Climate Change and Health: Impacts, Vulnerability and Mitigation

Jamal Hisham Hashim, PhD, MCIEH
Professor of Environmental Health & Research Fellow
International Institute for Global Health
United Nations University

Presented at the Seminar on Climate Change and Health: Exploring the Linkages,
Outline of Talk

• What is climate change
• Health impacts of climate change
• Community vulnerability and disasters
• Disaster risk reduction
• Mitigation and co-benefits
What is Climate Change?

• According to the Intergovermental Panel on Climate Change (IPCC), it refers to any change in climate over time, whether due to natural variability or as a result of human activity.

• According to the UN Framework Convention on Climate Change, it refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, and that is in addition to natural climate variability observed over comparable time periods.
Figure 1.1: Schematic view of the components of the global climate system (bold), their processes and interactions (thin arrows) and some aspects that may change (bold arrows). Source: IPCC 4th Assessment Report, 2007.
Climate Change – AR5

• Observed changes in the climate system is unequivocal since the 1950’s.
• In the Northern Hemisphere, 1983–2012 was likely the warmest 30-year period of the last 1400 years.
• The globally averaged combined land and ocean surface temperature data show a warming of 0.85 [0.65 to 1.06] °C, over the period 1880 to 2012.
• Changes in many extreme weather and climate events have been observed since about 1950.

• SEA is prone to the effects of climate change due to its hydro-meteorological hazards.
• Some SEA countries have limited capacity for climate adaptability.
• Climate change-sensitive infectious diseases are endemic in the region.

HOW THE ENVIRONMENT IMPACTS OUR HEALTH

People are exposed to risk factors in their homes, work places and communities through:

- **AIR POLLUTION** including indoors and outdoors
- **INADEQUATE WATER, SANITATION** and hygiene
- **CHEMICALS** and biological agents
- **RADIATION** ultraviolet and ionizing
- **COMMUNITY NOISE**
- **OCCUPATIONAL RISKS**
- **CLIMATE CHANGE**
- **BUILT ENVIRONMENTS** including housing and roads
- **AGRICULTURAL PRACTICES** including pesticide-use, waste-water reuse

ENVIRONMENTAL IMPACTS ON HEALTH

**WHAT IS THE BIG PICTURE?**

**FACT:** 23% of all global deaths are linked to the environment. That’s roughly 12.6 million deaths a year.

WHERE IS IT HAPPENING?

- 3.8 million in South-East Asia Region
- 3.5 million in Western Pacific Region
- 2.2 million in Africa Region
- 1.4 million in European Region
- 854,000 in Eastern Mediterranean Region
- 847,000 in the Region of the Americas
17 Sustainable Development Goals (2015-2030) with 169 Targets
Likelihood of Health Effects of Climate Change

• Greater likelihood of injury, disease, and death due to more intense heat waves and fires (*very high confidence*).

• Increased likelihood of under-nutrition resulting from diminished food production in poor regions (*high confidence*).

• Increased risks from food- and water-borne diseases (*very high confidence*) and vector-borne diseases (*medium confidence*).

• Marginalized populations are especially vulnerable to climate change and also to some adaptation and mitigation responses.

Source: IPCC Assessment Report 5, 2014
Health Impacts of Climate Change

- Climate change affects the social and environmental determinants of health – clean air, safe drinking water, sufficient food and secure shelter.
- Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from childhood malnutrition (95,000), malaria (60,000), diarrhoea (48,000) and heat stress in the elderly (38,000).
- The direct damage costs to health is estimated to be between US$ 2-4 billion/year by 2030.
- Developing countries with weak health infrastructure will be the least able to cope without assistance to adapt and respond.
- Reducing emissions of greenhouse gases through transport, food and energy-use choices can result in improved health, particularly through reduced air pollution.

Source: WHO 2016.
Estimated future annual mortality attributable to climate change under A1B emission scenario in 2030 (blue bars) and 2050 (orange bars) by world region and health outcome
Global distribution of the *Aedes aegypti* mosquito and dengue.


### Dengue, countries or areas at risk, 2008*

*As of 1 November 2008.*

The contour lines of the January and July isotherms indicate the potential geographical limits of the northern and southern hemispheres for year-round survival of *Aedes aegypti*, the principal mosquito vector of dengue viruses.
Figure 7.3 Additional number\textsuperscript{a} of children aged under 5 years stunted due to climate change in 2030 and 2050 in the 12 study regions under low growth (L), base case (B) and high growth (H) socioeconomic scenarios.

