Climate Change and its effects on health

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Imperial Horizons
6 February 2012
Learning objectives

1. why is CO2 rising?
2. inequalities on a global scale in exposure to climate change
3. which are the main health consequences of climate change?
4. which are the uncertainties involved?
5. the example of Bangladesh: sea level rise and salinity
6. the example of China: sand storms and other phenomena
7. what is adaptation?
Human-induced Climate Change linked to CO$_2$ Emissions from Industrialisation

Sources: Maddison, 2007 and CDIAC
CO₂ over the last 650,000 years

For 650,000 years, atmospheric CO₂ has never been above this line ... until now
CO2 Emissions by country (2002)
Cartogram of Climate-related Mortality (per million pop) yr. 2000

Source: from the WHO Comparative Risk Assessment, 2004
Pathways by which climate change may affect health outcomes (Haines and Patz 2003)

**REGIONAL WEATHER CHANGES:**
- heatwaves
- extreme events
- temperature
- precipitation

**Indirect mechanisms**
- floods
- droughts
- crop production
- socio economic decline

**Modulating influences**

**HEALTH EFFECTS**
- Extreme weather-related health effects
- Air (ozone) pollution related
- Water-related diseases
- Food borne diseases
- Vector-borne dis. rodent-borne dis.
- Malnutrition

**Adaptation measures**

**CLIMATE CHANGE**
Problems of assessing climate change and health

- the large spatial scale (i.e. national, regional or global);
- the long temporal scale (20-100 years);
- the level of complexity in the systems being studied.
- multiple uncertainties from environmental and social changes that affect health.

DH report on health effects of climate change in UK, 2008
Mortality in Paris during heat wave 1999-2002 compared to deaths in 2003

Source: Institut de Veille Sanitaire, 2003
Growing burden of climate disasters
(UNDP 2007)

- Greatest impacts in developing countries
- Weather related insurance losses going up faster than population, inflation and coverage
- Climate change may be contributing
- Increases in floods, droughts, lightning strikes, intensity of tropical cyclones

**Figure 2.1** Climate disasters are affecting more people

<table>
<thead>
<tr>
<th>People affected by hydrometeorological disaster (millions per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing countries</td>
</tr>
<tr>
<td>High-income OECD, Central and Eastern Europe, and the CIS</td>
</tr>
</tbody>
</table>

**Source:** HDRO calculations based on OFDA and CRED 2007.
The Global Water Crisis

- Water scarcity is growing - by 2025 more than half of the world’s population is projected to live under conditions of severe water stress

- Water quality is declining in many parts of the world

- 70% of all freshwater is used for irrigation

- 50-60% of wetlands have been lost
Setting the scene

- 1/3 of global burden of disease is related to water and sanitation

1 billion cases of diarrhoea each year

300 million people suffer malaria every year

200 million people are infected by schistosomiasis

6 million people visually impaired by trachoma
Global burden of disease…

..due to water associated diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Type of Disease</th>
<th>Annual morbidity</th>
<th>Annual mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholera</td>
<td>Water-borne</td>
<td>4,000,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Typhoid</td>
<td>Water-borne</td>
<td>25,000,000</td>
<td>216,000</td>
</tr>
<tr>
<td>Dracunculiasis (Guinea worm)</td>
<td>Water-based</td>
<td>3,190</td>
<td>&lt;300</td>
</tr>
<tr>
<td>Schistosomiasis (bilharzia)</td>
<td>Water-based</td>
<td>200,000,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Trachoma</td>
<td>Water-washed</td>
<td>41,000,000</td>
<td>-</td>
</tr>
<tr>
<td>Malaria</td>
<td>Water-related</td>
<td>350,000,000</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Dengue</td>
<td>Water-related</td>
<td>50,000,000</td>
<td>200,000</td>
</tr>
</tbody>
</table>

WHO data, June 2010
Global burden of disease...

..due to water associated diseases
Water, Sanitation and Disease: how are they related?

- There are different types of water associated diseases
  - Water-borne diseases
  - Water based diseases
  - Water washed diseases
  - Water related diseases (Vector-borne diseases)
Water and Disease: how are they related?

- There are different types of water associated diseases

- Waterborne diseases:
  - Caused by pathogenic organisms.
  - People become ill by ingesting contaminated water.
  - Waterborne diseases are the result of “dirty water” caused by lack of proper water supply and sanitary facilities.
  - About 3 billion people lack appropriate sanitary facilities and 1.2 billion people have no access to clean drinking water.
Water and Disease: how are they related?

