Lecture 10 – Impacts of climate change - 3

Impact on ecosystems

Definition of ecosystem

- An ecosystem is a complex set of relationships among the living resources, habitats, and residents of an area. It includes plants, trees, animals, fish, birds, micro-organisms, water, soil, and people.
- Everything that lives in an ecosystem is dependent on the other species and elements that are also part that ecological community.
- If one part of an ecological system is damaged or disappears, it has an impact on everything else.
- When an ecosystem is healthy, scientists say it is sustainable.

Source: http://forest.mtu.edu/kidscorner/ecosystems/definition.html

- Ecosystems are of great importance to human communities.
- They provide supplies for human communities in the provision of food, water, fuel, wood and biodiversity.
- They also provide important regulation especially for components of the hydrological cycle. Further they possess a wide range of important cultural value.
- All these together are commonly called ecosystem services .
- A *biome* is a very specialized ecosystem that only exists in a certain area or climate. They are identified by factors like temperature, rainfall, soil type and altitude.

- The variety of plants and animals that constitute a local ecosystem is sensitive to the climate, the type of soil and the availability of water.
- Ecologists divide the world into regions characterised by their distinctive vegetation.

Summarising the impacts of climate change on ecosystems with a warming of global average temperature of 2 °C or more from its pre-industrial value, there are five areas of particular concern

1. The resilience of many ecosystems (their ability to adapt) is likely to be exceeded by an unprecedented combination of change in climate, associated disturbances (e.g. flooding, drought, wildfire, insects, ocean acidification) and in other drivers such as land-use change, pollution and over exploitation of resources.
2. The terrestrial biosphere is currently a net carbon sink (see Table 3.1). As was mentioned in Chapter 3 , during the twenty-first century, it is likely to become a net carbon source thus amplifying climate change.
3. Approximately 20–30% of plant and animal species so far assessed (in an unbiased sample) are likely to be at increasingly high risk of extinction.

Table 3.1 Components of annual average global carbon budget for 1980s and 1990s in Gt of carbon per year (positive values are fluxes to the atmosphere, negative values represent uptake from the atmosphere)

	1980s	1990s	2000–2005
Emissions (fossil fuel, cement)	5.4 ± 0.3	6.4 ± 0.4	7.2 ± 0.3
Atmospheric increase	3.3 ± 0.1	3.2 ± 0.1	4.1 ± 0.1
Ocean–atmosphere flux	–1.8 ± 0.8	–2.2 ± 0.4	–2.2 ± 0.5
Land–atmosphere flux*	–0.3 ± 0.9	–1.0 ± 0.6	–0.9 ± 0.6
**partitioned as follows*			
Land-use change	1.4 (0.6 to 2.3)	1.6 (0.5 to 2.7)	not available
Residual terrestrial sink	–1.7 (–3.4 to 0.2)	–2.6 (–4.3 to –0.9)	not available

Source: 2009. Global warming the complete briefing, 4th edition by Jon Houghton

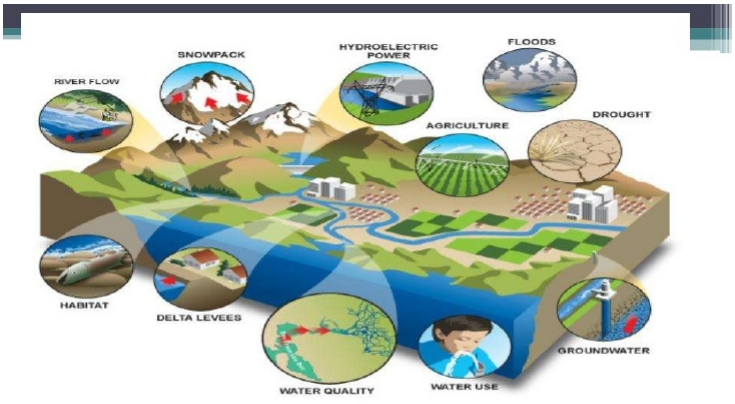
4. Substantial changes in structure and functioning of terrestrial ecosystems are very likely to occur with some positive impacts due to the carbon dioxide fertilisation effect but with extensive forest and woodland decline in mid to high latitudes and the tropics associated particularly with changing disturbance regimes (e.g. through wildfire and insects).
5. Substantial changes in structure and functioning of marine and other aquatic ecosystems are very likely to occur. In particular the combination of climate change and ocean acidification will have a severe impact on corals .

