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Global environmental change and health: impacts, inequalities, and the health sector

Human pressures on the environment are damaging the world's biophysical and ecological systems. **A J McMichael and colleagues** discuss the resulting unequal effects on health and set out strategies to help prevent and lessen the harm

Human actions are changing many of the world's natural environmental systems, including the climate system. These systems are intrinsic to life processes and fundamental to human health, and their disruption and depletion make it more difficult to tackle health inequalities. Indeed, we will not achieve the UN millennium development health goals if environmental destruction continues. Health professionals have a vital contributory role in preventing and reducing the health effects of global environmental change.

Problems of focus

In 2000 the United Nations set out eight development goals to improve the lives of the world's disadvantaged populations. The goals seek reductions in poverty, illiteracy, sex inequality, malnutrition, child deaths, maternal mortality, and major infections as well creation of environmental stability and a global partnership for development. One problem of this itemisation of goals is that it separates environmental considerations from health considerations. Poverty cannot be eliminated while environmental degradation exacerbates malnutrition, disease, and injury. Food supplies need continuing soil fertility, climatic stability, freshwater supplies, and ecological support (such as pollination). Infectious

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diseases cannot be stabilised in circumstances of climatic instability, refugee flows, and impoverishment.

The seventh millennium development goal also takes a limited view of environmental sustainability, focusing primarily on traditional localised physical, chemical, and microbial hazards. Those hazards, which are associated with industrialisation, urbanisation, and agriculture in lower income countries, remain important as they impinge most on poor and vulnerable communities. Exposure to indoor air pollution, for example, varies substantially between rich and poor in urban and rural populations. And the World Health Organization estimates that a quarter of the global burden of disease, including over one third of childhood burden, is due to modifiable factors in air, water, soil, and food. This estimated environment related burden is much greater in low income than high income countries overall (25% versus 17% of deaths—and widening further to a two-fold difference in percentages between the highest and lowest risk countries). Heavy metals and chemical residues contaminate local foods, urban air pollution causes premature deaths, and waterborne enteric pathogens kill two million children annually.

These relatively localised environmental health hazards, though, are mostly remediable. Meanwhile, a larger scale, less remediable, and potentially irreversible category of environmental health hazard is emerging. Human pressures on the natural environment, reflecting global population growth and intensified economic activities, are now so great that many of the world's biophysical and ecological systems are being impaired. Examples of these global environmental changes include climate change, freshwater shortages, loss of biodiversity (with consequent changes to functioning of ecosystems), and exhaustion of fisheries. These changes are unprecedented in scale, and the resultant risks to population health need urgent response by health professionals and the health sector at large.

Who will be affected

The health effects of global environmental change will vary between countries. Loss of healthy life years in low income African countries, for example, is predicted to be 500 times that in Europe. The fourth assessment report of the Intergovernmental Panel on Climate Change concluded that adverse health effects are much more likely in low income countries and vulnerable subpopulations. These disparities may well increase in coming decades,



Fig 1 | Although installation of wells in Bangladesh has reduced diarrhoeal disease, contamination with naturally occurring arsenic jeopardises the safety of both drinking water and food. This hand pump has been painted red to show contamination, (clean wells are painted green)

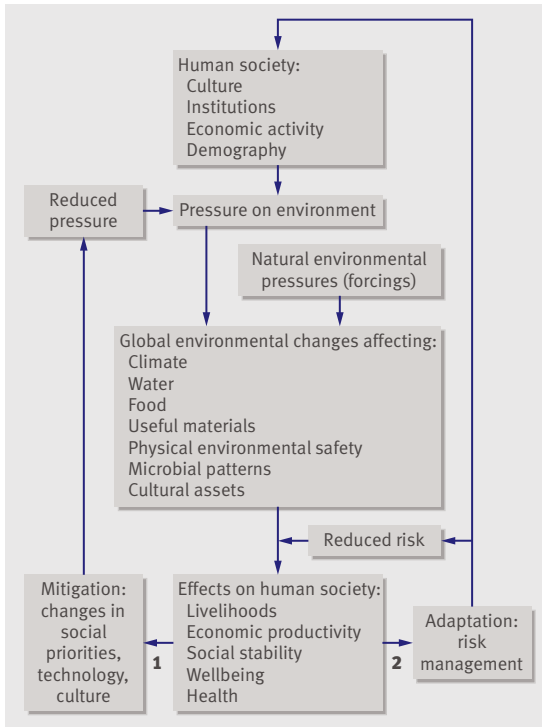


Fig 2 | Relations between human induced global environmental changes affect health and social policy responses. True primary prevention (path 1) reduces or eliminates the human pressures on environment. A more defensive type of prevention is attained through adaptive interventions to lessen risk (path 2), particularly in vulnerable communities

not only because of regional differences in the intensity of environmental changes (such as water shortages and soil erosion), but also because of exacerbations of differentials in economic conditions, levels of social and human capital, political power, and local environmental dependency.

