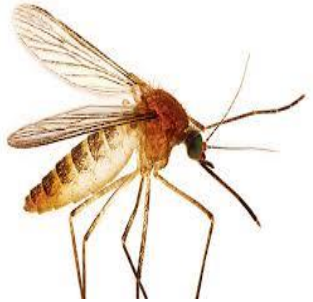
CLIMATE CHANGE AND VECTOR BORNE DISEASES



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What is Climate Change?

Climate change refers to any change in *climate over time, whether due to* natural variability or as a result of human activity (IPCC,2007).

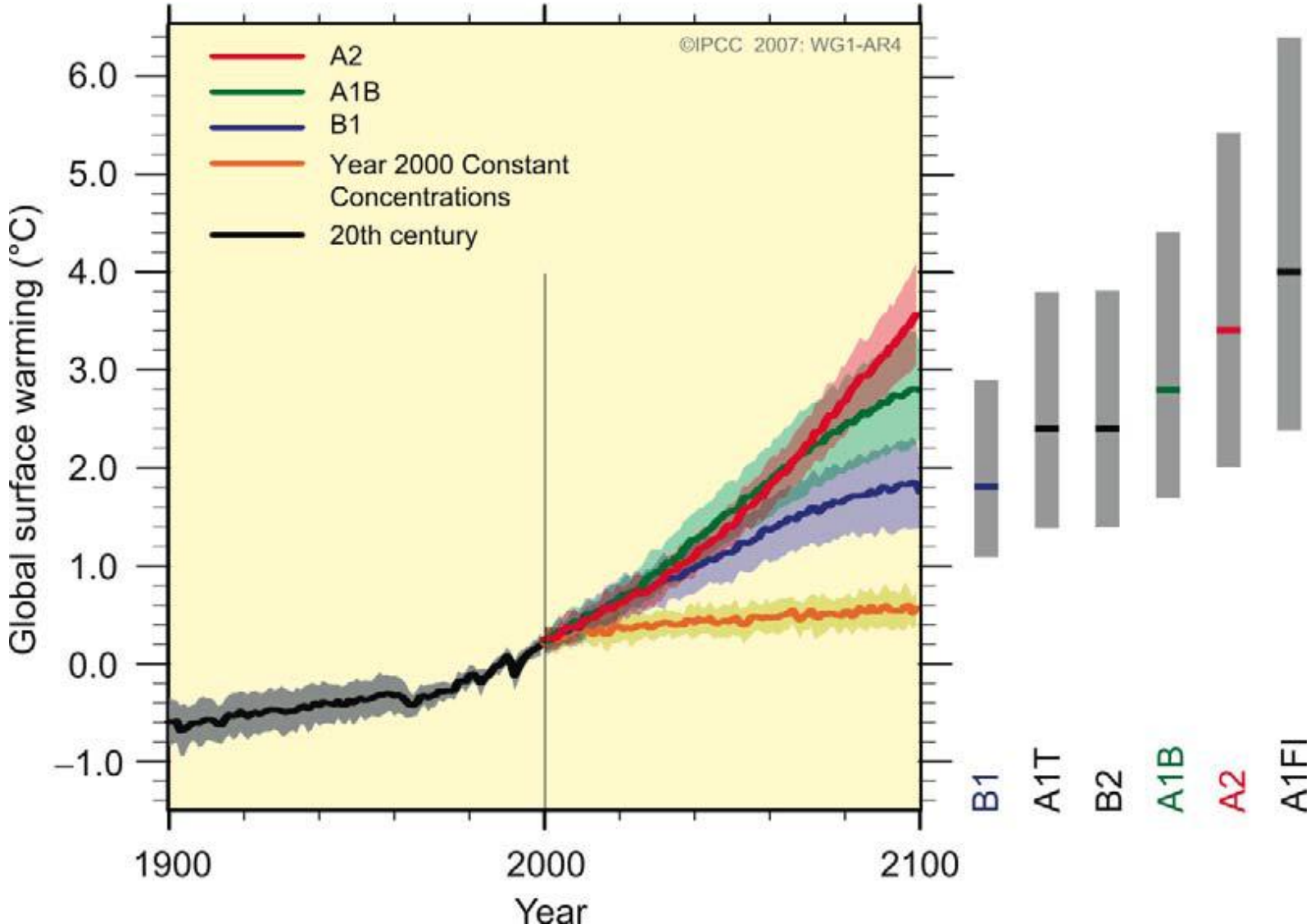
Challenge of Climate change

Climate change is the most serious challenge facing human and animal populations, as it affects population dynamics of wild animals, reproductive success and population densities of some species.