Impact on human health

- Human health is dependent on a good environment.
- Many of the factors that lead to a deteriorated environment also lead to poor health.
- Pollution of the atmosphere, polluted or inadequate water supplies and poor soil (leading to poor crops and inadequate nutrition) all present dangers to human health and well-being and assist the spread of disease.

- Malnutrition due to droughts and low agricultural yields
- Heatwaves
- Spread of diseases like malaria

http://www.slideshare.net/ghaiath/climate-change-and-its-impact-on-health



Health impact of climate change

WHO: five major health impacts of climate change

- Malnutrition
- Deaths and injuries caused by storms and floods. (Flooding can also be followed by outbreaks of diseases, such as cholera)
- Water scarcity / contamination (droughts and sudden floods) – increased burden of diarrhoeal disease.
- Heatwaves – direct increases in morbidity and mortality; indirect effects via increases in ground-level ozone, contributing to asthma attacks.
- Vector-borne disease – malaria and dengue.

World Health Organization

Vulnerable population groups

- Chronic medical conditions including mentally ill, clients with special needs
- Social isolation
- Poor & vulnerable communities
- Being confined to bed
- Certain medical treatments
- Some types of occupation, outdoor workers
- Very young children
- Elderly suffer the greatest effects of heat-waves (impact on mortality greater in women)

Health impact of climate change

- **Air pollution** - a reduction in the cold, calm winter weather associated with winter air pollution episodes together with reduced emissions of key pollutants including particles, oxides of nitrogen and sulphurdioxide could lead to a reduction (up to 50%) in the adverse health effects of winter air pollution.
- A small overall increase in the number of summer ozone episodes coupled with a longer-term increase in background levels of ozone could cause a rise in the number of premature deaths.

Air Pollution

- Pollution determined by emissions & weather
- Increases in ozone:
  - extra deaths &
  - hospital admissions
- Air quality decline:
  - severity of asthma
- Ozone levels dependent on pollution control in Europe

- Between 2003 – 2020, increase in ozone levels will result in a 51-53% increase in attributable deaths and hospital admissions for respiratory diseases, threshold assumptions of 35-50ppb (attributable to climate change)

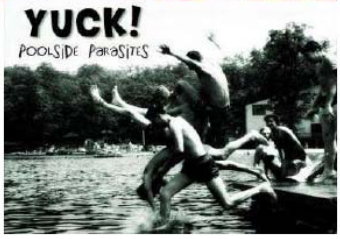
Infectious diseases – foodborne and waterborne diseases

Foodborne diseases

- Likely increase in cases of food poisoning
- incidence dependent on future food hygiene behaviour
- evidence confirms the effect of temperature on salmonellosis
- role of temperature in Campylobacter transmission remains uncertain

Waterborne diseases

- Likely increase in cases of Cryptosporidiosis
- Impact of increased temperature on water quality & disinfection



- **Salmonellosis** is an infection caused by the *Salmonella* bacteria. Most people with salmonellosis develop diarrhea, fever, vomiting, and abdominal cramps 12 to 72 hours after infection.
- **Campylobacteriosis** is an infection by the *Campylobacter* bacterium,[1] most commonly *C. jejuni*. It is among the most common bacterial infections of humans, often a foodborne illness. It produces an inflammatory, sometimes bloody, diarrhea or dysentery syndrome, mostly including cramps, fever and pain.
- **Cryptosporidiosis** is a diarrheal disease caused by parasites named *Cryptosporidium*; the parasites have a life cycle that can be completed in humans and many types of animals.