Examples of major waterborne diseases are:

- cholera
- giardiasis
- typhoid fever
- E.coli
- hepatitis A&E

- Major symptoms: diarrhoea and vomiting, sometimes with fever
Water and Disease: how are they related?

- Water based diseases:

- Parasite spends part of life cycle in water/water animal as intermediate host.

- Ingested or skin penetration

- Examples: Guinea Worm, Schistosomiasis, tape worms

- Symptoms: Very painful chronic illness, can damage internal organs and can impair cognitive development in children
Guinea worm
Water and Disease: how are they related?

Water washed diseases

• The result of lack of water for hygiene purposes (face and/or cloth washing) and inadequate sanitation

• Examples of major water based diseases are:
  – Trachoma: It is transmitted through contact with discharge of an infected eye (through fingers or flies)
  – Scabies: Is caused by a mite, which can be transmitted through hands
Water and Disease: how are they related?

Water related diseases

- Also called vector-borne diseases. Transmitted by insects, such as mosquitoes and tsetse flies.

- They are called water related, because they breed in polluted and unpolluted mainly stagnant water

- Note: not all vector-borne diseases are water related
Water and Disease: how are they related?

What is a disease vector?

• In epidemiology, a **vector** is an insect (or other living carrier) that transmits an infectious agent (e.g. parasite).

• Vectors are vehicles by which infections are transmitted from one host to another.

• Most commonly known vectors consist of flies, mosquitoes, arthropods, domestic animals, or mammals.

• Transmit parasitic organisms to humans or other mammals.

• A sexual multiplication of the parasite in the vector
Water and Disease: how are they related?

- Which disease vectors do we know:
  - Fleas - transmitting Bubonic Plague.
  - Mosquitoes of the *Anopheles* genus - human malaria
  - *Aedes aegypti* mosquitoes - dengue fever and yellow fever

Non-water related disease vectors:

- Ticks - Lyme disease (grassy areas)
- Triatomine bugs - Chagas disease (mud, indoors)
- Tsetse flies - human African trypanosomiasis (African sleeping sickness)
- Sand flies – leishmaniasis (organic matter)
Water and Disease: how are they related?

- Water related (vector-borne) diseases
Diarrheal disease and rainfall


- 4% (1-7%) increase in diarrhoea incidence in children aged <5 per 10 mm/month decrease in rainfall

- Reduced effect of hand washing where rainfall is low?
Non-communicable diseases

The case of Bangladesh
Adverse effects of Climate Change – greatest among the most vulnerable – the poor, the elderly, children, coastal populations, women.

**Bangladesh is particularly vulnerable**
- Deltaic plains of the Ganges, Brahmaputra Meghna rivers
- Suffer from acute climate events – floods, droughts, cyclones
- Long-term environmental degradation → salinization & soil degradation
- Effects likely to be exacerbated by climate change & sea-level rise
A satellite image of Bangladesh. Much of the country is a vast river delta for the Ganges, Brahmaputra and Meghna Rivers. Directly in the middle of the image, just at the edge of the dark green mangrove forests, shrimp farming has taken over from rice farming.
### Factors Increasing Bangladesh’s Vulnerability to Climate Change

<table>
<thead>
<tr>
<th>Geography</th>
<th>Most elevations under 10m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>Subject to severe natural disasters</td>
</tr>
<tr>
<td>Population</td>
<td>Approx. 150 million. High growth rate and population density</td>
</tr>
<tr>
<td>Economy</td>
<td>Poor nation. 1999 GNP/capita: $370</td>
</tr>
<tr>
<td>Education</td>
<td>Literacy rate of 53%</td>
</tr>
<tr>
<td>Human Health</td>
<td>Life expectancy: 58 years. 56% under 5 malnourished. 50% of Women suffer from chronic energy deficiency</td>
</tr>
</tbody>
</table>
Floods

- Injuries
- Population displacement
- Adverse effects on food production
- Freshwater availability and quality
- Increased risk of infectious diseases – diarrhoeal diseases
- Toxic contamination
- Mental health

- Higher rates of stunting and wasting among flood exposed pre-school children and higher rates of chronic energy deficiency among flood exposed women (Del Ninno 2001).
Drought

- Acute and chronic nutritional problems
  - undernutrition, protein-energy malnutrition, micro-nutrient deficiency

- Infectious diseases
- Respiratory diseases
- Deaths

- Production of wheat and rice might no longer be economically suitable under climate change.