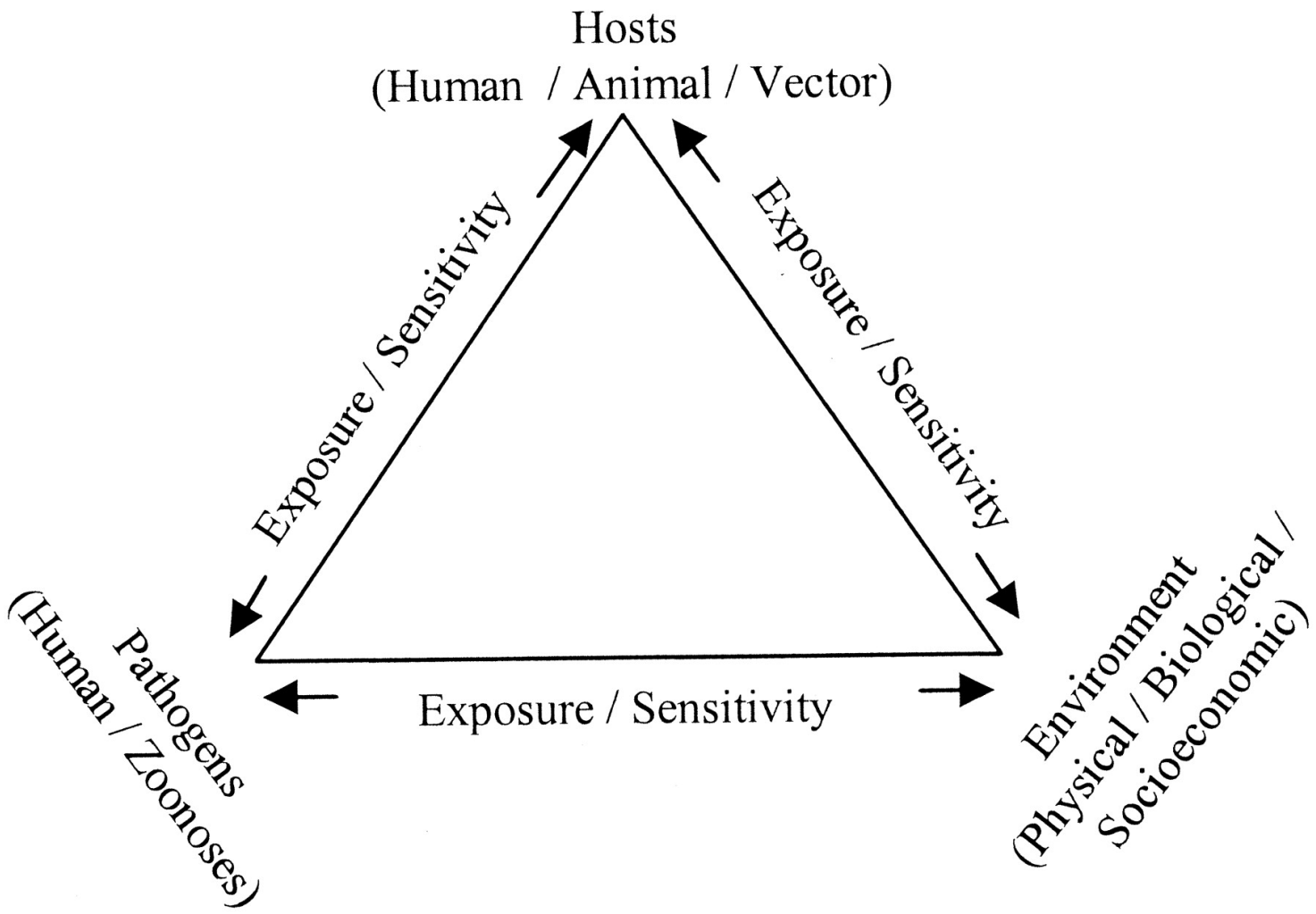
Livestock excrete many micro-organisms which have zoonotic potential. These pathogens can be transmitted by water and food and the risk of transmission to humans is increased if food crops are watered with contaminated water.

