Climate Change and Public Health: Charting a Sustainable Future

Oregon Public Health Division / Portland State University / Oregon Environmental Council / Physicians for Social Responsibility
Portland, Oregon
November 8, 2007

Howard Frumkin, M.D., Dr.P.H., Director
National Center for Environmental Health / Agency for Toxic Substances and Disease Registry
Centers for Disease Control and Prevention
Climate Change

The Greenhouse effect

ATMOSPHERE

SUN

Net incoming solar radiation: 240 Watt per m²

Some solar radiation is reflected by the atmosphere and earth's surface
Outgoing solar radiation: 103 Watt per m²

Some of the infrared radiation passes through the atmosphere and is lost in space
Net outgoing infrared radiation: 240 Watt per m²

Solar radiation passes through the clear atmosphere.
Incoming solar radiation: 343 Watt per m²

Solar energy is absorbed by the earth's surface and warms it...
168 Watt per m²

... and is converted into heat causing the emission of longwave (infrared) radiation back to the atmosphere

GREENHOUSE GASES

Surface gains more heat and infrared radiation is emitted again

Sources:
- Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1996, The science of climate change, contribution of working group 1 to the second assessment report of the Intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.
Rising CO₂

![Graph showing rising CO₂ concentrations over time.](Image)
Rising temperatures
Severe weather events

Three-day average temperature, 25–27 August 2005. Temperatures >28° C (red, orange and yellow) are hot enough for hurricanes to form.

Image: NASA Aqua satellite
The bold curve in (A) is the maximum global hurricane wind speed (in m/sec). The horizontal dashed lines show the 1970–2004 average numbers in each category.

Since 1979, more than 20% of the polar ice cap has melted away.
The Northwest Passage, 2005

- Historically: impassable (Lord Franklin)
- First crossing: Amundsen, 1905 (more than 2 years)
- 2005: Only 40 miles of scattered ice in Victoria Strait

Source: National Snow and Ice Data Center, 2005
North Pole Expedition

"Helsinki - Murmansk - Barent Sea - North Pole - Franz Joseph Land"

Some places on our planet are so out of reach that their very isolation has stirred generations of explorers into voyages of adventure and discovery. One such place is the North Pole. Join us on a historic voyage to 90 North. Sailing from Murmansk (Russia), we head north through dense, multi pack ice to the North Pole, a worthy goal for our amazing ship. Only very few vessels have the power to negotiate the challenging Ice of the Arctic Basin. Navigating the polar pack at speeds up to 12 knots, we are enthralled by an ever-changing panorama of wind-polished ice, narrow channels of dark green water and aquamarine pools.

From the North Pole, we head southward to Franz Joseph Land, a marvellous place of glaciers, volcanic mountains and wildlife. Here we hope to encounter walruses and polar bears on the ice.

This is the expedition of a lifetime.

The Itinerary

The itinerary displayed below leaves from Moscow. We also operate North Pole cruise leaving from Moscow, Russia.

DAY 1: Helsinki, Finland
A day of leisure with time to explore the charming capital of Finland before meeting fellow travelers at our hotel, the Radisson SAS Plaza Hotel, or similar centrally located hotel.

DAY 2: Murmansk, Russia
This morning we transfer to the airport for our flight to Murmansk. Surrounded by birch and spruce forest, Murmansk is almost halfway between Moscow and the North Pole. With a population of about 400,000, it is the largest city north of the Arctic Circle, and the home port of Russia's nuclear icebreakers. We transfer to the port to embark the Yamal.

DAY 3: Barents Sea
Today is our iced-in day and there is time to relax and enjoy our expedition.
• Hudson Bay polar bear population ↓ 22% from 1987-2004
• Polar bear cub one-year survival in Alaska’s Beaufort Sea ↓ from 65% (late 1980s) to 43% (current)
• Reports of polar bears drowning while swimming long distances between ice floes
• Reports of polar bear cannibalism

Source: USGS Alaska Science Center
Glacier Bay National Park, 1941. The glacier is 2,000 feet thick. USGS photo, available www.coasttocoastam.com/shows/2005/01/29.html
Same scene, Glacier National Park, 1988
Matterhorn, Italian-Swiss border

©Bradford Washburn

©David Arnold
Portage Glacier, Alaska

1914

2004

Portage Glacier, Alaska
Extent of ice melt in Greenland, 1992 and 2002

Arctic Climate Impact Assessment 2004
Appendix Figure A.7. Number of Flood Events by Continent and Decade Since 1950 (C16, Fig 16.6)
A changing world

