

The British government has also supported economic regeneration in Bulgaria and Ukraine,<sup>w66</sup> countries dependent on the arms industry. However, links between the trade in arms and commodities such as oil mean that for powerful arms exporting countries the resulting economic advantages in terms of all trade are complex and probably substantial.

Programmes of weapons collection and destruction intended to demilitarise countries have included food, medical care, and education for individuals or communities that surrender weapons.<sup>w67</sup> Perhaps the country that has provided the weapons should provide the compensation.

### Better prevention of illegal manufacture and trading in arms

International laws and their aggressive enforcement should stop illegal arms trading, including its support systems, such as money laundering and smuggling. An international police force (perhaps better termed an international family protection force) working closely with national police is needed to arrest and charge the hundreds of criminally active illegal arms dealers, most of whom are already known and on databases.<sup>w18</sup> Banks and companies supporting illegal trading should be targeted. Enhanced control of borders to detain aircraft, ships, or vehicles and arrest and charge people responsible for smuggling would have an impact. Many illegal arms dealers are based in rich, relatively well governed countries, so stopping them should be possible.

Investigations by the UN into breaches of arms embargoes often result in information about the state and individual actors involved and lead to expressions

of concern but no action. No one has been convicted of violating UN arms embargoes.<sup>w18</sup> The UN seems to be powerless to act, and it clearly needs to find a way of mobilising states to accept an international family protection force as well as giving more power to the international criminal court.<sup>w68</sup> Tragically, trafficking of arms to Africa seems to be low on the world's priority list.<sup>w8</sup> One possible way forward could involve the UN Convention against Transnational Organized Crime,<sup>w69</sup> within which is a draft protocol against the illicit manufacture of and trafficking in firearms.

### Conclusion

The real question raised by the above analysis is whether powerful arms trading countries want to address the problems they are causing. Children and mothers in poor countries seem to be regarded as much too unimportant and expendable. Somehow the UN has to find a way of creating a system that ethically regulates legal arms trading, and the international community needs to establish a protection force to address illegal trading.

We thank J Saunders, policy adviser on conflict, Oxfam, and the Campaign against the Arms Trade ([www.caat.org.uk](http://www.caat.org.uk)) for their advice. The opinions expressed in this article are those of the two authors and not the organisations to which they are affiliated.

Contributors: DPS conceived and designed the study; BAMOH collected data on arms; DPS collected data on health statistics; both authors drafted and revised the paper and approved the version to be published. DPS is guarantor.

Competing interests: The aid agency Child Advocacy International might benefit from the publication of this paper.

## How healthy is the world?

Bjørn Lomborg

We are often told that we are destroying our environment and that living conditions are deteriorating. The author of *The Skeptical Environmentalist* looks at global data and comes up with a more optimistic view

In *The Skeptical Environmentalist* I set out to describe the entire state of the world in a single book.<sup>1</sup> This was by no means easy, and so I was a bit hesitant when the *BMJ* asked me to do the same again—only this time in 1500 words. So how can the true state of the world be reduced to 1500 words? Of course, it cannot be. But by relying on official statistics, global trends, and long term tendencies (what I usually refer to as fundamentals), we can draw a reasonably good picture. However, not everything can be fitted into this picture, and this article will focus on human welfare.

Measuring human welfare is complex because it consists of a myriad of inter-related subjective and objective factors. I will therefore focus on internationally acknowledged objective indicators of human welfare such as life expectancy, prosperity, and the fulfilment of basic needs.

### Life expectancy

One of the central aspects of human welfare is life itself. Life expectancy is a proxy for the general state of

### Summary points

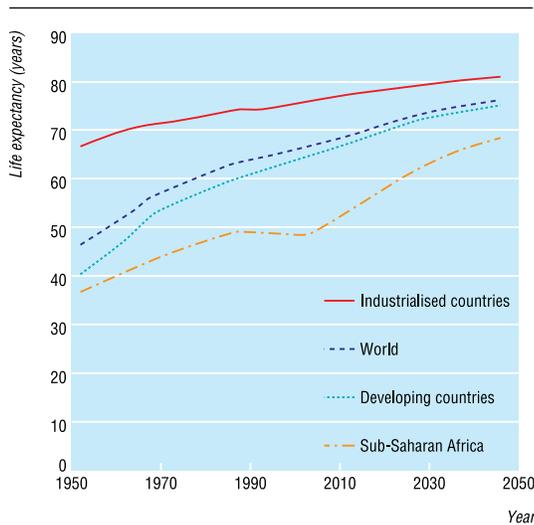
- Life expectancy and prosperity have risen in developed and developing countries over the past 50 years and are expected to continue to rise
- Food production should keep up with population growth without greatly encroaching on forest area
- Available energy resources are increasing
- Pollution is likely to fall as countries become wealthier
- The Kyoto agreement to reduce carbon dioxide emissions will have little effect on global warming