Source: Hales et al. (2014).
Figure 2.2 Relationship\textsuperscript{a} between temperature index (daily maximum temperature minus optimum temperature) and relative mortality for people aged over 65 years

\textsuperscript{a} Cumulative effect over 15 days

Reproduced using results from Honda et al. (2014)
Summary of Health Effects of Global Climate Change

- Greenhouse gases
- Positive radiative forcing
- Global warming
- Melting of polar ice
- Increase sea level
- Coastal flooding

Health impacts:
- Increase surface temperature
- Ocean warming
- Increase precipitation
- Vector breeding
- Thermal stress
- Altered wind patterns
- Decrease precipitation
- Flooding

Environmental impacts:
- Extreme weather
- Drought
- Mudslide
- Water pollution
- Poor food production
- Malnutrition

Environmental modifications:
- Rodent-transmitted diseases

Global cooling:

Negative radiative forcing:
- Injury & death
- Respiratory diseases
- Aerosol pollution
- Forest fires

Source: Hashim and Hashim (2016)
Climate Change and Extreme Weather

• According to IPCC’s AR5, more extreme weather events have been observed since the 1950s.
• Globally, from 1993 to 2012, more than 530,000 people died from almost 15,000 extreme weather events.
• Since 2000, 1.2 billion people in the Asia Pacific Region have been exposed to hydrometeorological hazards through 1,215 disaster events, with losses of more than US$2.5 trillion in PPP.
• Environmental hazards + human exposure + population vulnerability = health risk.

• Cyclone Nargis hit Myanmar in May 2008.
• Wind speed up to 134 mph.
• 138,366 fatalities.

Source: Hashim and Hashim (2016)
Luber et al. (2014).

Figure 9.7. Heavy downpours, which are increasing in the United States, have contributed to increases in heavy flood events (Ch. 2: Our Changing Climate, Key Message 6). The figure above illustrates how people can become exposed to waterborne diseases. Human exposures to waterborne diseases can occur via drinking water, as well as recreational waters. (Figure source: NOAA NCDC / CICS-NC).
2014 Kelantan River Basin Floods

- Triangular shaped.
- Rivers flow northwards.
- Main tributaries include Sg. Lebir, Sg. Galas, Sg. Pergau and Sg. Nenggiri.
- Around 13,088 km² of catchment area (88% of Kelantan state).
- Steep, mountainous topography upstream.
- Previous major floods in 1923, 1926 and 1967.
- Maximum rainfall fell in Gunung Gagau; 1765 mm (77%) from 17 to 24 Dec., compared to 2300 mm average annually.
Impact of the 2014 Malaysian Floods

- 541,896 flood victims; 319,156 (58.9%) in Kelantan
- 2,076 homes destroyed
- 6,698 homes damaged
- 1,335 evacuation centres
- 25 flood-related deaths; 11 in Kelantan
- RM 2.85 billion in public property loss (not including personal and private properties)

Source: Malaysian National Security Council
Conceptual Framework on Health Impacts from Extreme Weather Events

Source: Hashim et al., 2015
A Supplement Issue of the APJPH on climate change, extreme weather events and urbanization

Global Environmental Change and Human Health

Jamal Hisham Hashim, PhD, MCIEH¹
and Jose Gabriel Siri, MPH, PhD¹

Global Environmental Change and Human Health

It has become evident that our planetary ecosystem is changing rapidly in response to human activities. This has led scientists to recognize the present-day era as a new geological epoch, the Anthropocene, in recognition of the substantial effect of man on the Earth’s systems.

Climate Change, Extreme Weather Events, and Human Health Implications in the Asia Pacific Region

Jamal Hisham Hashim, PhD, MCIEH¹, and Zailina Hashim, MSc, PhD³

Abstract

The Asia Pacific region is regarded as the most disaster-prone area of the world. Since 2000, 1.2 billion people have been exposed to hydrometeorological hazards alone through 1,215 disaster events. The impacts of climate change on meteorological phenomena and environmental consequences are well documented. However, the impacts on health are more elusive. Nevertheless, climate change is believed to alter weather patterns on the regional scale, giving rise to extreme weather events. The impacts from extreme weather events are definitely more acute and traumatic in nature, leading to deaths and injuries, as well as debilitating and fatal communicable diseases. Extreme weather events include heat waves, cold waves, floods, droughts, hurricanes, tropical cyclones, heavy rain, and snowfalls. Globally, within the 20-year period from 1993 to 2012, more than 530,000 people died as a direct result of almost 15,000

Impact of Climate Change on Air Quality and Public Health in Urban Areas

Noor Artika Hassan, MSc¹, Zailina Hashim, MSc, PhD³, and Jamal Hisham Hashim, PhD, MCIEH¹,⁴

Abstract

This review discusses how climate undergoes changes and the effect of climate change on air quality as well as public health. It also covers the inter relationship between climate and air quality. The air quality discussed here are in relation to the 5 criteria pollutants: ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and particulate matter (PM). Urban air pollution is the main concern due to higher anthropogenic activities in urban areas. The implications on health are also discussed. Mitigating measures are presented with the final conclusion.
What is a Disaster

A disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community’s or society’s ability to cope using its own resources. Though often caused by nature, disasters can have human origins.

\[
(VULNERABILITY + HAZARD) / CAPACITY = DISASTER
\]

Number of Climate-related Disasters Around the World (1980-2011)