- Rising temperatures
- More severe weather events
- Loss of polar ice cover
- Ecological damage (polar bears)
- Glacier loss
- Sea level rise
- Floods
Potential Health Effects of Climate Change

Climate change:
- Temperature rise
- Sea level rise
- Hydrologic extremes

Adapted from J. Patz
The direct health effects of heat
### European heat wave, 2003

#### CONFIRMED MORTALITY

<table>
<thead>
<tr>
<th>Country</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>2,091</td>
</tr>
<tr>
<td>Italy</td>
<td>3,134</td>
</tr>
<tr>
<td>France</td>
<td>14,802</td>
</tr>
<tr>
<td>Portugal</td>
<td>1,854</td>
</tr>
<tr>
<td>Spain</td>
<td>4,151</td>
</tr>
<tr>
<td>Switzerland</td>
<td>975</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1,400-2,200</td>
</tr>
<tr>
<td>Germany</td>
<td>1,410</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>29,817-30,617</strong></td>
</tr>
</tbody>
</table>

#### TIME LINE (FRANCE)


South Florida Shoreline Change after a 1-Meter Rise in Sea Level

Areas shown in red are subject to inundation after a 1-meter rise in sea level

Source: Elevations from USGS digital data
Florida after a 3.5 m sea level rise

New York after a 3.5 m sea level rise

<table>
<thead>
<tr>
<th>Disease</th>
<th>Vector</th>
<th>Population at risk (million)¹</th>
<th>Number of people currently infected or new cases per year</th>
<th>Present distribution</th>
<th>Likelihood of altered distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>Mosquito</td>
<td>2,400²</td>
<td>300-500 million</td>
<td>Tropics and Subtropics</td>
<td>![Highly likely]</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>Water snail</td>
<td>600</td>
<td>200 million</td>
<td>Tropics and Subtropics</td>
<td>![Very likely]</td>
</tr>
<tr>
<td>Lymphatic Filariasis</td>
<td>Mosquito</td>
<td>1,094³</td>
<td>117 million</td>
<td>Tropics and Subtropics</td>
<td>![Likely]</td>
</tr>
<tr>
<td>African Trypanosomiasis</td>
<td>Tsetse fly</td>
<td>55⁴</td>
<td>250,000 to 300,000 cases per year</td>
<td>Tropical Africa</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>(Sleeping sickness)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dracunculiasis (Guinea worm)</td>
<td>Crustacean</td>
<td>10⁵</td>
<td>100,000 per year</td>
<td>South Asia, Arabian Peninsula, Central-West Africa</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>(Guinea worm)</td>
<td>(Copepod)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>Phlebotomine</td>
<td>350</td>
<td>12 million infected, 500,000 new cases per year⁶</td>
<td>Asia, Southern Europe, Africa, Americas</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>sand fly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onchocerciasis (River blindness)</td>
<td>Black fly</td>
<td>123</td>
<td>17.5 million</td>
<td>Africa, Latin America</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>American Trypanosomiasis</td>
<td>Triatomine bug</td>
<td>10⁷</td>
<td>18 million</td>
<td>Central and South America</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>(Chagas disease)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dengue</td>
<td>Mosquito</td>
<td>1,800</td>
<td>10-30 million per year</td>
<td>All Tropical countries</td>
<td>![Unknown]</td>
</tr>
<tr>
<td>Yellow Fever</td>
<td>Mosquito</td>
<td>450</td>
<td>more than 5,000 cases per year</td>
<td>Tropical South America</td>
<td>![Unknown]</td>
</tr>
</tbody>
</table>

1. Top three entries are population-prorated projections, based on 1989 estimates.
5. Ranque, personal communication.
6. Annual incidence of visceral leishmaniasis; annual incidence of cutaneous leishmaniasis is 1-1.5 million cases/yr (PAHO, 1994).

Source: Climate change 1995, Impacts, adaptations and mitigation of climate change: scientific-technical analyses, contribution of working group 2 to the second assessment report of the Intergovernmental Panel on Climate Change, UNEP and WMO, Cambridge Press University, 1996.
Global Warming's greatest threat may also be the smallest.
The predictable...