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health, but it also possesses an intrinsic value. Figure 1 shows the remarkable increase in life expectancy for the developing world over the past 50 years, from

41 years in 1950 to 64.7 years in 2002. For the developed world, the progress has been more modest because life expectancy had already soared at the beginning of the last century. The current life expectancy for countries in the Organisation for Economic Cooperation and Development (OECD) is 76.8 years.<sup>2</sup>

Figure 1 also shows the expected development in life expectancy over the next 50 years, incorporating the adverse effects of AIDS and HIV. By 2020, life expectancy in the developing world will pass the 70 years barrier, causing the world's life expectancy to continue to climb. The United Nations' populations division projects that in 2080, the world's life expectancy will be more than 80 years.<sup>3</sup>

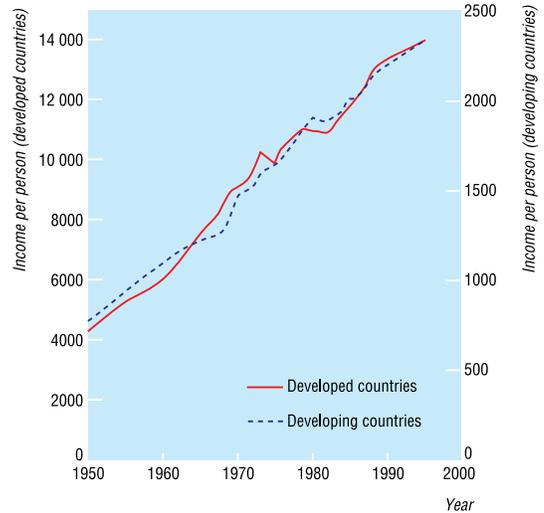


**Fig 1** Life expectancy for industrialised countries, developing countries, sub-Saharan Africa, and entire world 1950-2050. Predictions from 2000 incorporate effects of HIV and AIDS<sup>1</sup>

### Prosperity

Income is a good indicator of welfare because it expands the range of opportunities open to people and allows them to live a better life. Although wealth might not always make you happier, it at least ensures freedom from famine and material deprivation—issues that play a huge part in many people's lives. The gross domestic product per capita (in 1985 power purchase parity dollars) has increased by over 200% for both the developed world and the developing world over the past 50 years (fig 2).

The increase in gross domestic product per capita has been accompanied by a fall in worldwide poverty. According to the United Nations, "in the past 50 years, poverty has fallen more than in the previous 500."<sup>4</sup> Whether inequality has also fallen is more debatable, since inequality is highly sensitive to the choice of population quintiles and the method of comparison. As for the future, all official international organisations predict an exponential rise in worldwide income and decreasing inequality as the growth rates of developing countries outpace those of industrialised countries in next 50 years.<sup>5-7</sup>

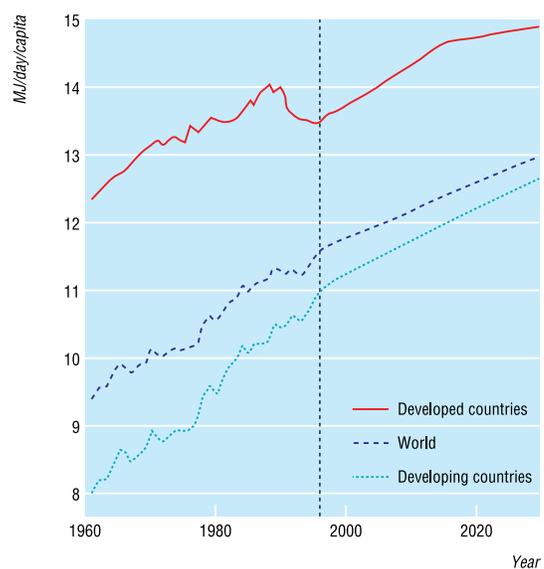


**Fig 2** Gross domestic product per capita for the developed and developing world in 1985 power purchase parity dollars, 1950-95<sup>1</sup>

