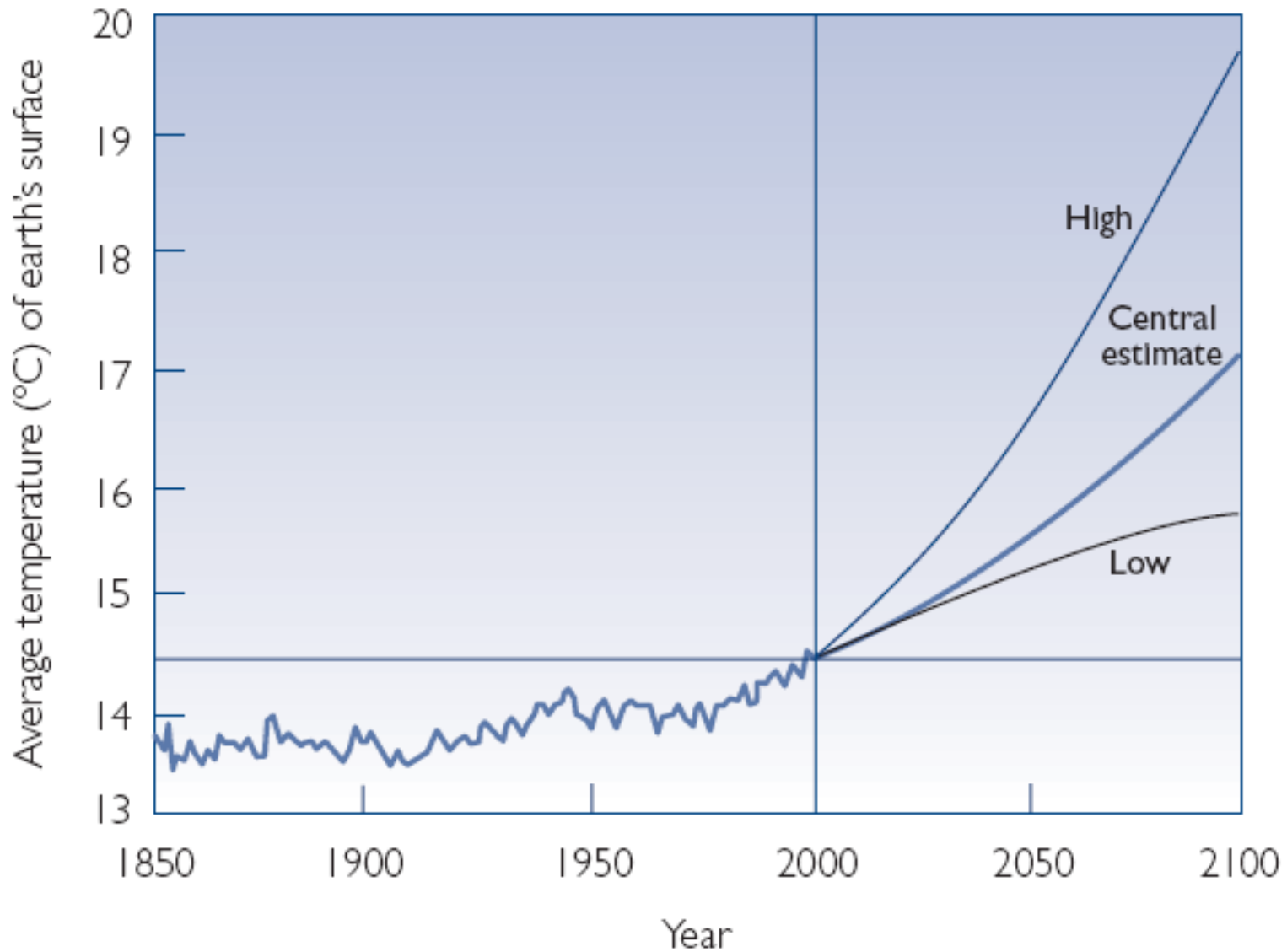
