Climate change and health – challenges and opportunities

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Human Health in the Anthropocene epoch (Rockefeller/Lancet Commission on Planetary Health 2015)

- **Tropical forest loss**
  - Global tropical forest loss compared with 1700 baseline (%)
  - Graph showing increase from 1800 to 2000

- **Water shortage**
  - World population affected by water shortage (millions)
  - Extreme Shortage, High Shortage, Moderate Shortage

- **Ocean acidification**
  - Global ocean acidification (mean hydrogen ion concentration, mmol/L)
  - Increase from 1800 to 2000

- **Temperature change**
  - Temperature anomaly, °C
  - Increase from 1800 to 2000

- **Biodiversity**
  - Global vertebrate biodiversity (index value; 1970=1)
  - Decrease from 1900 to 2000

Image: Globaia
Carbon dioxide trends

For centuries, atmospheric carbon dioxide had never been above this line.
### What are Short-Lived Climate Pollutants (SLCPs)?

**SLCPs**
- **Near term response to mitigation**
- **Long-lived Pollutants**
  - Longer term response to mitigation

<table>
<thead>
<tr>
<th>SLCPs</th>
<th>Anthropogenic Sources</th>
<th>Impacts/Mitigation Response</th>
<th>Lifetime in Atmosphere</th>
<th>Current Radiative Forcing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Carbon (BC)</td>
<td></td>
<td>Local ○ Global ○</td>
<td>days</td>
<td>0.64 Wm²</td>
</tr>
<tr>
<td>Methane (CH₄)</td>
<td></td>
<td>Local ○ Global ○</td>
<td>12 years</td>
<td>0.48 Wm²</td>
</tr>
<tr>
<td>Tropospheric Ozone (O₃)</td>
<td></td>
<td>Local ○ Global ○</td>
<td>weeks</td>
<td>0.40 Wm²</td>
</tr>
<tr>
<td>Hydrofluorocarbons (HFCs)</td>
<td></td>
<td>Local ○ Global ○</td>
<td>15 years (averaged by weight)</td>
<td>0.02 Wm²</td>
</tr>
</tbody>
</table>

**Impacts**
- Atmospheric impacts:
  - More thermal radiation is captured
  - Less sunlight is reflected
  - Cloud and rainfall patterns are affected
  - Ice melts and sea level rises

**Long-lived Pollutants**
- **Carbon Dioxide CO₂**
  - Deep and persistent cuts in CO₂ and other long-lived greenhouse gases are necessary to stabilize global temperature rise through 2100 and beyond
  - Up to 60% <100 years
  - Up to 25% >1000 years
  - 1.82 Wm²

- Harms public health
- Harms food security
Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850 for all scenarios.
Projections of soil moisture change 1986-2005 to 2081-2100 for high emission scenario

The availability of water will be different in a climate changed by our emissions. Just how different depends on how quickly we move to a low-carbon world.
Risk Underestimate? (Lancet Climate Change Commission 2015)
Exposure to thermal stress (monthly mean Wet Bulb Globe Temperature hottest month) late 21st century (RCP 6.0 emissions pathway HadGEM2/GFDL midpoint)

CLIMATE CHANGE: Poor Countries Projected to Fare Worst

MODELLED CHANGES IN CEREAL GRAIN YIELDS, TO 2050

Plus climate-related:
- Flood/storm/fire damage
- Droughts – range, severity
- Pests (climate-sensitive)
- Infectious diseases (ditto)

UN Devt Prog, 2009
Many millions more people are projected to be flooded every year due to sea-level rise by the 2080s.

Figure TS-8: Relative vulnerability of coastal deltas as indicated by the indicative population potentially displaced by current sea level trends to 2050 (Extreme ≥ 1 million; high =1 million – 50,000; medium 50,000 – 5000 [B6.3]. Climate change would exacerbate these impacts.

Source: IPCC Wg II, TSI 2007.
• Unusually high incidence of pre-eclampsia in coastal pregnant women: Significant association with drinking water sodium

• Significant reduction in blood pressure, when changing from saline drinking water source, to low-saline (rainwater based) alternative

• Odds of hypertension 16% lower for each 100mg/l lower sodium concentration in drinking water

Coastal populations relying on surface/shallow ground water sources

Low-lying coastal areas in South-east Asia, vulnerable to climate change

Coastline of Bangladesh
Record drought in Syria – risk more than doubled by climate change

Timeline of Events
Prior to the 2011 Uprising

- 1970s-1990s: Agricultural policies promote production of staple crops, leading to increase in number of groundwater wells and use of inefficient and outdated irrigation methods.

2003-2010: Iraqi and Syrian Refugees and Internally Displaced Persons (IDPs) Net Urban Influx [in Millions]

- Syrian IDPs
- Iraqi Refugees

12 March, 1971: Hafez al-Assad becomes president of Syria

- Syria achieves self-sufficiency in wheat production
- Drying of the Khabur River in NE Syria
- Since 2005: Apartment prices in Damascus have more than doubled
- Winter 2007-08: Driest in observed record
- Since 2007: Wheat, rice, and feed prices have doubled

March 2011: Uprising in Syria

Kelley et al., PNAS 2015
What are the physical, behavioural and technological limits to how much we can adapt - who should pay?