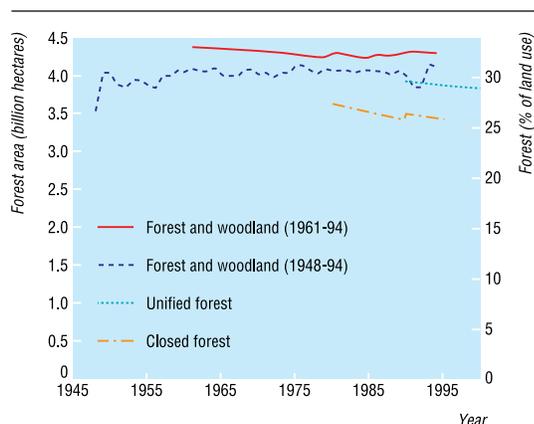
### General increase in welfare

Other improvements in welfare during the past 50 years include heightened educational levels and literacy, more political and civil rights, and increased accessibility to technological innovations such as the vacuum cleaner, radio, television, computers, and the internet. In general, humankind has had an unprecedented increase in welfare. And not only that. Every single region has experienced an increase in welfare.

Of the more than 100 countries that are included in the United Nations Development Programme's human development report, only one (Zambia) experienced a drop in human development from 1975 to 1999.<sup>8</sup> All other countries had improved



**Fig 3** Daily energy intake (MJ) per capita in industrial and developing countries and world, 1961-2030.<sup>1</sup> Predicted values from 1998 onwards



**Fig 4** UN Food and Agriculture Organization estimates of global forest cover: forest and woodlands, 1948-94 (from FAO Production Yearbook) and 1961-94 (from FAO database), closed forest for 1980-95, and new unified forest definition 1990-2000<sup>1</sup>

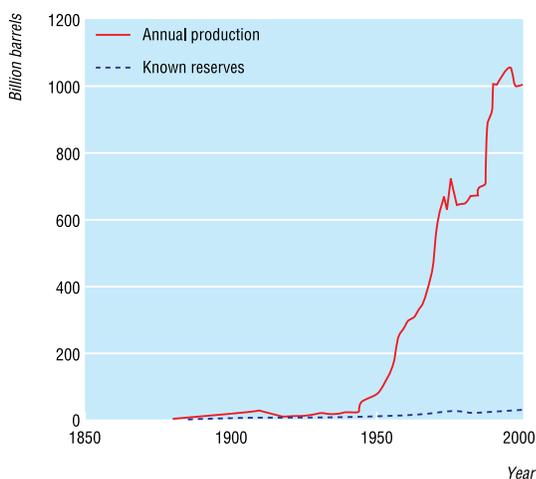
human development, and the developing countries had by far the largest increase. Although most indicators show that humankind's lot has vastly improved, this does not mean that everything is good enough.

### Can the development continue?

The interesting question is whether this development can continue. As I noted above, the main official international organisations predict that welfare will improve in all countries.<sup>5-7</sup> Yet, many people believe that we live on borrowed time and that everything is getting worse. Let us examine the two major concerns of today—whether we can feed a future population and the consequences of our use of energy.

### Will we have enough food in future?

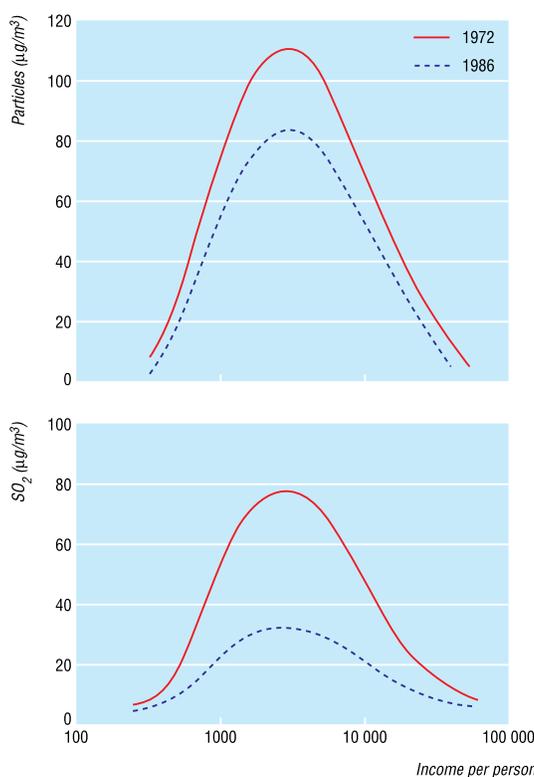
One major concern is whether the world will be capable of feeding a growing population. Firstly, it is important to emphasise that the rate of population growth has fallen to 1.26% in 2000, down from the record high



**Fig 5** World's known oil reserves and world oil production 1920-2000. Total reserves until 1944 are for America only and after 1944 for entire world<sup>1</sup>

of 2.17% in 1964.<sup>9</sup> Even the absolute number of people added to the world peaked in 1990 at 87 million; it is now 76 million a year and still falling. Secondly, there is no reason to expect that food production will not keep up with future population growth as it has done in the past. Figure 3 shows the development of worldwide energy intake per capita from the 1960s and depicts the positive trend up to 2030.