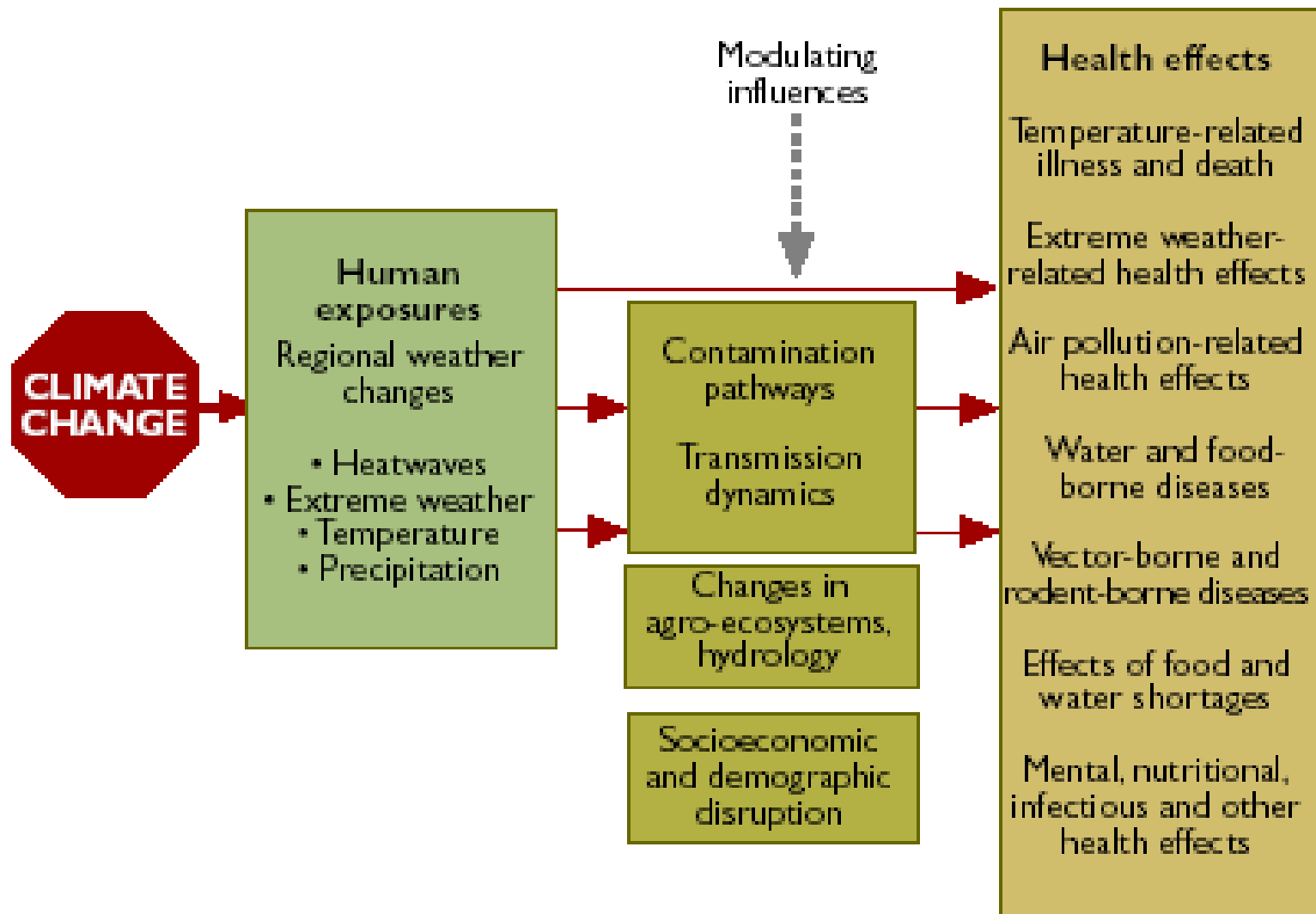