Densely crowded urban environments, especially those without adequate sanitation, are of great public health concern because they are sources of disease epidemics.

Projected Global Climate Change (IPCC, 2007)

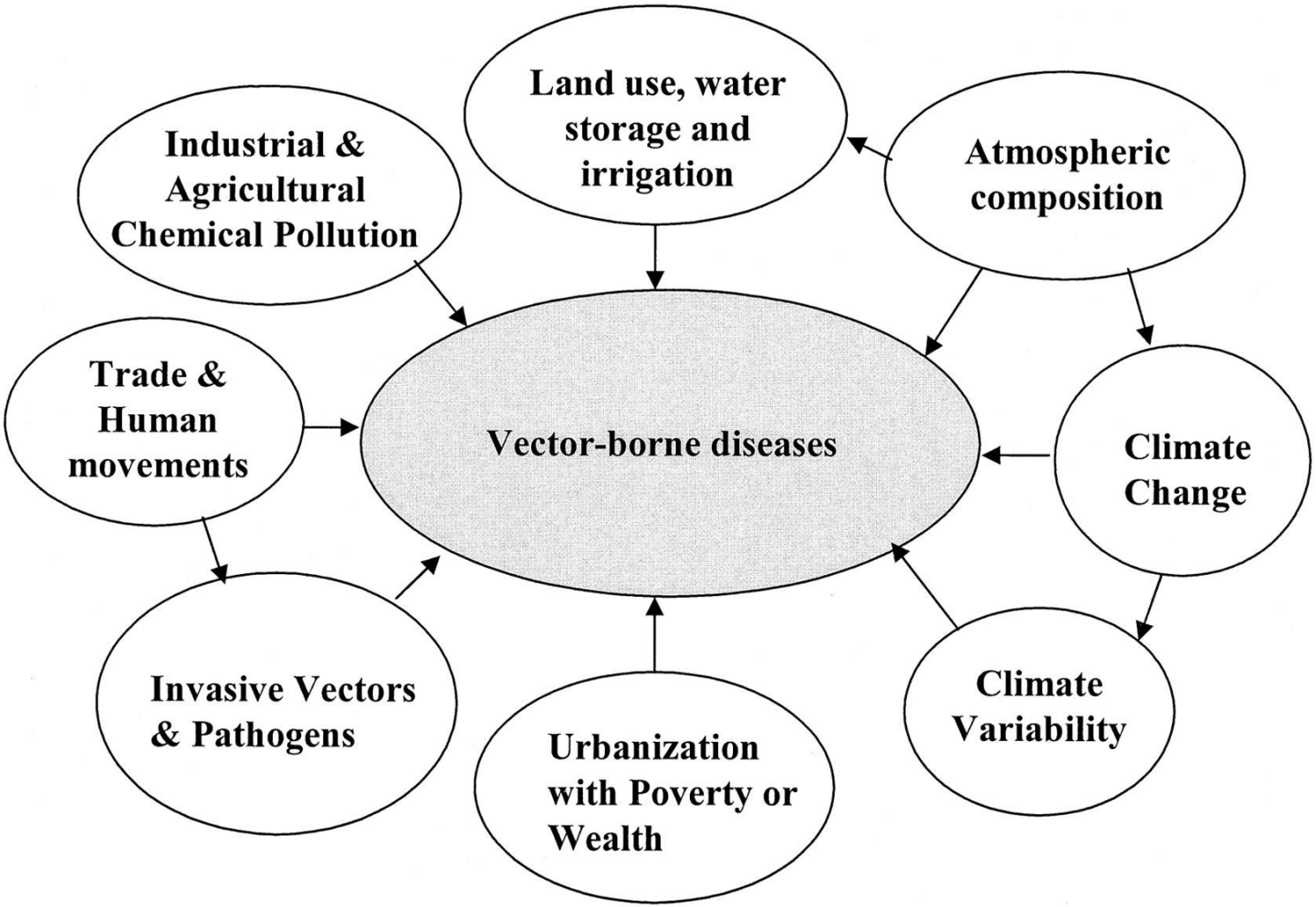


A host-pathogen-vector-environment framework for the assessment of risks to humans from vector-borne diseases under global change.