Some argue that satisfying our need for food could turn the earth into a giant human feedlot.<sup>10 11</sup> However, according to estimates from the Food and Agriculture Organization, we are currently using about 11% of the global land surface area for agriculture, and in 2030 we will be feeding more than 8 billion people better than now (13 MJ/day compared with about 11.8 MJ today) by using 12% of the land surface.<sup>12</sup> Thus, there is reason to believe that the increase in cropland areas will be minimal—just as it has been in the past 40 years. The world's forest cover is therefore likely to remain stable into the future, just as it has done over the past 50 years (fig 4). In fact, almost all the UN climate panel scenarios predict that it will increase in the future.<sup>7</sup>



**Fig 6** Connection between gross domestic product (1985 purchasing power parity dollars) and particle pollution and sulphur dioxide concentrations in 48 cities in 31 countries, 1972 and 1986<sup>15</sup>

### Use of energy

The worries we have about the world's energy consumption have changed in recent years. Previously, we worried about running out of energy, but these concerns turned out to have little merit. Not only has the availability of oil, coal, and natural gases increased throughout this century, but we also leave the

generation of tomorrow with many more sources of energy (including renewables). In short, we are not running out but rather leaving the world with ever more energy. Figure 5 shows the increase in the world's oil reserves from 1850 until now. The picture is the same for vital minerals (non-energy resources) such as copper, zinc, aluminium, and iron.<sup>13</sup> In both cases, the reason for the increased availability is that we have improved our ability to find more resources, to use them more efficiently, and eventually to substitute other and more efficient sources.

**Ecological consequences**

Concern has therefore shifted towards the ecological consequences of our energy use. As Greenpeace put it: "We are in the a second world oil-crisis. But in the 1970s the problem was a shortage of oil. This time round the problem is that we have too much."<sup>14</sup> The use of fossil fuels leads to air pollution, which constitutes a health hazard to residents of large industrialised cities. The infamous London smog is an example of extreme air pollution. Empirical evidence suggests, however, that air pollution is more correlated with income than with energy consumption. As income rises beyond a certain point, the concentrations of major air pollutants fall rapidly despite an increase in energy consumption (fig 6).

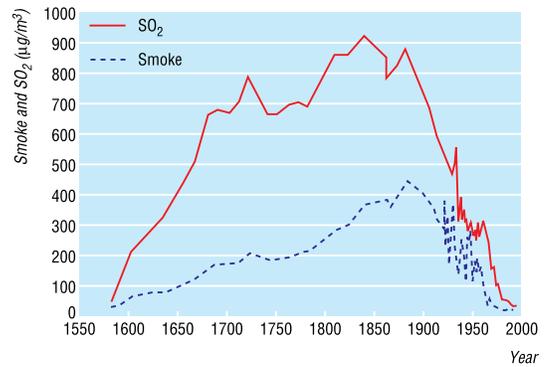
Also note that pollution for all levels of income has fallen from 1972 to 1986, which can be ascribed to the technological advances combined with increased political action to reduce pollution. Thus, in richer cities, smog is a thing of the past as almost every type of air pollution has fallen significantly. This is evident in London, where smoke pollution today is the lowest for 450 years (fig 7).

**Other energy problems**

There are other problems with the use of energy, however. One important problem is that the emission of carbon dioxide causes global warming. With renewable energy taking over before 2100, the UN Climate Panel estimates a temperature increase of 2-3°C.<sup>7</sup> Global warming is not expected to have a severe impact on human welfare as a whole. The total cost of global warming for the next 100 years is estimated at \$5 trillion,<sup>16</sup> which compares with a total expected income of \$800-\$900 trillion in the same period.<sup>7</sup> However, the rise in temperature is projected to have little net impact on the industrialised world but a fairly severe impact on the developing world.