# Historical and projected global temperatures (according to IPCC)



# Pathways by which climate change affects human health



# Climate change and vector-borne diseases

Disease	Vector	Population at risk (million) <sup>1</sup>	Number of people currently infected or new cases per year	Present distribution	Likelihood of altered distribution
Malaria	Mosquito	2,400 <sup>2</sup>	300-500 million	Tropics and Subtropics	
Schistosomiasis	Water snail	600	200 million	Tropics and Subtropics	
Lymphatic Filariasis	Mosquito	1 094 <sup>3</sup>	117 million	Tropics and Subtropics	
African Trypanosomiasis (Sleeping sickness)	Tsetse fly	55 <sup>4</sup>	250 000 to 300 000 cases per year	Tropical Africa	
Dracunculiasis (Guinea worm)	Crustacean (Copepod)	100 <sup>5</sup>	100 000 per year	South Asia, Arabian Peninsula, Central-West Africa	
Leishmaniasis	Phlebotomine sand fly	350	12 million infected, 500 000 new cases per year <sup>6</sup>	Asia, Southern Europe, Africa, Americas	
Onchocerciasis (River blindness)	Black fly	123	17.5 million	Africa, Latin America	
American Trypanosomiasis (Chagas disease)	Triatomine bug	100 <sup>7</sup>	18 million	Central and South America	
Dengue	Mosquito	1,800	10-30 million per year	All Tropical countries	
Yellow Fever	Mosquito	450	more than 5 000 cases per year	Tropical South America, Africa	

1. Top three entries are population-prorated projections, based on 1989 estimates.

2. WHO, 1994.





3. Michael and Bundy, 1995.

4. WHO, 1994.

5. Ranque, personal communication.

6. Annual incidence of visceral leishmaniasis; annual incidence of cutaneous leishmaniasis is 1-1.5 million cases/yr (PAHO, 1994).

7. WHO, 1995.

 Highly likely  Very likely  Likely  Unknown

   
GRAPHIC DESIGN: PHILIPPE REKACEWICZ

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.

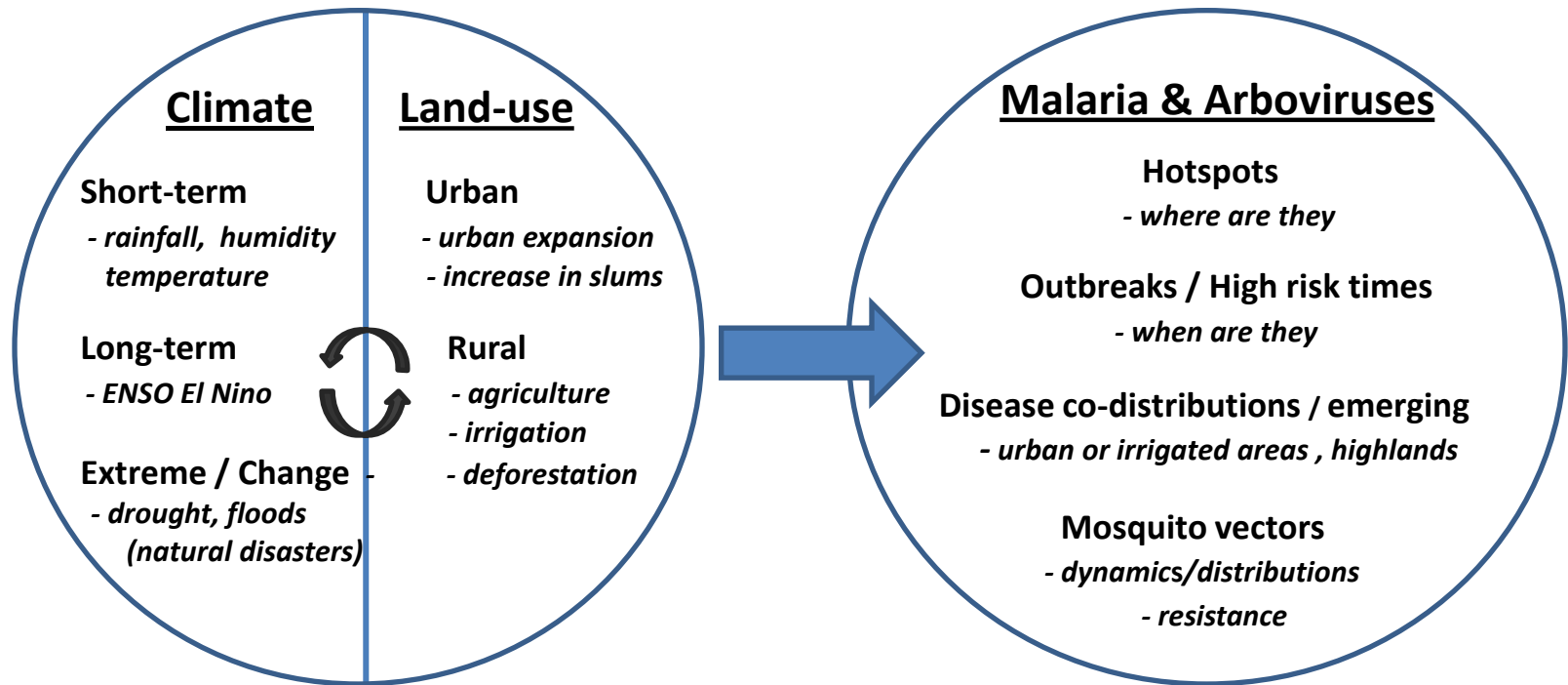
# Mechanisms by which above-average rainfall can affect health

