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Climate change and human health: risks and responses

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In 1996 a group of health researchers organized by WHO, the World Meteorological Organization (WMO), and the United Nations Environment Programme (UNEP) published the first comprehensive assessment of climate change and human health (*1*). *Climate change and human health: risks and responses* updates this work — and opens new pathways through which to examine the consequences the future climate may hold for the ecological systems that underpin our health. As the rates of warming, CO_2 build-up, and weather anomalies increase, events that have previously been projected merely as scenarios have begun to unfold and they have already begun to influence our health, biological diversity, and the global economy.

Climate change and human health: risks and responses, whose thirteen chapters are written by leading experts, examines those disease outcomes that are attributable to climate change, the methodologies used to assess them, the use of scenarios in generating policy options, and the means of adapting to a changing climate. A WHO report issued in 2002 attributed 160 000 deaths annually to climate change. Considering the increasing weather volatility and severity that is accompanying rapid warming and the accumulating heat in the deep ocean (*2*) — this is probably a vast underestimate; and this work gives proper attention to this dimension of climate change so crucial for understanding its wide-ranging impacts on health and ecological systems. While temperature constrains the range of infectious diseases and disease vectors (as it does for all plant and animals), it is severe weather that is taking the greatest toll on the health of nations.

Over the last six years, extreme precipitation events, heatwaves and droughts have been responsible for disease outbreaks and unprecedented loss of human life. Hurricane Mitch dropped almost two metres of rain in three days on Honduras in 1998, killing over 11 000 people, and left a "cluster" of water-, vector- and rodent-borne diseases. In Venezuela in 1999 severe rains whipped up an outbreak of Venezuelan equine encephalitis, while landslides killed tens of thousands. In Mozambique in 2000 intense flooding and three cyclones over a six-week period left the country with epidemics of malaria and cholera and displaced tens of thousands.

The tempo of outlier climatological events (those outside 2 or 3 standard deviations from the mean) is quickening. The temperatures and mortality levels associated with the surprisingly intense 2003 European summer heatwave far exceeded all model projections (and sparked wildfires and crop failures as well as an estimated 10% reduction in Alpine glaciers). In May 2004 a total of 1.5 metres of rain fell on Hispaniola in 36 hours, killing over 3300 people; and 520 tornadoes battered a middle-swathe of the USA. Then, on 27 June 2004, 40 cm of rain fell on Guam in 24 hours, shattering daily rainfall records. In August Hurricane Charley with 143 miles per hour winds cut a devastating path across Jamaica, Cuba then Florida in the US, killing 27 and causing over US$ 20 billion in property and agricultural losses, and business interruptions. The pace of large storms continues and we are now in the sixth consecutive year of drought (perhaps the longest in 500 years) in the western states of the US, which is attributable to anomalous Pacific Ocean conditions, described as "The perfect ocean for drought" (*3*). The pace of such anomalies is punishing for many nations and the wide swings from norms indicate instability and increased propensity for more surprises, shifts and shocks.

There are several scenarios of abrupt change — including thawing of permafrost, releasing methane, and rapid sea level rise resulting from slippage of the Antarctic Peninsula or Greenland ice shelves. (The Greenland ice shelf is now melting at 10 metres per annum, up exponentially from the 1 metre per year measured in 2000!) The potential for a "cold reversal" in the Northern Hemisphere deserves particular mention. Scandinavia could see fewer of the Lyme-disease and virus-carrying ticks that are now migrating northwards, lockstep with each warm winter. Winters may be as cool — or crueler — as those the north-east US experienced in 2002–04. Europe is already experiencing the higher circumpolar and cross Atlantic wind speeds from the freshening and cooling of the North Atlantic — resulting from melting polar and Greenland ice and more rain falling at high latitudes (from evaporation of warmed, saltier tropical oceans). Evaporation levels over cool waters are less than those from warm ocean surfaces, and the droughts and heatwaves in Europe are attributable in great part to such coupled ocean-atmospheric changes occurring at high latitudes. (Mirror image changes are occurring in the Southern Hemisphere creating the conditions for persistent drought in Australia.)

Indeed all of the world's oceans are currently in anomalous states, observations that convinced previously skeptical climatologists that only an anthropogenic signal, superimposed upon natural variability (dominated by atmospheric–ocean oscillations such as the El Niño/Southern Oscillation, the North Atlantic Oscillation and the Pacific Decadal Oscillation), could explain present conditions.