Dengue Fever Epidemic Potential as Projected by General Circulation Models of Global Climate Change


1 Department of Environmental Health Sciences, Johns Hopkins School of Hygiene and Public Health, Baltimore, MD 21205-2179 USA
2 Department of Mathematics, Maastricht University, Maastricht, The Netherlands
3 Center for Medical, Agricultural and Veterinary Entomology, Agricultural Research Service, U.S. Department of Agriculture, Gainesville, FL 32604 USA
4 Department of Entomology, Graduate School for Production Ecology, Wageningen Agricultural University, Wageningen, The Netherlands
Deadly dengue fever surging in Mexico
Mosquito-control teams dispatched to springtime tourist areas

The deadly hemorrhagic form of dengue fever is increasing drastically in Mexico, and experts predict a surge throughout Latin America fueled by climate change, migration and faltering mosquito eradication efforts.

Overall dengue cases have increased by more than 600 percent in Mexico since 2001, and worried officials are sending special teams to tourist resorts to spray pesticides and remove garbage and standing water where mosquitoes breed ahead of the peak Easter Week vacation season.

The Intergovernmental Panel on Climate Change, made up of the world’s leading climate scientists, predicted in March that global warming and climate change would cause an upsurge in dengue. In Mexico, officials say longer rainy seasons already are leading to more cases.

“It used to be seasonal, in the hottest, wettest months, and now in some regions we are seeing it practically all year,” said Joel Navarrete, an epidemiologist with the Mexican Social Security Institute.
A rare genotype of Cryptococcus gattii caused the cryptococcosis outbreak on Vancouver Island (British Columbia, Canada)


Discussion

Until the recent emergence of cryptococcal infection on Vancouver Island, C. gattii had been considered to be restricted to areas with tropical and subtropical climates (2). The identification of large-scale colonization of C. gattii in the environment occurring in a temperate climate zone indicates a striking change in the distribution of this species. Furthermore, the identification of the C. gattii
By Doug Struck
Washington Post Foreign Service
Sunday, April 8, 2007; Page D01

VICTORIA, B.C. -- The mystery emerged slowly, its clues maddeningly diverse.

Sally Lester, an animal pathologist at a British Columbia laboratory, slipped a slide under her microscope -- a tissue from a dog on Vancouver Island. Her lens focused on a tiny cell that looked like a boiled egg. It was late 1999. She had started seeing a lot of those.

On the eastern side of the island, several dead porpoises washed ashore early the next year. Scientist Craig Stephen, who runs a research center on the island, slit one open. He found its lungs seized by pneumonia and its other organs swollen by strange, flowerlike tumors.

"As climate change happens, new ecological niches will become available to organisms, and we will see this kind of thing happen again," said Karen Bartlett, a scientist at the University of British Columbia who played a central role in the search for the disease's cause.

Her investigation eventually would focus on a fungus, a member of the yeast family called *Cryptococcus gattii*. The microscopic fungus is normally found in the bark of eucalyptus trees in Australia and other tropical zones.
Global Warming May Be Spurring Allergy, Asthma

Dr. Ziska's Ragweed Loves Carbon Dioxide; Toxic Pollen in Cities?

By GAUTAM NAIK
May 3, 2007; Page A1

There's growing scientific evidence that global climate change is linked to the dramatic rise in allergies and asthma in the Western world.

Studies have found that a higher level of carbon dioxide turbocharges the growth of plants whose pollen triggers allergies. In 2001 Lewis Ziska planted ragweed -- the main cause of hay fever in the fall -- at urban, suburban and rural sites near Baltimore. The plots had the same seeds and soil and were watered in the same way. Yet the downtown plants soon exploded in size, flowering earlier and producing five times the pollen of rural plants. The city pollen was a lot more toxic, too. The likely cause? The city plants experienced warmer temperatures and 20% more carbon dioxide, the effect of more cars and pollution.
Poison Ivy

- *Toxicodendron radicans*
- \( \uparrow \text{CO}_2 \) leads to
  - \( \uparrow \) photosynthesis
  - \( \uparrow \) water use efficiency
  - \( \uparrow \) growth
  - \( \uparrow \) biomass
  - More allergenic urushiol
- Greater \( \text{CO}_2 \) stimulation than most other woody species

Source: Mohan et al. PNAS 2006;103:9086-89.
Ragweed

- Genus *Ambrosia*
- ↑ CO₂ and temperature → ↑ pollen counts, longer growing season

**Something in the Air**

Researchers at the U.S. Dept. of Agriculture planted ragweed in and around Baltimore in 2001 to test how the plant responds to different concentrations of CO₂. The results:

<table>
<thead>
<tr>
<th>Area</th>
<th>Period of collection</th>
<th>Pollen count, grains per cubic meter of air</th>
<th>Average CO₂ level, parts per million in the air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>July 30-Sept. 7</td>
<td>12,138</td>
<td>600</td>
</tr>
<tr>
<td>Suburban</td>
<td>Aug. 6-Sept. 10</td>
<td>3,252</td>
<td>400</td>
</tr>
<tr>
<td>Rural</td>
<td>Aug. 15-Sept. 17</td>
<td>2,294</td>
<td>200</td>
</tr>
</tbody>
</table>

Source: Lewis Ziska, U.S. Dept. of Agriculture

Maximum Daily Ozone Concentration in Atlanta, GA, and New York, NY Versus Maximum Daily Temperature


ppbv = parts per billion volume
Current U.S. ozone standard is 120 ppbv (maximum daily one-hour average).
Ozone Season in Atlanta

Source: M. Chang, Ph.D., Georgia Tech
Climate change and food

Temperature
Precipitation
CO₂ levels
Plant diseases
Plant pests
Animal diseases

Climate Change

Food supply and demand

Land degradation

Unsustainable forestry

Biodiversity loss

Loss and fragmentation of habitats

Nitrogen fertilization

Salinization and erosion

Loss of crops, genetic diversity

Sedimentation

Fertility loss
## Changes in simulated crop yields

<table>
<thead>
<tr>
<th>CROP</th>
<th>% change in simulated crop yield</th>
<th>Climate change alone</th>
<th>Climate change with direct CO₂ effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>-16 to -33</td>
<td>11 to -13</td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>-24 to -25</td>
<td>-2 to -5</td>
<td></td>
</tr>
<tr>
<td>Maize</td>
<td>-20 to -31</td>
<td>-15 to -24</td>
<td></td>
</tr>
<tr>
<td>Soy</td>
<td>-19 to -57</td>
<td>16 to -33</td>
<td></td>
</tr>
</tbody>
</table>

Civil strife
Climate Change Scenarios Scare, and Motivate, Kids

By Darragh Johnson
Washington Post Staff Writer
Monday, April 16, 2007; Page A01

The boy has drawn, in his third-grade class, a global warming timeline that is his equivalent of the mushroom cloud.

"That's the Earth now," the 9-year-old says, pointing to a dark shape at the bottom. "And then," he says, tracing the progressively lighter stripes across the page, "it's just starting to fade away."

How we're damaging the environment is more of a worry to you than getting a girl or boyfriend, says a survey.

The results showed three quarters of 11 to 14-year-olds worry about climate change, compared to 41% who are worried about going out with someone.

And it looks like you lot aren't just all talk - 63% turn off the lights when you leave a room, 32% of you recycle, and 75% say we should recycle more.

The survey quizzed 1,554 kids on their views on the
“This past summer, I got deeply depressed about our planet—as if I didn’t have enough problems of my own.”
"Hargrove, what's all this I hear about your living in constant fear of the polar ice caps melting?"
Mental Health Problems From Katrina Persist

By Dorie Tumer
Associated Press
Thursday, November 9, 2006: Page A12

ATLANTA, Nov. 8 -- Hurricane Katrina left more than gutted houses and empty streets along the Gulf Coast. The military and disaster workers尚 were helping thousand faces emerged, more than a week or two. The mental health workers say many hurricane survivors may need psychological help in the weeks to come.

'A Very Long Recovery'
A psychologist talks about the emotional fallout from disasters like Hurricane Katrina and what can be done to help the victims cope.

Is New Orleans Having a Mental Health Breakdown?
By Russell McCulloch, New Orleans

Over the past several months, psychiatrist James Barbee has witnessed a disturbing trend among his patients in New Orleans — a noticeable slide from post-Katrina anxiety to more serious, and harder to treat, cases of major depression. At the same time, the city’s system for dealing with mental health care is suffering a major breakdown of its own. "People are just wearing down," says Barbee. "There was an initial spirit about bouncing back and recovering, but it’s diminished over time, as weeks have become months."
Potential Health Effects of Climate Change

Climate change:
- Temperature rise
- Sea level rise
- Hydrologic extremes

Adapted from J. Patz
Thinking about climate change

Climate change is...
• Here to stay
• Not the only challenge we’ve got
• Hard to think about
Looking over the horizon
Past and future CO₂ atmospheric concentrations

Observations

Projections

Scenarios
- A1B
- A1T
- A1FI
- A2
- B1
- B2
- IS92a
Projected changes in global temperature: global average 1856-1999 and projection estimates to 2100