These differential health risks also reflect the wider issue of access to global and local “public goods.” Most of the world’s arable land has now been privatised; stocks of wild species (fish, animals, and wild plants) are declining as population pressures and commercial activities intensify; and freshwater is increasingly becoming subject to market pricing. Social policies should therefore pay particular attention to the health inequalities that flow from unequal access to environmental fundamentals.

Availability of safe drinking water illustrates the point about access to what, historically, was common property: 1.1 billion people lack safe drinking water, and 2.6 billion lack basic sanitation. Beyond diarrhoeal disease, water related health risks also arise from chemical contamination—such as arsenic as a cause of skin pigmentation, hyperkeratosis, cardiovascular disease, neuropathy, and cancer (fig 1).

Role of social conditions

The relation of environmental impoverishment to health risks and inequalities is complex. Environmental degradation impairs health, while health deficits (for example, malnutrition or depletion of the workforce

from AIDS) can amplify environmental mismanagement. This causes inequalities in both health endangering exposures and health outcomes.

India provides a good example of the complexity of these relations. The country’s average life expectancy is relatively low but is expected to improve with industrialisation and modernisation. Industrialisation is contributing to the rapid increase of coal burning in India, and the resultant addition to global emissions and climate change amplifies health risks worldwide. These health risks will affect the world’s most vulnerable populations.

The risks to population health from environmental change have far reaching implications for prevention strategies (fig 2). Global changes result in loss of natural resources. Resolution of these risks therefore requires a different approach from that used for the more familiar challenges presented by time limited and reversible local environmental contamination.

Climate change and health

Human induced global climate change is now an acknowledged reality. We have taken a long time to recognise the resultant health risks, current and future, and their unequal effects around the world, but the topic is now attracting much attention. Risks to health will arise by direct and indirect pathways and will reflect changes in both average climate conditions and in climatic variability. The main risks are:

- Effects of heat waves and other extreme events (cyclones, floods, storms, wildfires)
- Changes in patterns of infectious disease
- Effects on food yields
- Effects on freshwater supplies
- Impaired functioning of ecosystems (for example, wetlands as water filters)
- Displacement of vulnerable populations (for example, low lying island and coastal populations)
- Loss of livelihoods.

Extreme weather events, infection, and malnutrition will have the greatest health effects in poor and vulnerable populations (box 1). In sub-Saharan Africa over 110 million people currently live in regions prone to malaria epidemics. Climate change could add 20-70 million to this figure by the 2080s (assuming no population increase, and including forecast malaria reductions in West Africa from drying). Any such increase would exacerbate poverty and make it harder to achieve and sustain health improvements.

Some links between climate change and human health are complex. For example, the predicted drying in sub-Saharan Africa could increase the incidence of HIV infection, as impoverished rural farming families move to cities where conditions foster sex work and unsafe sex.

The recent report of the Global Environmental Change and Human Health project gives a good summary of the major categories of current and predicted health effects of global environmental changes other than climate change.

Box 1 | Africa and climate change

Africa is very vulnerable to climate change because of other environmental and social stresses. The economy depends critically on agriculture, which accounts for two thirds of the workforce and up to half of household incomes and food.

- Climate models predict regional increases in mean temperatures of several degrees centigrade by 2100, a decline in summer rainfall in southern and northern Africa and some increase in west and east Africa. Drying, plus the demands of population growth and economic development, will exacerbate regional water scarcity
- Falls in crop yields due to 1-2°C warming by 2050 would add an estimated 12 million additional Africans to the 200 million currently undernourished
- Extreme events such as flooding change will affect food availability by damaging roads, storage, and markets—floods in 2000 in Mozambique damaged about 10% of farmland and 90% of irrigation, displaced two million people, and affected up to 1.5 million livelihoods (mostly in poor rural areas)
- Livestock viral diseases such as east coast fever, foot and mouth disease, blue tongue virus, Rift valley fever are climate sensitive. Regional increases in temperature and rainfall could affect tsetse fly habitat and hence trypanosomiasis in livestock
- Climate change and agricultural downturn in Africa may force populations to move, generating conflicts over territory. Pastoralists forced to search for grazing land because of wells drying up may partly explain the Darfur crisis in Sudan