Source: en.wikipedia.org

Health impact of climate change

- Extremes of temperature - heat-related deaths could increase to around 2,800 cases per year.
- This is likely to be offset by milder winters leading to a fall in cold-related winter deaths of up to 20,000 cases per year.

Exposure to ultra violet radiation

Likely increases in:
- Sunburn
- Skin cancer
- Possibly cataracts


melanoma

SunSmart

Health impact of climate change

- **Flooding** – increased frequency of severe coastal and river floods,
- Analysis of more recent river flooding shows that mental health problems are the most important health impact among flood victims due to experience of personal and economic loss and stress.

River, Coastal Flooding & Flash Floods

- Few direct deaths
- Full effect in terms of mortality and morbidity not known
  - Accidents – drowning, electrical
  - Contamination of drinking water
  - Rise in waterborne infections
  - Exposure to toxic pollutants
  - Psychological consequences
  - Disruption, injuries & deaths
  - Late effects include stress & mental health problems
- Food and water safety concerns
- Effects on health and social ser

UK floods of summer 2007

Health impact of climate change

- • **UV exposure** – levels of UV radiation reaching the earth's surface may increase due to sunnier summers,
- a decline in cloud cover and ozone depletion (which
- reduces the capacity of the ozone layer to absorb UV).
- predicted an extra 5,000 cases of skin cancer and 2,000 of cataract per year by 2050.

Health impact of climate change

- Vector-borne diseases – various diseases transmitted by mosquitoes or ticks are climate-sensitive and can increase or be introduced due to climate change.
- Malaria might be re-established in non-endemic areas.
- Potential emergence of other vector-borne diseases, such as West Nile Fever.

Vector-borne diseases

- Outbreaks of malaria likely to be rare
- Tick borne likely to be more common, but relate to land use/leisure activities rather than climate change
  - Lyme disease – no observed correlation between temperature and incidence
  - Tick-borne encephalitis – low chances of occurrence
- Possible increase in flies

(diarrhoeal disease), midges, fleas, stinging insects

- Need to be alert to possibility of emerging infections

Health impact of climate change

- **Food poisoning** - higher temperatures in summer could cause an estimated 10,000 extra cases of salmonella infection per year.
- **Storms** – any increase in the frequency of severe winter storms could lead to an increase in personal injuries from flying debris and falling trees.

Health impact of climate change

- **Water-borne disease –** climate change might increase levels of cryptosporidium and campylobacter in water.
- Secure sanitation systems should safeguard supplies of drinking water, but possible contamination of stormwater outflows could carry disease into basements and nearby rivers, affecting the health of residents and river users.

What diseases are the most climate sensitive?

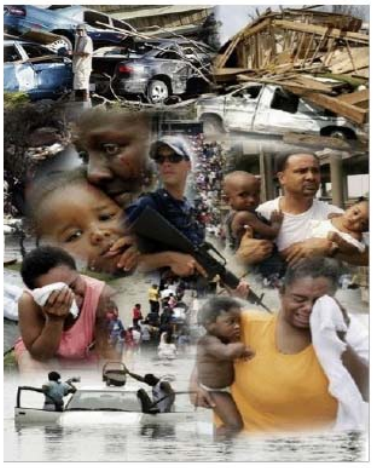
- heat stress
- effects of storms
- air pollution effects
- asthma
- vector-borne diseases
- water-borne diseases
- food-borne diseases
- sexually-transmitted diseases

Health impact of extreme events

Extreme weather-related events (natural disasters)

Lead to:

- Social disruption
- Homelessness
- Injuries, deaths, disability
- Impacts on food and water supply



Impact type	Health impact	Potential impact pathway
Direct impact to humans	Fatalities, injuries, heat stress	• Direct physical injuries from extreme events • Direct temperature related effects from heat waves
Natural Environment		
Water borne	Gastro-intestinal diseases Diarrhea, vomiting	• Run-off events from heavy rainfall, risk of contamination by disease pathogens; such as Cryptosporidium spp. • Contamination from wildlife and stock deaths in drought, bushfires.
Water supply	Water stress	• Effect on quantity and quality of water to reservoirs – increase sediment, nutrient and debris flow • Changes to land cover – change in runoff patterns
Vector borne	• Ross River Virus disease (RRv) • Barmah Forest Virus disease (BFv) • Dengue • Murray Valley Encephalitis (MVE) • Other exotic diseases	• Extreme events will impact on the complex ecological cycles of the diseases, as well as our ability to respond. Direction of impacts likely to be positive or negative. • Changes to climate may allow exotic diseases and vectors to establish.