Water issues always warrant greater attention than they receive, since the accelerating hydrological cycle (ocean warming, ice melting, water vapour rising) is exacerbating a suite of crisis-level local problems that threaten hygiene, health, and food production. New data on warming and salmonella infections in New Zealand are discussed, complementing previous data on foodborne outbreaks in Japan during hot summers. But food security and nutrition might have been given more coverage. Pests, pathogens and weeds already consume an estimated 42% of growing and stored crops, and their ranges will change with global warming. But extremes are the real culprits: droughts encourage aphids, locust and whiteflies (vectors of geminiviruses), while floods foster fungi and nematodes. An 1 °C increase in average global temperatures is projected, itself, to reduce rice yields by 10%; and, in 2004, soybean yields in Argentina, Brazil, and

the USA (the three leading producers) were 60% of expected due to severe weather. Model projections and data are moving in tandem — providing mounting "fingerprints" of human influence (together amounting to an unsustainable ecological "footprint" (accordingly we are now using the resources of 1.2 earths; http://www.ecouncil.ac.cr/rio/focus/report/english/footprint/.)

The threat to coral reefs from warming is addressed in this work, but separately from the section on food. Loss of reef nurseries, plus algal biotoxins, the 150 hypoxic, non-productive "dead" zones around the world and chemicals — such as mercury emanating from coal-fired power plants and off-shore oil rigs — endanger an essential source of protein for the residents of many nations and an important, healthy source of pleasure and protein for people the world over.

Adaptation to climate change receives extensive coverage. Early warning systems for heatwaves are now in place in some urban centres, thanks to the sustained efforts of some of the authors, along with other researchers, WHO, WMO, and UNEP. Infrastructure will also need reconstruction and — most poignantly — so much is needed to reduce the vulnerabilities of poor nations. Several years ago Jeffrey Sachs proposed that wealthy nations pay reparations for the damages incurred. Such international funds might best be used today as incentives to jump-start the clean energy transition — the first and necessary step towards reprogramming and refinancing sustainable development — a process that can truly buttress public health and reduce vulnerabilities to environmental change.

Developing clean energy technologies could be the best "no-regrets" strategy for our health, or adaptation and for mitigation (i.e. primary prevention). Distributed energy generation, with solar, wind, tidal, wave, geothermal and fuel cells feeding into the power grid (where it exists) — and energy-efficient "green" buildings, improved public transport, hybrid vehicles, along with roof gardens, bicycle and walking paths — will decrease the vulnerability of the grid to storm interruptions and overload during heatwaves. Where grids do not exist, such measures can provide energy for purifying and pumping water, irrigation, cooking, running computers, radios, lighting and small enterprises (i.e. interventions that directly improve public health).

This attractive, well-written, well-organized and authoritative book on the ongoing and projected impacts of climate change cannot fail to convince even the most cautious public health authorities to adopt the precautionary principle. The informative glossary and extensive index help make this comprehensive volume useful as an introductory text and a reference for those already initiated. Its call to include stakeholders in assessments is pertinent, for public–private partnerships will be needed on micro- and macro- scales to create the infrastructure and craft the scaffolding that builds the global economy and benefits the environment.

Climate change threatens to destabilize the relationships among microbes and other species established over the last 10 000 years (the Holocene epoch), and climate instability and emerging infectious diseases are together stalking wildlife, livestock and crops, and forest and coral reef habitats. This important book highlights the need to place public health at the forefront in reframing the development agenda. ■

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Toman's tuberculosis: case detection, treatment, and monitoring

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In the late 1950s and early 1960s developing countries, in particular India, produced a considerable amount of quality technical and health systems research on tuberculosis. This period, the first golden age of TB research in developing countries, provided the foundation for the national TB control programme. The new policies were gradually shaped in a series of WHO and International Union against Tuberculosis (IUAT) documents to reach the most refined expression in the ninth report of the WHO Expert Committee on TB, published in 1974. Scientists, mainly from developed countries, raised a number of objections, critical remarks and doubts on the evidence supporting the TB control policies. In order to clarify the issues and dispel misunderstandings, WHO and the IUAT commissioned a book to function as a commentary on the scientific knowledge and practical experience underlying the ninth report's policies on TB control for developing countries.

Dr Kurt Toman, a Czech phthisiologist, was selected for this job. Besides being a WHO short-term consultant in TB control for developing countries, he was the Director of the WHO/UNDP International Training Course on Epidemiology and Control of Tuberculosis, held in Prague over three months every year in the 1960s. Seated in a corner of the rostrum, he attended with exemplary discipline all the lectures, which were delivered by a prestigious international faculty, and took note of every question raised by the students with the corresponding authoritative reply. These notes were his main source in writing the book (*Toman's tuberculosis*) and moved him to shape its format as selected Questions and Answers about the technical bases for the policies on case finding and treatment of pulmonary TB. The first English edition was issued by WHO in 1979 and was then translated into French, Spanish, Arabic and Portuguese. *Toman's tuberculosis* soon became the most useful reference publication on the technical basis of the case management strategy for TB control in developing countries.

Although most chapters of the first edition retained their technical validity, there were three important technical features that made *Toman's tuberculosis* out of date by the 1990s: 12-month treatment regimens had been replaced by short-course chemotherapy in which

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