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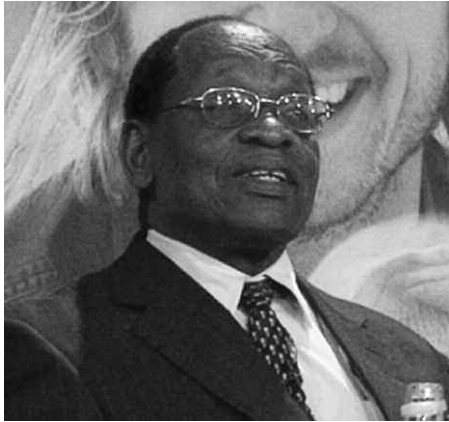
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The global impacts of climate change on human health¹

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Introduction

Human health is intimately linked to the environment in which people live. Even in ordinary times human beings are sensitive to climate fluctuations and climate variability. Today, however, we are not just talking about climate variability, but about climate change which is the product of the widespread global warming which has been closely studied by the Intergovernmental Panel on Climate Change (IPCC) in the last 20 years or more.

In its latest scientific assessment and report at the end of the year 2007 the IPCC concluded that 'global warming is unequivocal, as seen by the widespread melting of ice in the temperate latitudes, the shrinking of glaciers world-wide, global sea level rise, and the increase in the occurrence of extreme events in many parts of the world, all of which are occurring virtually simultaneously'.

What we are talking about is the projected gradual rise in global temperatures which will be as much as 5°C by the year 2100, with even higher figures expected to be experienced in the higher latitudes (up to 7°C), in addition to sea level rise of up to 1 metre by the end of this century. These changes are expected to trigger erratic increases in amounts and intensity of precipitation, as well as triggering such extreme events such as droughts, floods, heat waves, high winds, cyclones and ice melts in glaciated regions including tropical mountain regions of the world.

Conclusions of the IPCC on the state of the world climate

The IPCC concluded that warming of the climate system is unequivocal, as is now evidenced from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea levels. They also concluded that observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

The causes of climate change

The IPCC, in its Fourth Assessment (AR4), has shown that changes in atmospheric concentrations of greenhouse gases (GHGs), and aerosols, land-cover and solar radiation alter the energy balance of the climate system.

Global GHG emissions, caused by human activities, have grown since pre-industrial times with an increase of 70% between 1970 and 2004.

Observations

Eleven of the last 12 years, between 1995 and 2006, have been ranked among the 12 warmest years in the history of instrumental recording of global surface temperature since 1850.

The average atmospheric water vapour content has increased since at least the 1980s over land and ocean as well as in the upper troposphere. The increase is broadly consistent with the extra water vapour that warmer air can hold.

Since 1961, observations have shown that the average temperature of the global ocean has increased to depths of at least 3,000m and that the ocean has been absorbing more than 80% of the heat added to the climate system. Such warming causes seawater to expand, contributing to rises in sea level.

Global average sea level rose at an average rate of 1.8mm per year between 1961 to 2003, and the rate was faster at about 3.1mm per year between the period 1993 to 2003.

There is high confidence that the rate of observed sea level rise increased from the 19th to the 20th century.

Changes in precipitation increased drought and increase in extreme events.

The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapour.

Widespread changes in extreme temperatures have been observed over the last 50 years. Cold days, cold nights and frost have become less frequent, while hot days, hot nights and heat waves have become more frequent.

There is observational evidence for an increase of intense tropical cyclone activity in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures.

Projections of future changes in climate

For the next two decades a warming of about 0.2°C per decade is projected for a range of emission scenarios. Even if the concentrations of all greenhouse gases and aerosols had been kept constant at year 2000 levels, a further warming of about 0.1°C per decade would be expected. In addition, continued greenhouse gas emissions at

or above current rates would cause further warming and induce many changes in the global climate system during the 21st century, that would very likely be larger than those observed during the 20th century. In the 21st century, projected warming is expected to be greatest over land and at most high northern latitudes, and least over the Southern Ocean and parts of the North Atlantic.

Snow cover is projected to contract along with widespread increases in thaw depth over most permafrost regions. Sea ice is projected to shrink in both the Arctic and Antarctic, and some project that Arctic late-summer sea ice will disappear almost entirely by the latter part of the 21st century.

It is very likely that hot extremes, heat waves and heavy precipitation events will continue to become more frequent. Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and heavier precipitation associated with ongoing increases of tropical sea surface temperatures.

In addition, extra-tropical storm tracks are projected to move poleward, with consequent changes in wind, precipitation and temperature patterns.

Based on current model simulations, it is very likely that the meridional overturning circulation (MOC) of the Atlantic Ocean will slow down during the 21st century.