Robert W. Sutherst Clin. Microbiol. Rev. 2004;17:136-173

Drivers of global change considered in relation to potential changes in the status of vector-borne diseases.



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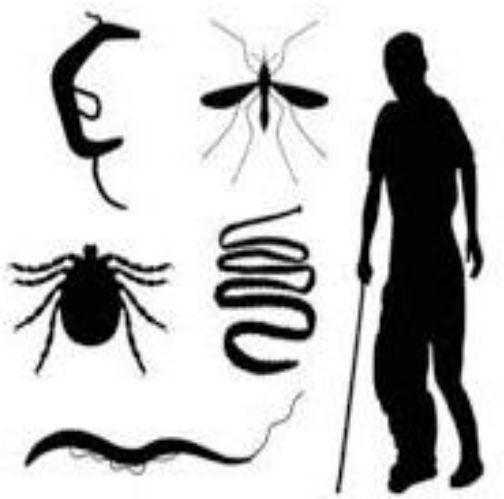
Vector-borne diseases

Vectors carry and transmit disease

• Vectors are insects (mosquitoes, ticks, fleas, black flies and sandflies) that carry infectious agents such as protozoa, bacteria and viruses.

• They carry and transmit numerous diseases to humans: parasitic vector-borne diseases such as malaria, Leishmaniasis, and Chagas disease; Arboviral diseases such as dengue fever, yellow fever, West Nile Virus, Rift Valley fever, and tickborne encephalitis; and bacterial and rickettsial diseases such as Lyme borreliosis, tularemia and plague.



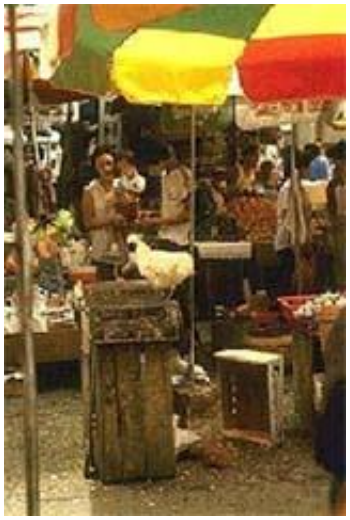
Global warming impacts on vector-borne diseases

- Vector organisms and the infectious agents they carry are cold-blooded, so changes in temperature will affect their development, reproduction, behavior and survival rates.

- Changing temperature and precipitation may shift the geographic range in which they can live and the seasonal period of disease risk.

- Temperature also can affect pathogen development within vectors, precipitation can influence the availability of breeding sites, and climatic variables can affect the distribution and abundance of their vertebrate host species

World Population
6,056,528,577



Health is a big challenge.

Vector-borne diseases are the biggest risk to health.

Developing countries are the most vulnerable to climate change

- **Impacts are worse** - already more flood and drought prone and a large share of the economy is in climate sensitive sectors
- **Lower capacity to adapt** because of a lack of financial, institutional and technological capacity and access to knowledge
- **Climate change is likely to impact disproportionately upon the poorest countries and the poorest persons within countries,** exacerbating inequities in health status and access to adequate food, clean water and other resources.
- **Vector-borne diseases will spread, emerge and/or re-emerge with greater intensity.**

Drivers of Health Issues

- Population density
- Urbanization
- Public health infrastructure
- Economic and technologic development
- Environmental conditions
- Populations at risk
  - Poor
  - Children
  - Increasing population of elderly residents
  - Immunocompromised

The risk factors that play a key role in the spread and transmission of dengue and other vector-borne diseases in India and across its borders include:

- globalisation
- unplanned and uncontrolled urbanisation
- developmental activities
- poor environmental sanitation
- poor household water-storage practices
- improper drainage of water
- widespread travelling
- human migration

Global warming and mosquitoes:

Mosquitoes are highly sensitive to temperature. Higher temperatures:

• boost their reproductive rate, lengthen their breeding season, and make them bite more frequently;

• shorten the time it takes for the pathogens they carry to mature to an infectious state;