Event	Type	Description	Potential health impact
Heavy precipitation event	meteorological	“extreme event”	increased mosquito abundance or decreased (if breeding sites are washed away)
Flood	hydrological	river/stream over tops its banks	changes in mosquito abundance contamination of surface water
Flood	social	property or crops damaged	changes in mosquito abundance contamination of water with faecal matter and rat urine (leptospirosis).
Flood	catastrophic flood /“disaster”	Flood leading to >10 killed, and/or 200 affected, and/or government call for external assistance.	changes in mosquito abundance contamination of water with faecal matter and rat urine and increased risk of respiratory and diarrhoeal disease deaths (drowning) injuries health effects associated with population displacement loss of food supply psychosocial impacts

# Mechanisms by which below-average rainfall can affect health

Event	Type	Description	Potential health impact
Drought	meteorological	evaporation exceeds water absorption, soil moisture decreases.	changes in vector abundance if vector breeds in dried up river beds, for example.
		Several indices have been developed based on meteorological variables, e.g. Palmer Drought Severity Index.	
Drought	agricultural	drier than normal conditions leading to decreased crop production	depends on socioeconomic factors, i.e. other sources of food available and the means to acquire them.
Drought	social	reduction in food supply or income, reduction in water supply and quality	food shortage, illness, malnutrition (increases risk of infection) increased risk of disease associated with lack of water for hygiene.
Drought	food shortage/ famine/drought disaster	food shortage leading to deaths  >10 killed, and/or 200 affected, or government call for external assistance.	deaths (starvation) malnutrition (increases risk of infection) health impacts associated with population displacement