Countries agreeing to the Kyoto protocol have promised to cut industrialised carbon emissions by 30% of the expected level in 2010. The global costs will be large: the estimates from all macroeconomic cost-benefit models show a cost of \$150-\$350bn every year.<sup>17</sup> Yet, the benefits will be marginal. The climate models show that the Kyoto protocol will affect temperature imperceptibly even 100 years from now, postponing the temperature rise a mere six years from 2100 to 2106.<sup>18</sup>

If our goal is to improve welfare, especially in the developing world, reducing carbon emissions is not the most effective way. For the same amount of money that the Kyoto protocol will cost just the European Union every year, the UN estimates that we could provide every person in the world with access to basic health, education, family planning, and water and



**Fig 7** Average concentrations of sulphur dioxide and smoke in London, 1585-1995. Data for 1585-1935 are estimated from coal imports and have been adjusted to the average of measured data<sup>1</sup>

sanitation services.<sup>19</sup> Access to clean drinking water and sanitation alone would save nearly two million lives each year and prevent half a billion diseases annually.<sup>20</sup>

The views expressed in this article are not necessarily the views of the Danish Environmental Institute. Figure 6 is reproduced by kind permission of Oxford University Press.

Competing interests: BL has received fees for speaking at meetings ranging from the oil industry through university environmental programmes to debates with Greenpeace and WWF, all organisations which are likely to be affected by the outcomes of the debate.

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**Christmas competition: see p 1498**

## Commentary: Gilding the global lily

Anthony J McMichael

When Lomborg's book was published in 2001, it caused an international sensation. At last, claimed assorted enthusiasts, here was a no-nonsense affirmation that we are all heading towards greater wealth, health, equality, and happiness in an environmentally improving world.

The above article encapsulates the book in content and style. The author's tone, however, is a little less overly confident, perhaps because of the extensive criticism of his book during the past 18 months.<sup>1</sup> Nevertheless, in my view, his article repeats many of the shortcomings of his original treatise—a blend of naivety and ignorance.

### Alternative view

Scepticism and debate in science is healthy and important. All scientists form world views that affect their interpretation of "facts." In my view, even as we solve various familiar local environmental problems we are increasingly running this planet into ecological deficit—as shown by incipient global climate change, stratospheric ozone depletion, accelerating biodiversity losses, freshwater depletion, land degradation, and the weakening or collapse of various ocean fisheries.<sup>2</sup> This poses diverse risks to human wellbeing and health.<sup>3 4</sup> We have achieved much in the past two centuries, as shown by the enormous (though unequal) gains in wealth, leisure, and life expectancy. But, as financial advisers intone, past performance does not guarantee future success.

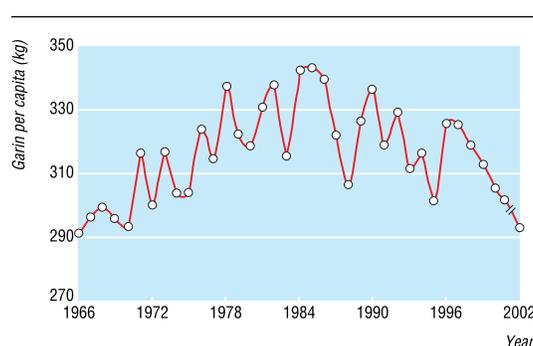
Researchers broadly comprise linear optimists and systemic optimists.<sup>5</sup> Linear optimists, including most economists and demographers, see progress as a linear and open ended process, buoyed up by human ingenuity, technological advance, and market stimuli and unconstrained by ecological limits. There is a cornucopian world view, based on a "growth is good" philosophy.

Systemic optimists, which include most environmental scientists, most ecologists, and many social scientists, believe that the natural and social worlds comprise complex systems with non-linear processes, thresholds, and feedback processes. There are optimal conditions and natural limits. This group recognises that development is not synonymous with growth and seeks out sustainable strategies. Their optimism is predicated on humans' capacity—albeit latent—to imagine the future and act pre-emptively.

These two camps do not represent a clash of optimism and pessimism. Rather, they represent alternative views about preferred paths to the future.

### Are the forecasts valid?

Lomborg displays no real understanding of the larger scale processes of the biosphere. Indeed, his repeated citation of official forecasts, especially from United Nations agencies, is superficial and naive. He cites the Food and Agriculture Organization's food production projections for coming decades and blithely states,



Time trend in global production of cereal grain per person. Value for 2002 is revised data from the US Department of Agriculture<sup>6</sup>

"There is no reason to expect that food production will not keep up with future population growth." This assertion is no substitute for looking critically at recent per person falls in yields of cereal grain (the prime index of global food energy supply, and of storage) (figure), for recalling the widespread land degradation caused by the green revolution (which sought to end hunger through use of modern, high yielding seeds and substantial inputs of water and chemicals) during the 1970s and 1980s, and for considering the consequences of ongoing damage to the terrestrial and marine ecosystems essential for world food production. And, even if all official international organisations predict an exponential rise in worldwide income and decreasing inequality, can we reconcile that with the persistent divide between rich and poor (at least in exchange rate adjusted incomes, relevant to a globalised marketplace) over recent decades?