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Impact type	Health impact	Potential impact pathway
Food borne	Food poisoning	• High temperatures may increase proliferation of bacterial pathogens including Salmonella, Campylobacter and Listeria spp. • Heavy rainfall events – increase risk of Cryptosporidiosis. • Temperature increase may cause increase in mycotoxins and aflatoxins.
Food production	Changes to diet	• All extreme events particularly in relation to reduced water from rainfall, destroy or damage a wide range of crops and livestock – changes in cost and availability of food.
Air quality	Respiratory effects Asthma Allegic reactors	• Bushfires – increase air pollutants • Droughts/wind – increase dust • Heat events – increase smog • Links between high temperature and ground ozone levels
Biodiversity	Very difficult to determine Likely impact on ecological goods and services	• Wide range of potential impacts on biodiversity, particularly drought and bushfires
Others	Chemical exposure	• Damage to chemical pipelines, storage • Drought increases concentration of soil and water contaminants

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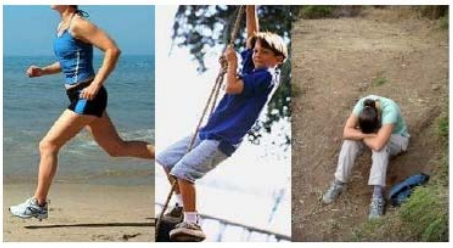
Potential health benefits

Due to both direct & indirect effects:

- Increased physical activity due to extended warm weather. But, outcomes could be worse due to extreme heat
- Reduced obesity and road traffic injuries through active transport
- Possibly healthy eating through adoption of sustainable farming & food policy and diets containing less animal products
- Reduced respiratory illness by improvements in air quality
- Increased home energy efficiency reducing temperature-related illness



Conclusions

Impact on ecosystem

- Changes in the timing of seasonal life cycle events, such as migration, blooming, and mating.
- Range shifts: While this means a range expansion for some species, for others it means a range reduction or a movement into less hospitable habitat or increased competition. Some species have nowhere to go because they are already at the northern or upper limit of their habitat.
- Food web disruptions: e.g. Arctic food web.
- Threshold effects: Prairie potholes regions in North America has experienced temporary droughts in the past. Coral reefs (As ocean temperatures warm and the acidity of the ocean increases, bleaching and coral die-offs are likely to become more frequent. Chronically stressed coral reefs are less likely to recover).
- Pathogens, parasites, and disease: Climate change and shifts in ecological conditions could support the spread of pathogens, parasites, and diseases, with potentially serious effects on human health, agriculture, and fisheries.
- Extinction risks: Examples of species that are particularly climate sensitive and could be at risk of significant losses include animals that are adapted to mountain environments, such as the pika, animals that are dependent on sea ice habitats, such as ringed seals, and cold-water fish, such as salmon in the Pacific Northwest.

Conclusions

Impact on human health

- Impact from heat wave
- Impacts from extreme weather events
- Impacts from reduced air quality
  - Increase in ozone
  - Changes in fine particulate matter
  - Changes in Allergens
- Impacts from climate-sensitive diseases
  - Food-borne diseases
  - Water-borne diseases
  - Animal-borne diseases
- Other health linkages: food security, malnutrition, spread of infectious diseases, and food poisoning.

References

- http://www.epa.gov/climatechange/impacts-adaptation/ecosystems.html
- http://www.epa.gov/climatechange/impacts-adaptation/health.html