simultaneously improving maternal and child health.
6. *Further research.* There is an urgent need for more research to model the health impacts of climate change in specific locations, to evaluate approaches to reducing vulnerability, and to perform cost-effectiveness analyses on different adaptation approaches.

Specific policy recommendations must be based on a careful analysis of local conditions. National-level risk assessments that cut across disciplines and sectors will be critical to helping countries target limited resources to the highest-priority threats and the most vulnerable populations.

Moving Forward in a Changing World

Accelerating changes to the planet’s land surface and the functioning of its ecosystems are acting synergistically with climate change to generate threats to human health at an unprecedented scale. Responding to these threats effectively will require new approaches to economic and human development, new technologies, and new research efforts, as well as new approaches to policy and decision making. The good news is that much of the human suffering likely to result from these trends is preventable—and a tremendous amount can be done.

There are many positive trends that should encourage us as we seek to slow the pace of environmental

change and lessen its toll on health. These include advances in reducing global population growth as well as efforts to reverse or at least manage some of the worst impacts of environmental change—from less-polluting cookstoves and water-efficient farming practices, to improvements in urban transport and advances in renewable energy technologies. In the health arena, inexpensive multimedia and mobile communications technologies are an important component of health-systems strengthening. The challenge will be to take these efforts to scale rapidly enough to slow the pace of environmental change.

From a research standpoint, there is a critical need to improve our understanding of the complex connections between environmental change and health. This includes:

- better integrating information across sectors and scientific disciplines;
- better integrating the training of research scientists, with researchers in health, natural, and social sciences learning across each other's disciplines; and
- filling important gaps in the availability of reliable, high-resolution, and geographically referenced data about population, health, and environmental conditions.

Unfortunately, the sheer complexity of some of these relationships will make the exact impacts of changing environmental conditions on human wellbeing difficult to quantify. In this context, stepped-up surveillance will improve efforts to detect changing patterns of infectious disease, malnutrition, heart and respiratory disease, morbidity from natural disasters, and environmental migration.

Governments and other stakeholders will also need to mobilize substantial financial resources, technical capacity, and new partnerships that can help build capacity over the long term. For many years, the industrialized world has done less than it could to relieve suffering among the global poor. Now, it will need to vigorously reframe its development assistance to address the impacts of climatic disruption. With the

upcoming climate talks in Copenhagen, Denmark, 2009 may be a defining moment in human history: a year in which the historical injustice of human-induced climate change could fuel an international effort to reduce vulnerability and simultaneously address some of the longest-standing scourges to human health.



Courtesy USAID

In a refugee camp in Liberia, a mother comforts her son who is suffering from malnutrition and cholera.

Addressing the health impacts of global environmental change needs to be a priority for the public health community, environmental scientists, and natural resource managers, as well as for governments and intergovernmental bodies such as the United Nations and multilateral development banks. What we need most are political will and financial resources. While these resources will need to be large, they are small compared to the cost of ignoring the impacts of large-scale change and trying to address the overwhelming problems of famine, epidemic disease, massive population displacement, and civil strife that may ensue.