Similarly, the UN population division has projected a global life expectancy of over 80 years by 2080. However, we should also consider the effect on future mortality of such things as:

- The perennial succession of greater than forecast ravages from HIV and AIDS
- The consequences of potential heightened conflict over both dwindling life support resources (freshwater, fish stocks, fertile land, etc) and increasing material inequality
- The likely future adverse health effects of global climate change and other large scale disruptions to the ecosystem.<sup>3</sup>

### Selective use of data

Lomborg is selective in his use of data. He cites a UN Development Programme statistic indicating that all but one of a long list of countries have made gains in human development since 1975. This conveniently overlooks the fact that many of these countries have gone backwards in the past decade.

Elsewhere, his argument that, to maximise benefits, we should spend on today's poor the money otherwise required for reducing global greenhouse gas emissions creates a spurious choice. The rich world already has

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plenty of other money it could spend on alleviating world poverty. Think of what we spend on cigarettes, gambling, pet food, and wars in Iraq. More importantly, Lomborg's trivialising of global climate change shows ignorance about the profound ecological and social implications of global environmental changes. His statement that "global warming is not expected to have a severe impact on human welfare as a whole" suggests that he has not read the wide ranging reports of the Intergovernmental Panel on Climate Change.<sup>6</sup> Or is this another example of his selectivity?

He is certainly selective in quoting just one, conservative, estimation of the economic effects of global warming. There is a huge and divergent literature on this topic. Likewise, belittling the Kyoto protocol is mischievous. Kyoto is widely understood to be a first, small, symbolic step. Indeed, its acknowledged marginal impact on global warming highlights the need for more radical, and politically challenging, cuts in emissions over coming decades.

### What is human welfare?

Lomborg also takes a narrow view of human welfare. Yes, material comforts, money, consumer freedoms, and increased life expectancy are very desirable, although we recognise increasingly that their attainment must be compatible with sustainable develop-

ment. He concedes that "wealth might not always make you happier" but neglects other important dimensions of welfare. These include spiritual experience, peace of mind, community dynamics, and opportunities for self expression.

Lomborg has compiled much useful information showing that, within the conventional agenda of environmental quality and human material wellbeing, we have made some great advances. He fails to understand the concerns of the systemic optimists, who believe that past economic practices, technology choices, and exploitation of the ecosystem are ecologically and socially unsustainable.

Competing interests: None declared.

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## Time and tide wait for no man

David Shearman

Global warming presents a new hazard to human health. Recognising the predominant human mechanisms for our failure to address this problem may help in formulating strategies for action

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Humanity is making little progress in solving the global issues of war, famine, poverty, environmental destruction, population overload, and climate change that increasingly threaten its wellbeing, health, and survival. The national and international responses to all these major problems are totally inadequate, and the medical profession should be active in seeking remedies.

While all these global issues seem insoluble in their scale and complexity, global warming presents a particular and unfamiliar hazard to human health. The United States, with 4% of the world's population, produces a quarter of its greenhouse gases. The *BMJ* has addressed the inadequacies of the US president's response to global warming.<sup>1</sup> Ill health due to climate change is likely to arise both directly (such as via thermal stress) and through complex mechanisms that disturb ecological systems, many of which are already stressed by pollution, bio-invasion, and loss of resilience due to altered biodiversity. For example, the impacts of climate change on plant physiology and agroecosystem functioning may interact with soil degradation to decrease the yields of crops needed to feed a growing human population. Global warming may thus impair health by reductions in nutrition,

### Summary points

Climate change presents a unique threat to humanity because it is difficult to comprehend responsibility beyond our existing descendants

Our psychological mechanisms and economic ideology also preclude effective action

Doctors have the skill and responsibility to help solve global issues

The medical profession must work to influence governments and their leaders by personal interaction and persuasion

economic activity, and habitable locations and increases in infectious diseases. Extreme weather events and a changing distribution of precipitation could cause physical disasters, exacerbate conflicts, and augment the flow of environmental refugees as communities compete for diminishing natural resources.