- **Physical limits**: small low lying islands e.g. Cayman Islands

- **Behavioural limits**: influence where we live and why, e.g. New Orleans

- **Technological limits**: e.g. to the flood defences
Health co-benefits from the ‘low-carbon’ economy (avoiding harms)

Through policies in several sectors e.g.
- Housing
- Transport
- Food and agriculture
- Electricity generation
A 7% increase in investment can save over 3 million lives in 2040, while providing energy access for all, lower energy import bills and leading to a peak in CO₂ by 2020.
Health Economic Benefits of reducing air pollution through low carbon policies

- Marginal benefits of avoided mortality $50-380/tCO2 - exceed abatement costs (West et al. Nature Climate Change 2014)

- Global Fossil fuel subsidies
  - $5.3 tn. annually (IMF 2015)

Addressing coal combustion is a priority
Reducing black carbon emissions could prevent 2.4 million (0.7-4.6m) premature deaths annually by 2030 especially in Asia (UNEP2011)

- Improved biomass stoves
- Modern coke ovens
- Remove big smokers / DPF
- Cooking with clean fuel
- Improved brick kilns
SLCP Climate Benefits Avoided global warming

Rapid implementation of SLCP mitigation measures, together with measures to reduce CO₂ emissions, would greatly improve the chances of keeping the Earth’s temperature increase to less than 2°C relative to pre-industrial levels.

Avoided global warming by 2050:
- BC + CH₄: 0.5°C
- HFCs: 0.1°C
- SLCPs: 0.6°C

Simulated temperature change under various mitigation scenarios CO₂, BC, CH₄, HFCs

Year: 1900, 1950, 2000, 2050
°C: 1°, 2°, 3°
The Future of Planetary health will depend on cities

Cities responsible for ~ 85% of global GDP in 2015 and 71–76% of global energy-related greenhouse gas (GHG) emissions.

Newclimateeconomy.report/workingpaper_cities_final_web.pdf 2015

More compact development can reduce transport emissions by an order of magnitude.

Figure 1: Potential annual NHS expenditure averted by year and health outcome from Increased Active Travel scenario

- Diabetes
- Dementia
- IHD
- Cerebrovascular disease
- Breast cancer
- Colorectal cancer
- Depression
- RTIs
What could cities do for climate change mitigation and adaptation?

- Accessible efficient public transport and active travel
- Universal access to clean low carbon energy
- Safe access to green spaces and ecosystem strategies for resilience
- Housing Improvements Water and Sanitation
### Mitigation action
- Promoting healthy low-GHG (plant-based) diets
- Reducing food waste

### SLCP-related climate benefit
- High
- Medium-high

### Potential health benefit
- High
- Low-medium

### Main health benefit(s)
- Reduced diet-sensitive chronic diseases
- Reduced food insecurity/undernutrition

### CO_2_ reduction co-benefit
- Medium-high

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#### Graph

<table>
<thead>
<tr>
<th>Food</th>
<th>kg CO_2e per kg food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>0</td>
</tr>
<tr>
<td>Apples</td>
<td>1.5</td>
</tr>
<tr>
<td>Onions</td>
<td>1.5</td>
</tr>
<tr>
<td>Cabbages</td>
<td>1.5</td>
</tr>
<tr>
<td>Oats</td>
<td>1.5</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1.5</td>
</tr>
<tr>
<td>Oranges</td>
<td>1.5</td>
</tr>
<tr>
<td>Wheat</td>
<td>1.5</td>
</tr>
<tr>
<td>Milk</td>
<td>1.5</td>
</tr>
<tr>
<td>Bananas</td>
<td>1.5</td>
</tr>
<tr>
<td>Pulses/legumes</td>
<td>2.0</td>
</tr>
<tr>
<td>Chicken</td>
<td>2.0</td>
</tr>
<tr>
<td>Eggs</td>
<td>2.0</td>
</tr>
<tr>
<td>Green salad</td>
<td>2.0</td>
</tr>
<tr>
<td>Rice</td>
<td>2.0</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>2.5</td>
</tr>
<tr>
<td>Pork</td>
<td>3.0</td>
</tr>
<tr>
<td>Cheese</td>
<td>3.5</td>
</tr>
<tr>
<td>Beef</td>
<td>5.5</td>
</tr>
</tbody>
</table>
Greenhouse gas emissions from various diets

Fig 2. Relative differences in GHG emissions (kg CO2eq/capita/year) between current average diets and sustainable dietary patterns.

http://journals.plos.org/plosone/article?id=info:doi/10.1371/journal.pone.0165797
Climate change has far-reaching and potentially catastrophic impacts but many ‘low carbon’ policies can improve health and the economy.