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Box 2 | How health professionals can promote adaptive strategies

- Public education, especially through healthcare settings such as doctors' waiting rooms and hospital clinics
- Preventive programmes—eg, vaccines, mosquito control, food hygiene and inspection, nutritional supplementation
- Health care (especially mental health and primary care) for communities affected by environmental adversity
- Surveillance of disease (especially infectious disease) and key risk factors
- Forecasting future health risks from projected climate change
- Forecasting future health risks and gains from mitigation and adaptation strategies
- Health sector workforce training and in-career development

Strategies that extend beyond health sector:

- Early warning systems for impending extreme weather (eg, heat waves, storms)
- Neighbourhood support schemes to protect the most vulnerable people
- Climate-proofed housing design, urban planning, water catchment, and farming practices
- Disaster preparedness, including capacity of the health system

Roles for doctors and other health professionals

The spectrum of potential strategies to reduce health risks is wide, commensurate with the diversity of threats to health posed by climate change and other global environmental changes. Local policies and actions, both to mitigate environmental change at source and to adapt to existing and unavoidable risks to health, will often need support from health attuned policies at provincial, national, and international levels. For example, community programmes to mosquito-proof houses will need to be reinforced by improvements in the national surveillance of infectious diseases and in outbreak warning systems.

Doctors and other health professionals have particular knowledge, opportunity, and, often, political leverage that can help ensure—through advocacy or direct participation—that preventive actions are taken. Actions include promoting public understanding, monitoring and reporting the health effects of environmental change, and proposing and advocating local adaptive responses (box 2).

Various websites list and discuss actions for doctors to take, both individually and collectively (box 3). For example, the US Centers for Disease Control and Prevention lists 11 functions for the public health system and practitioners for responding to climate change. And Doctors for the Environment Australia has run a successful, continuing, national campaign of patient education by distributing posters and pamphlets for use in doctors' waiting rooms.

Adaptive strategies to lessen health risks

Many local actions can be taken to reduce the vulnerability of communities and populations. These will vary considerably between different regions of the world, and in relation to prevailing socioeconomic conditions and available resources. During Australia's recent prolonged drought (2001-7), some rural health doctors reported that fostering and supporting communal activities (community choirs, social gatherings, financial advisory networks, etc) increased local resilience against depression associated with loss of livelihood.

Climate change and other large scale environmental changes are unlikely to cause entirely new diseases (although they may contribute to the emergence of new strains of viruses and other microbes that can infect humans). Rather, they will alter the incidence, range, and seasonality of many existing health disorders. Hence, existing healthcare and public health systems should provide an appropriate starting point for adaptive strategies to lessen health effects.

Preventive action

Although adaptive strategies will minimise the effects of climate change, the greater public health preventive challenge lies in stopping the process of climate change. This requires bold and far sighted policy decisions at national and international levels, entailing much greater emissions cuts than were being proposed a decade ago.

SUMMARY POINTS

The biophysical and ecological systems of the natural environment are fundamental to human health

Mounting human pressures on the environment are disrupting and depleting these systems

The resulting health risks will particularly affect vulnerable and poorly resourced populations

Adaptive strategies can lessen current and impending health risks

Health professionals are well placed to contribute to adaptive and preventive strategies

Scientists have concluded that we need to prevent atmospheric carbon dioxide concentrations exceeding 450-500 ppm to avoid the serious, perhaps irreversible, damage to many natural systems and ecological processes that a global average temperature increase of 2-3°C would cause. This requires early radical action as today's concentrations are approaching 390 ppm (compared with 280 ppm before industrialisation). Health professionals, acting through citizens' or professional organisations, have both the opportunity and responsibility to contribute to resolving this momentous issue. Improving awareness of the problem is the first step. Since 1993, doctors from 14 countries (including six low income countries) have had a central role in the Intergovernmental Panel on Climate Change's assessment of the health effects of climate change. We should also add this topic, including its relevance to health professional activity, to the medical curriculum.

The health sector, meanwhile, must minimise greenhouse gas emissions from its own infrastructure, especially hospitals. Health researchers should act to minimise greenhouse gas emissions from their own studies.

Conclusion

The Stern report, in 2006, highlighted the potentially great damage to the world's economic system from unconstrained climate change. The greater risk, however, is to the vitality and health of all species, including humans, if current trends continue to weaken the earth's life support systems. The health professions have a crucial role in promoting public understanding of this fundamental association and health protecting responses to it.