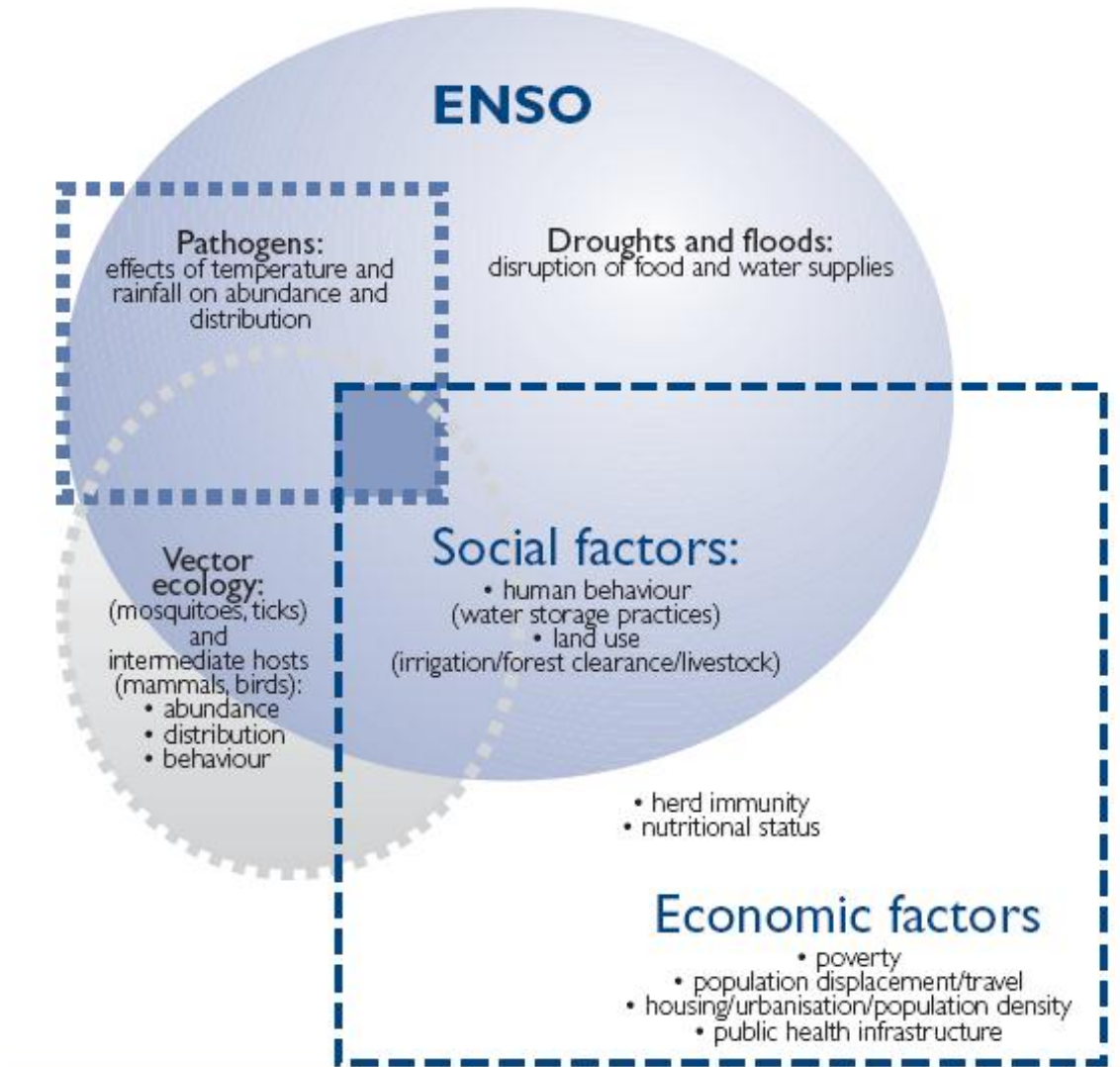
# Environmental impact on vector-borne diseases such as malaria and dengue



Changes in climate change & land use patterns/development are interlinked.  
The potential impact on vector-borne diseases needs to be better understood