The “Warming Commitment”

Constant Composition  

Constant Emissions

CO₂ concentration, temperature, and sea level continue to rise long after emissions are reduced

**Magnitude of response**

- CO₂ emissions peak 0 to 100 years

**Time taken to reach equilibrium**

- Sea-level rise due to ice melting: several millennia
- Sea-level rise due to thermal expansion: centuries to millennia
- Temperature stabilization: a few centuries
- CO₂ stabilization: 100 to 300 years

Source: IPCC
“Hubbert’s peak”

Source: Hubbert, 1956
Peak petroleum
Peak petroleum and public health

• Medical supplies and equipment
  – Medications
  – Supplies

• Transportation
  – Health services
    e.g. ambulances
  – Workforce transportation

• Energy

• Food
Limits on land
Limits on water
Population growth

World population development

Billions

Developing countries

Industrialized countries
Systems thinking

Reality (simplified)
Climate change and human health: Challenges to our thinking

- Bad news, apocalyptic visions
- Highly technical and complex
- Beyond anyone’s experience or imagination
- Terrifying to contemplate
- Resistance to behavioral changes
- Misinformation actively disseminated
Public health action on climate change
Mitigation: Climate stabilization wedges

Pacala S, Socolow R. Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. Science 2004;305;968-72
Adaptation

- More dikes, dams, and levees
- Relocation
- Changes in agricultural practices
- Heat wave plans
- Air conditioning
- Vector-borne disease control programs
- Changes in food handling
- And many more
Public Health Action on Climate Change

- Study and predict links between climate change and health
- Track diseases and trends related to climate change
- Investigate infectious water-, food-, and vector-borne disease outbreaks
- Communicate effectively on climate change
- Partnerships with private sector, civic groups, NGOs, faith community, etc.
- Heat wave and severe storm response plans; focus on the most vulnerable
- Public health workforce prepared to respond
- Investigate infectious water-, food-, and vector-borne disease outbreaks
- Investigate infectious water-, food-, and vector-borne disease outbreaks
- Investigate infectious water-, food-, and vector-borne disease outbreaks
- Investigate infectious water-, food-, and vector-borne disease outbreaks
Public Health Action on Climate Change

- Predicting threats to public health
- Acting to protect public health
- Communicating effectively
- Promoting co-benefits
- Mobilizing partnerships
Vulnerability analysis

Risk for Hyperthermia: Census & Thermal Model

Legend
- Death from Hyperthermia (Primary Cause)
- Risk as Predicted from Logistic Regression
  - Low
  - Moderate
  - High

Death Locations are in Assigned Census Tracts but are Randomly Offset to Protect Privacy
Planning and acting to protect public health
Communicating effectively

THE END IS NIGH
Therefore do your important paperwork now, this morning, because if you leave it until this afternoon you might find that it is too late, thereby leaving you in a bit of a pickle.

WORLD ENDS TOMORROW
REPENT! REUSE! RECYCLE!
LEST YE BURN!

PRAISE THE GLOBE!
Summer heat waves will melt polar ice caps and result in...

OCEANS RISING 150 FT. & flooding coastal areas

WILL YOUR CITY SURVIVE?

SHOCKING MAP INSIDE SHOWS DANGER ZONES INCLUDING:
New York • Miami • Boston • Vancouver • San Diego • Mobile
San Francisco • Houston • Philadelphia • Baltimore • Halifax
New Orleans • Long Beach • Providence • Savannah • Galveston
When we don’t communicate effectively...
Edvard Munch does Climate Change

Despair

Anxiety

The Scream
“Think of the verbs associated with environmentalism and conservation: ‘stop,’ ‘restrict,’ ‘reverse,’ prevent,’ ‘regulate,’ and ‘constrain.’ All of them direct our thinking to stopping the bad, not creating the good.”

The need for positive, aspirational messages.
“I have a nightmare…”
“I have a dream...”
“The challenge of climate change is so massive, so global, and so complex that it can only be overcome if we look beyond the issue categories of the past and embrace a grand new vision for the future.”