- A study found that drought, lack of food were associated with increased risk of mortality from diarrhoeal diseases (Aziz 1991)
Existing Drought Situation, and drought situations in the years 2030 & 2075
Cyclones

- Cyclones in 1970 and 1991 killed 300,000 and 138,000 people, respectively. Recent cyclone Sidr in 2007 killed 3,500 people, destroyed 500,000 homes, affecting 845,000 households.

- Coastal flooding, damaged infrastructure, saltwater intrusion, damage to the ecosystem, coral reefs, fisheries, population displacement, changes in the range & prevalence of climate-sensitive health outcomes.

- Impaired crop production
- Population displacement: diverse health risks (nutrition, infection, mental health)
Salinity – not a new problem!

- Drinking water in coastal Bangladesh - often full of salt as rising sea levels force salt water further inland from the Bay of Bengal.
- Saline water further inland than in the past - as far as 130 km. This is partly because global temperature rises are causing sea levels to rise, occasionally flooding low-lying areas.

‘Cyclones like Sidr cause tidal surges, inundating drinking ponds and driving brackish water further inland. Once they enter ponds and fields, the trapped water cannot flow anywhere else, as the silted-up riverbeds block their way’.

shrimp farming has taken over from rice farming
Soil Salinity Intrusion
Map showing different SLR scenarios to estimate how much salt water will intrude inland

- **Rising sea levels in the Bay of Bengal** - resulting in salinization
- Currently saline 2.8 million ha
- **20 million people** currently affected by varying degrees
- In 2005, about 6 million people were exposed to very high degrees of salinity (>5 ppt), which is likely to increase to 13.6 and 14.8 millions in the years 2050 and 2080, respectively.
- In the last 50 years, salinity has risen by 45%
Rising salinity – cause of pregnancy-related hypertension in coastal Bangladesh?

% prevalence of hypertensive disorders in women attending antenatal check-ups [May – July 2007]

Khan et al., 2008
Prevalence rates of hypertension (with or without proteinuria) among pregnant patients aged 13-45, recorded between July 2008 and March 2010 in Upazilla Health Complex, Dacope, Bangladesh.

<table>
<thead>
<tr>
<th>Month</th>
<th>No. of cases</th>
<th>Total no. of pregnancies</th>
<th>Prevalence (95 % C.I.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May – Sept</td>
<td>20</td>
<td>393</td>
<td>5.09 (2.91 – 7.26)</td>
</tr>
<tr>
<td>Oct - April</td>
<td>70</td>
<td>576</td>
<td>12.2 (9.48 – 14.8)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>90</strong></td>
<td><strong>969</strong></td>
<td><strong>9.28 (7.46 – 11.1)</strong></td>
</tr>
</tbody>
</table>

Prevalence odds ratio (95% CI): 2.39 (1.43 – 3.99)
Baseline survey in 3 villages in Shyamnaga in the south west: 61% of households used pond water for drinking and 81% used it for household purposes in the dry season.

Access to tube wells was extremely limited and NGOs are currently supporting rainwater harvesting intervention.
Adaptation to salinity

• Currently, government and NGO’s are supporting rainwater harvesting as a source of fresh drinking water
  – However, no or very little facilities for storage!

Rainwater Harvesting in Sutarkhali, Khulna. 2009
Women and children from Sultansadi village are bringing safe water from far places. Photo - Salahuddin Azizee
Climate change in China

Basic Knowledge
China: National Assessment Report of Climate Change
Asian Dust Events

- Occur in the spring: March/April
  - Especially following drought in autumn and winter
  - Occurs in China 3~5 times/yr, lasting a few days
  - Sources: China’s deserts and arid-areas in Inner Mongolia and Xingjian
  - Can cross the Pacific and reach as far as US west coast (1998)
  - Official report claim frequency has decreased, but sharp increase observed after 1990.

http://www.lakepowell.net/asiandust2.htm

1998
Sand storms (from other sources)

- Can reduce visibility to <1km
- Concentrate and transport air pollution ($\text{PM}_{10}$, $\text{O}_3$, $\text{NO}_x$ etc)
- Health effects associated: (Taiwan and Korea)
  - ↑ Daily CVD and pneumonia admissions
  - 2 studies on daily mortality
    non-significant
  - Coarse vs. fine particles
Schistosomiasis transmission, China

Risk map of schistosomiasis transmission in China in 2000 (green colour = potential risk areas for schistosomiasis transmission)

Predicted risk map of schistosomiasis transmission in China in 2030 (blue colour = predicted additional risk areas)

Also thanks to:
Thank you!