# El Niño Southern Oscillation Index (ENSO) and disease

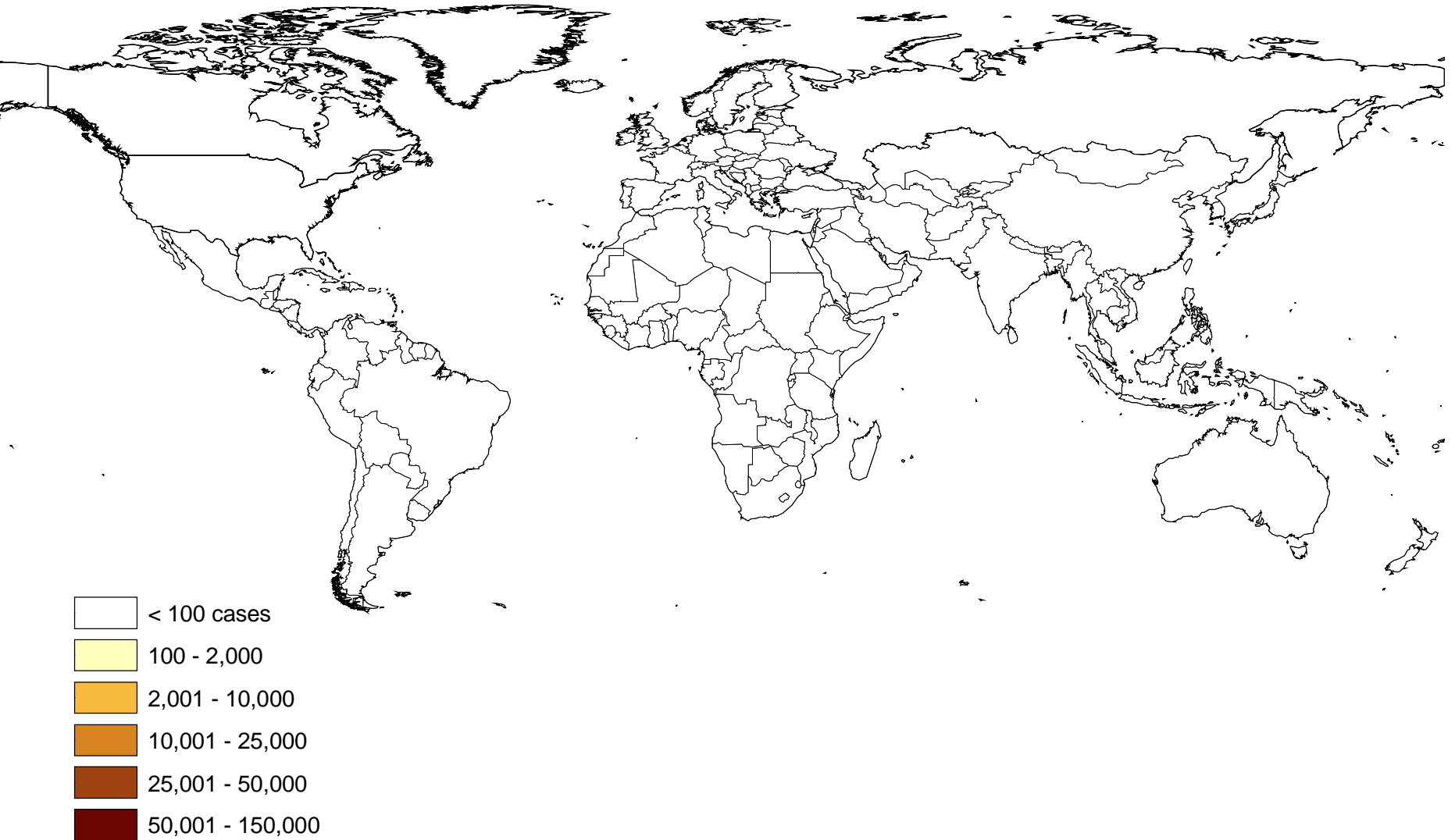
ENSO events can cause drought and floods leading to interactions with different combinations of social & economic factors, which may result in outbreaks of disease.





# Cholera Cases Reported to WHO

2000 - 2006





# Risk Factor of cholera outbreaks reported to Promed.

<b>Risk Factor</b>	<b>Cause</b>
Rainfall/flooding	Heavy rains and floods disrupt water systems and spread cholera
Water Source Contamination	A specific water source, such as lakes, rivers, or domestic water pipes, is contaminated with cholera
Poor Sanitation	general term used in many reports to refer to a lack of adequate latrines
Lack of potable water	Limited water availability forces people to use contaminated water for domestic purposes
Refugee Camp	Camps for refugees or internally displaced peoples are over-crowded with limited resources, such as water and latrines
Food	Contaminated shellfish or unwashed raw vegetables
Imported/Travelers	Travelers with cholera carry the disease to a new area
Conflict Zone	War zones can increase the risk of outbreaks because infrastructure is damaged and people do not have access to proper sanitation or medical care
Urban/dense populations	In cities and slums, people living in extremely close proximity increases the burden on sanitation and facilitates transmission
Seasonal	In some endemic areas, cholera reoccurs during certain seasons
Funeral/Feast	Some traditional funeral rites include the washing of the deceased and preparation of a large meal. This situation, combined with the fact that mourners often travel, allows for the spread of the disease
Prison	Prisoners do not always have control of their sanitation needs and live in close proximity to one another

# Food system activities and food security outcomes

## Food system ACTIVITIES

Producing food: natural resources, inputs, technology...  
Processing and packaging food: raw materials, standards, storage life...  
Distributing and retailing food: transport, marketing, advertising...  
Consuming food: acquisition, preparation, socializing...

## Food system OUTCOMES contributing to:

### Social welfare

- Income
- Employment
- Wealth
- Social and political capital
- Human capital



### Food security

#### FOOD UTILIZATION

- Nutritional value
- Social value
- Food safety

#### FOOD ACCESS

- Affordability
- Allocation
- Preference

#### FOOD AVAILABILITY

- Production
- Distribution
- Exchange



### Environmental security/ natural capital

- Ecosystems stocks, flows
- Ecosystem services
- Access to natural capital

Source: GECAFS Online.