The need for bold, cross-cutting thinking.
Promoting co-benefits
## Climate Change Synergies

<table>
<thead>
<tr>
<th>Environmental Feature</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat wave plans including “buddy systems”</td>
<td>↑ social capital</td>
</tr>
<tr>
<td>Vehicular travel</td>
<td>↓ car crashes; clean air; ↑ physical activity</td>
</tr>
<tr>
<td>Fuel efficiency</td>
<td>↓ air pollution</td>
</tr>
<tr>
<td>Locally grown food</td>
<td>Fresh food; ↓ pesticide exposure; local business</td>
</tr>
<tr>
<td>Energy-efficient buildings</td>
<td>↓ operating costs</td>
</tr>
<tr>
<td>Alternative energy sources</td>
<td>Business opportunities</td>
</tr>
</tbody>
</table>
Food and nutrition

Co-benefits: Food and nutrition

Livestock’s long shadow

Environmental issues and options

3.1 Issues and impacts

The livestock sector is a major source of greenhouse gas emissions, contributing to climate change. Livestock is a part of the long shadow of agricultural systems, which include all activities associated with the production, processing, and distribution of food products.

Inclusion of the livestock sector in a policy to reduce greenhouse gas emissions will require addressing a variety of issues, such as the co-production and consumption of livestock products.

Energy and Health

5. Food, livestock production, energy, climate change, and health

Food provides energy and nutrients, but its acquisition requires energy expenditure. In post-harvest storage and transportation, energy is used to keep the food fresh and safe.

Introduction

Food production involves various activities, including the cultivation of crops, the breeding and rearing of livestock, and the processing and distribution of food products.

Substantial and widespread public health problems of under-nutrition and over-nutrition exist in many countries. Livestock production systems are often associated with these problems.

Livestock’s role in climate change and air pollution

Section 3.1 discusses the impact of livestock production on greenhouse gas emissions and air pollution.

Section 3.2 focuses on the role of livestock in climate change and air pollution.

Key messages

- Greenhouse gas emissions from the agriculture sector account for about 22% of global total emissions; this contribution is similar to that of industry and greater than that of transport. Livestock production (including transport of livestock and feed) accounts for nearly 60% of the sector’s emissions.
- Methane and nitrous oxide (which arise from both livestock and feed) contribute much more to the sector’s warming effect than does carbon dioxide.
- Raising the increased greenhouse gas emissions from agriculture, especially livestock production, should therefore be a top priority, because it could slow warming rapidly. However, livestock production is often constrained by current trends, including population growth and urbanization.
- Available technologies for reducing emissions from livestock production, applied universally and effectively, could reduce net methane and nitrous oxide emissions by between 20% and 30%. The challenges include cost and technical feasibility. The costs of some technologies have increased, but the benefits are significant.

www.forestry.com Vol. 279 October 1, 2010

(Continued on next page)
Co-benefits: Transportation

- CO$_2$ emissions ↓
- Air pollution ↓
- Physical activity ↑
- Injuries ↓
- Osteoporosis ↓
- Infrastructure costs ↓
- Social capital ↑

And by the way…
Mobilizing partnerships

• Within government: Federal – state – local
• More broadly:
  – Energy
  – Transportation
  – Urban planning
  – Manufacturing
  – Architecture
  – Faith
  – Environmental
And in closing...
1. Envision healthy, wholesome, sustainable environments

“They are ill discoverers that think there is no land, when they can see nothing but sea.”

Sir Francis Bacon
2. Think big, think synthetically, think across many issues
3. Be a good ancestor
Care for the individual patient

Care for the community

Care for future generations

THE CLINICAL APPROACH

THE PUBLIC HEALTH APPROACH

THE LEGACY APPROACH
• Intergenerational responsibility
• Stewardship
4. Don’t be afraid to lead
5. Pursue justice
6. Be joyful and have fun
Public Health Action on Climate Change

- Study and predict links between climate change and health
- Track diseases and trends related to climate change
- Investigate infectious water-, food-, and vector-borne disease outbreaks
- Communicate effectively on climate change
- Partnerships with private sector, civic groups, NGOs, faith community, etc.
- Heat wave and severe storm response plans; focus on the most vulnerable
- Public health workforce prepared to respond

Public Health Action on Climate Change

Track diseases and trends related to climate change

Communicate effectively on climate change

Partnerships with private sector, civic groups, NGOs, faith community, etc.

Heat wave and severe storm response plans; focus on the most vulnerable

Public health workforce prepared to respond

Study and predict links between climate change and health
Environmental Change and Human Health: Charting a Sustainable Future

1. Envision healthy, wholesome, sustainable environments.
2. Think big, think synthetically, think across many issues.
3. Be a good ancestor.
4. Don’t be afraid to lead.
5. Pursue justice.
6. Be joyful and have fun.
Thank you!