- Floods: 3,455
- Storms: 2,689
- Droughts: 470
- Extreme Temps: 395
Tackling Vulnerability

- Reducing the impact of the hazard itself where possible (through mitigation, prediction and warning, preparedness).
- Building capacities to withstand and cope with hazards.
- Tackling the root causes of vulnerability, such as poverty, poor governance, discrimination, inequality and inadequate access to resources and livelihoods.
Sendai Framework for Disaster Risk Reduction

- Adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015.
- A significant shift in emphasis from disaster management to disaster risk management.
- Four priorities for action:
  - Understanding disaster risk.
  - Strengthening disaster risk governance to manage disaster risk.
  - Investing in disaster risk reduction for resilience.
  - Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.
## Health Co-benefits of Climate Change Mitigation

<table>
<thead>
<tr>
<th>Household energy</th>
<th>Country, city, or region</th>
<th>Mechanism of health effect</th>
<th>Main health outcome(s) affected</th>
<th>Approximate reduction in burden of disease (in DALYs per million population)</th>
<th>Approximate cost (US$)</th>
<th>Potential adverse health effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing-related energy efficiency</td>
<td>UK</td>
<td>Changes in indoor pollution (radon, particles, carbon monoxide, second-hand tobacco smoke); mould; winter indoor temperature</td>
<td>Lung cancer (radon), cardiovascular disease, acute and chronic respiratory disease, winter/cold-related death</td>
<td>850</td>
<td>$5000–50000, one-off cost per household; offset by lower recurrent fuel costs*</td>
<td>Increase in pollution concentration from reduced ventilation and increased cold-related risk from cooler indoor temperatures</td>
</tr>
<tr>
<td>Clean-burning cookstoves</td>
<td>India</td>
<td>Changes in exposure to indoor pollution</td>
<td>Acute lower respiratory tract infection, ischaemic heart disease, chronic obstructive respiratory disease</td>
<td>12 500</td>
<td>$50 cost per stove, perhaps every 5 years, continual fuel savings and/or time savings</td>
<td>No adverse effects identified</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transport system</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower carbon and more active transport</td>
<td>London, UK</td>
<td>Altered air pollution, changes in injury risk, changes in physical activity</td>
<td>Ischaemic heart disease, cerebrovascular disease, dementia, breast cancer, lung cancer, colon cancer, diabetes, depression, road traffic injuries</td>
<td>7400</td>
<td>Unclear: possibly negative (cost-saving) to households</td>
<td>Trade-off between reduced road traffic danger from less motor travel and increased exposure to remaining danger from more walking and cycling</td>
</tr>
<tr>
<td>Lower carbon and more active transport</td>
<td>Delhi, India</td>
<td>As for UK</td>
<td>Ischaemic heart disease, road traffic injuries, cerebrovascular disease, lung cancer, diabetes, depression</td>
<td>13 000</td>
<td>As for UK</td>
<td>As for UK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food and agriculture</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering consumption of animal products</td>
<td>UK</td>
<td>Lower saturated fat intake</td>
<td>Ischaemic heart disease</td>
<td>2900</td>
<td>Unclear: possibly negative (cost-saving) to households and society</td>
<td>Childhood growth and development from reduced animal-product consumption (low-income countries)</td>
</tr>
<tr>
<td>Lowering consumption of animal products</td>
<td>São Paulo city, Brazil</td>
<td>As for UK</td>
<td>As for UK</td>
<td>2200</td>
<td>As for UK</td>
<td>As for UK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electricity generation</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-carbon fuels/technologies</td>
<td>European Union</td>
<td>Reduced (particulate) air pollution</td>
<td>Cardiopulmonary mortality, lung cancer, occupational mortality</td>
<td>100</td>
<td>$140 per tonne carbon dioxide</td>
<td>Increase in fuel poverty from higher electricity costs, health risks from nuclear generation and carbon capture and storage</td>
</tr>
<tr>
<td>Low-carbon fuels/technologies</td>
<td>China</td>
<td>As for European Union</td>
<td>As for European Union</td>
<td>550</td>
<td>$70 per tonne carbon dioxide</td>
<td>As for European Union</td>
</tr>
<tr>
<td>Low-carbon fuels/technologies</td>
<td>India</td>
<td>As for European Union</td>
<td>As for European Union</td>
<td>1500</td>
<td>$40 per tonne carbon dioxide</td>
<td>As for European Union</td>
</tr>
</tbody>
</table>

DALY = disability-adjusted life-year. *More detailed explanation of these costs is given in the first paper in this Series.3*

### Table: Summary of the scenarios considered in the four sectoral assessments

Source: Haines et al., 2009.
Summary

• Climate change is unequivocal since the 1950’s and is mainly anthropogenic.
• The most obvious consequent of climate change will be extreme weather events.
• The main health impacts of climate change will be from malnutrition, vector, water-borne and zoonotic diseases, and heat illness.
• Tackling vulnerability, improving resilience and disaster risk reduction will help mitigate the health impacts of climate change.
Thank you