Box 3 | Environmental websites helpful for doctors and other health professionals

Centers for Disease Control and Prevention (US) (www.cdc.gov/nceh/climatechange)
 Doctors for the Environment Australia (www.dea.org.au)
 Global environmental change and human health project (www.essp.org/en/joint-projects/health.html)
 Intergovernmental Panel on Climate Change (www.ipcc.ch)
 International Society of Doctors for the Environment (www.isde.org)
 Medact UK (www.medact.org/env_climate_change.php)

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- McMichael AJ. Population health as the 'bottom line' of sustainability: a contemporary challenge for public health researchers. *Eur J Public Health* 2006;16:579-81.
- UN. *Millennium development goals*. New York: UN, 2000.
- Butler CD, McMichael AJ. Environmental health. In: Levy B, Sidel V, eds. *Social injustice and public health*. Oxford: Oxford University Press, 2005:318-36.
- WHO. *Fuel for life: household energy and health*. Geneva: WHO, 2006.
- Zhang J, Smith K. Household air pollution from coal and biomass fuels in China: measurements, health impacts, and interventions. *Environ Health Perspect* 2007;115:848-55.
- Prüss-Üstün A, Corvalán C. *Preventing disease through healthy environments. Towards an estimate of the environmental burden of disease*. Geneva: WHO, 2006.
- Intergovernmental Panel on Climate Change. *Climate change 2006: impacts, adaptation and vulnerability*. Cambridge: Cambridge University Press, 2007.
- Corvalán C, Hales S, McMichael AJ. *Ecosystems and human wellbeing: health synthesis*. Geneva: WHO, 2005.
- McMichael AJ, Butler CD. Emerging health issues: the widening challenge for population health promotion. *Health Promot Int* 2006;21 (suppl 1):15-24.
- WHO/Unicef Joint Monitoring Programme for Water Supply and Sanitation. *Meeting the MDG drinking water and sanitation target: the urban and rural challenge of the decade*. Geneva/New York: WHO/Unicef, 2006.
- Karim MM. Arsenic in groundwater and health problems in Bangladesh. *Water Res* 2000;34:304-10.
- Hassan MM, Atkins PJ, Dunn CE. *Social implications of arsenic poisoning in Bangladesh*. *Soc Sci Med* 2005;61:2201-11.
- McMichael AJ, Woodruff RE, Hales S. Climate change and human health: present and future risks. *Lancet* 2006;367:859-69.
- Haines A, Kovats RS, Campbell-Lendrum D, Corvalán C. Climate change and human health: impacts, vulnerability, and mitigation. *Lancet* 2006;367:2101-9.
- Hulme M, Doherty R, Ngara T, New M, Lister D. African climate change: 1900-2100. *Climate Res* 2001;17:145-68.
- Desanker P, Magadza C, Allali A, Basalirwa C, Boko M, Dieudonne G, et al. Africa. In: McCarthy J, Canziani O, Leary N, Dokken D, White K, eds. *Climate change 2001: impacts, adaptation, and vulnerability*. Cambridge: Cambridge University Press, 2001:433-67.
- Desanker P, Justice C. Africa and global climate change: critical issues and suggestions for further research and integrated assessment modeling. *Climate Res* 2001;17:93-103.
- Parry ML, Rosenzweig C, Iglesias A, Livermore M, Fischer G. Effects of climate change on global food production under SRES emissions and socio-economic scenarios. *Global Environ Change* 2004;14:53-67.
- Hirji R, Johnson P, Maro P, Matiza-Chiuta T. *Defining and mainstreaming environmental sustainability in water resource management in southern Africa*. Washington, DC: World Bank, 2002.
- Baylis M, Githeko A. *The effects of climate change on infectious diseases of animals*. London: UK Government Foresight, 2005.
- Barrios S, Bertinelli L, Strobl E. Climatic change and rural-urban migration: the case of sub-Saharan Africa. *J Urban Econ* 2006;60:357-71.
- Abdalla A. *Environmental degradation and conflict in Darfur: experiences and development options*. Addis Ababa: University of Peace, 2006:87-94.
- UN Environment Program. *Darfur. a post-conflict assessment*. Nairobi: UNEP, 2007.
- Earth System Science Partnership. *Global environmental change and human health: science plan and implementation strategy*. www.essp.org/fileadmin/redakteure/pdf/GEC_HHSciPlan.pdf.
- Frumkin H, Hess J, Luber G, Mahlay J, McGeehin M. The public health approach to climate change. *Am J Public Health* (in press).
- Sustainable Trials Study Group. *Towards sustainable clinical trials*. *BMJ* 2007;334:671-3.
- Stern N. *The economics of climate change: the Stern review*. Cambridge: Cambridge University Press, 2007.