# Climate change affects all four dimensions of food security

**Food production and availability:** Climate affects food production directly through changes in agro-ecological conditions and indirectly by affecting growth and distribution of incomes, and thus demand for agricultural produce. Changes in land suitability, potential yields (e.g. CO<sub>2</sub> fertilisation) and production of current cultivars are likely. Shifts in land suitability are likely to lead to increases in suitable cropland in higher latitudes and declines of potential cropland in lower latitudes.

**Stability of food supplies:** Weather conditions are expected to become more variable than at present, with increasing frequency and severity of extreme events. Greater fluctuation in crop yields and local food supplies can adversely affect the stability of food supplies and food security. Climatic fluctuations will be most pronounced in semi-arid and sub-humid regions and are likely to reduce crop yields and livestock numbers and productivity. As these areas are mostly in sub-Saharan Africa and South Asia, the poorest regions with the highest levels of chronic undernourishment will be exposed to the highest degree of instability.

**Access to food:** Access to food refers to the ability of individuals, communities and countries to purchase food in sufficient quantities and quality. Falling real prices for food and rising real incomes over the last 30 years have led to substantial improvements in access to food in many developing countries. Possible food price increases and declining rates of income growth resulting from climate change may reverse this trend.

**Food utilisation:** Climate change may initiate a vicious circle where infectious diseases, including water-borne diseases, cause or compound hunger, which, in turn, makes the affected population more susceptible to those diseases. Results may include declines in labour productivity and an increase in poverty, morbidity and mortality.

Source: Schmidhuber and Tubiello (2007).

## Increase in global mean temperature



### Impact on food security outcomes

#### *Food availability (production, distribution, exchange):*

- Reduced production of food crops and livestock products in affected areas
- Local losses could have temporary effect on local markets,
- Reduction in global supplies likely to cause market prices to rise

#### *Food accessibility (allocation, affordability, preference):*

- Impacts on incomes, prices and affordability uncertain
- Changes in preference uncertain

#### *Food utilization (nutritional value, social value, food safety):*

- Risk of dehydration
- Risk of ill health from eating food that is spoiled
- Ability of body to process food reduced due to heat stress or diseases

#### *Food system stability:*

- Higher cost for storing grain and perishable products

## Increase in frequency/intensity of extreme events



### Impact on food security outcomes

#### *Food availability (production, distribution, exchange):*

- Possible decrease in surplus production in flooded agricultural areas
- Increased need for emergency distribution of food rations

#### *Food accessibility (allocation, affordability, preference):*

- Possible increase in food prices
- Possible loss of farm income and non-farm employment, depending on extent of asset loss

#### *Food utilization (nutritional value, social value, food safety):*

- Food safety is compromised by water pollution and damage to stored food
- Ability of body to process food reduced due to diseases

# Impact of climate on food security

Impacts of droughts on livestock numbers in selected African countries, 1981 to 1999

Date	Location	Livestock losses	Source
1981–1984	Botswana	20 percent of national herd	FAO, 1984 cited in Toulmin, 1986
1982–1984	Niger	62 percent of national cattle herd	Toulmin, 1986
1983–1984	Ethiopia (Borana Plateau)	45–90 percent of calves, 45 percent of cows, 22 percent of mature males	Coppock, 1994
1991	Northern Kenya	28 percent of cattle; 18 percent of sheep and goats	Surtech, 1993 cited in Barton and Morton, 2001
1991–1993	Ethiopia (Borana)	42 percent of cattle	Desta and Coppock, 2002
1993	Namibia	22 percent of cattle; 41 percent of goats and sheep	Devereux and Tapscott, 1995
1995–1997	Greater Horn of Africa (average of 9 pastoral areas)	20 percent of cattle; 20 percent of sheep and goats	Ndikumana et al., 2000
1995–1997	Southern Ethiopia	46 percent of cattle; 41 percent of sheep and goats	Ndikumana et al., 2000
1998–1999	Ethiopia (Borana)	62 percent of cattle	Shibru, 2001 cited in Desta and Coppock, 2002

Source: IPCC, 2007a.