Temperatures in the Atlantic region are projected to increase despite such changes due to the much larger warming associated with projected increases in greenhouse gases.

Impacts of climate change on human health

Global climate change will have a wide range of impacts and overall, it is predicted that negative health impacts will outweigh positive impacts.

An indication of what health systems and institutions will have to deal with include the following:

1. Changes in frequencies of heat waves and cold spells will be accompanied by an increase in morbidity and mortality.

2. Other impacts will come from changes in the frequency of floods and droughts.
3. We should also expect changes in infectious disease occurrence.
4. Climate change is bound to impact on local food production and nutritional adequacy.
5. An obvious connection with climate change will be the concentration of local air pollutants and aeroallergens which are connected to disease.
6. In many cases where populations are displaced due to climate change, and where there is economic disruption, health of the populations involved will suffer.
7. We should note the fact that causes of human health disorders are multifunctional, and that there are differences in vulnerability to disease between different populations.

Climate impacts linked to disease

- Thermal stress (involving heat waves and cold spells).
- Extreme events and weather disasters, including droughts, floods, storms and tropical cyclones.
- Air pollution with the implied proliferation of dangerous gases, and fine particulates are linked to disease outbreaks. The combination of these with aero-allergens such as pollens add to the disease linkages.

Major diseases linked with climate change

The IPCC in their AR4 of 2007 has emphasised the fact that climate change currently contributes to the burden of disease and premature deaths, and notes that as global warming intensifies between now and 2100, the disease impacts will be more felt globally, but especially in the tropics. Of the major diseases already linked with climate change, the following are the most outstanding:

- Malaria
- Dengue
- Other Mosquito-borne viruses
- Leishmaniasis

- Schistosomiasis
- Chagas' Disease
- Plague
- Tick-borne diseases, such as Lyme disease and Tick-borne encephalitis
- Rodent-borne diseases such as Leptospirosis and Hantaviruses
- Water-related infectious diseases;
- Rift Valley Fever;
- Meningococcal Meningitis.

Why is there a link between disease and climate change?

Human beings are exposed to climate change through changing weather patterns (temperature, precipitation, sea level rise and more frequent extreme events), and indirectly through changes in water, air and food quality, and changes in ecosystems, agriculture, industry settlements and economy. It is expected that as climate changes, so will the prospects for disease linkages.

How climate change operates

- Altered distribution of infectious disease vectors, e.g. malarial mosquitoes.
- Altered regional distribution of some allergenic pollen species.
- Increase in heat wave-related deaths.
- Increase in malnutrition and consequent disorders.
- Increase in injury and deaths during heat waves, floods, storms, fires, and droughts.
- Increase in deaths and injury from tropical cyclones and hurricanes.
- Increase in conditions suitable for malaria expansion.
- Increase in the burden of diarrhoeal diseases.
- Increase in the numbers of people at risk from Dengue Fever.

What can be done to reduce impacts?

It is true that adverse health impacts are always greatest in low-income countries. Vulnerable

groups include the urban poor, elderly people and children, traditional societies, subsistence farmers and coastal communities.

Whereas economic development acts as an important component of adaptation, it will not insulate the world's population from disease and injury due to climate change. In other words economic growth must be accompanied with equity.

Climate change implications on human health in the future

The IPCC has identified the need for Health System Planning to take into account future climate change impact scenarios. Future health trends are relevant to climate change because the health of populations is an important element to climate change adaptive capacity. The future will be influenced by, among others, possible changes in the patterns of infectious diseases, changes in medical technology and health and social inequalities. The IPCC ventures to add that an age of sustained health could result from more wide-ranging investments in social and medical services, leading to a reduction in the incidence of disease, benefiting most segments of the population. However, they warn that major risks to health will remain unless the poorest countries share in the growth

and development experienced by richer parts of the world.

In Africa and Asia the future course of the HIV/AIDS epidemic will significantly influence how well populations can cope with challenges such as the climate related infections, food shortages and increased frequency of storms, floods and droughts.

Global population total is expected to increase from the current figure of 6.4 billion to 9 billion by the middle of this century. The disease burden is also expected to increase particularly in Africa where Chloroquine-resistant malaria (*p. falciparum*) is still a major killer and is spreading to formerly malaria-free highlands. Similarly as megacities continue to multiply, so will disease attacks in the new environments. Finally where poverty proliferates, so does disease continue to thrive. Removal of poverty could go a long way in reducing the burden of disease.

Note

1. These introductory remarks were presented at a panel session in which the author participated, at the conference 'Closing the gap in a generation: health equity through action on the social determinants of health', 6–7 November 2008, London. The text has been prepared by the editorial staff, based on material submitted to aid in the preparation of this Supplement.