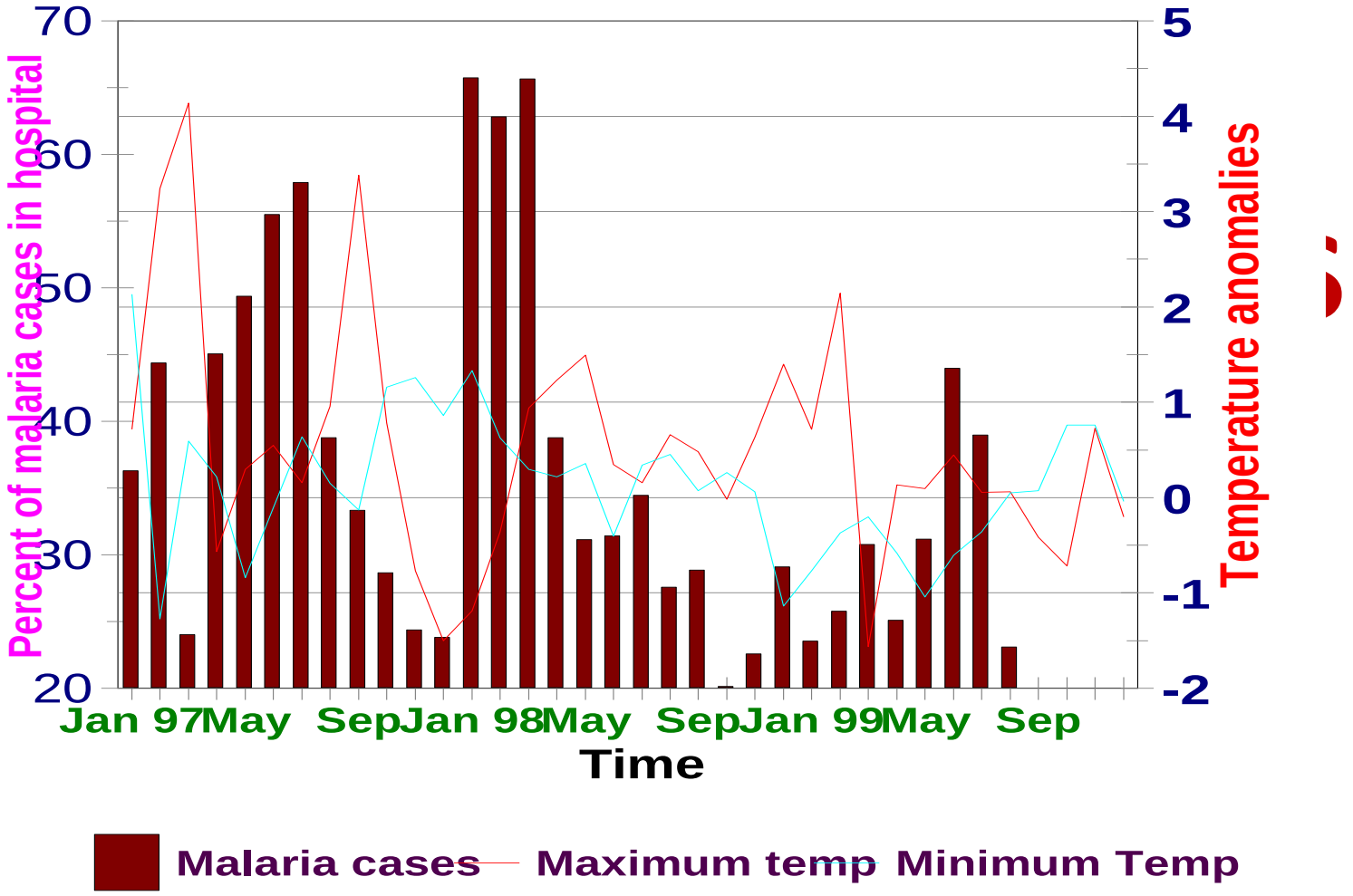
• can expand the mosquitoes' range to higher elevations and more northern latitudes, potentially putting previously unexposed populations at risk.

Storms, hurricanes and floods can contribute to the spread of malaria, as they leave behind vector breeding sites.

Temperature thresholds (0C) for pathogens and vectors of major vector borne diseases (**IPCC,2001**)

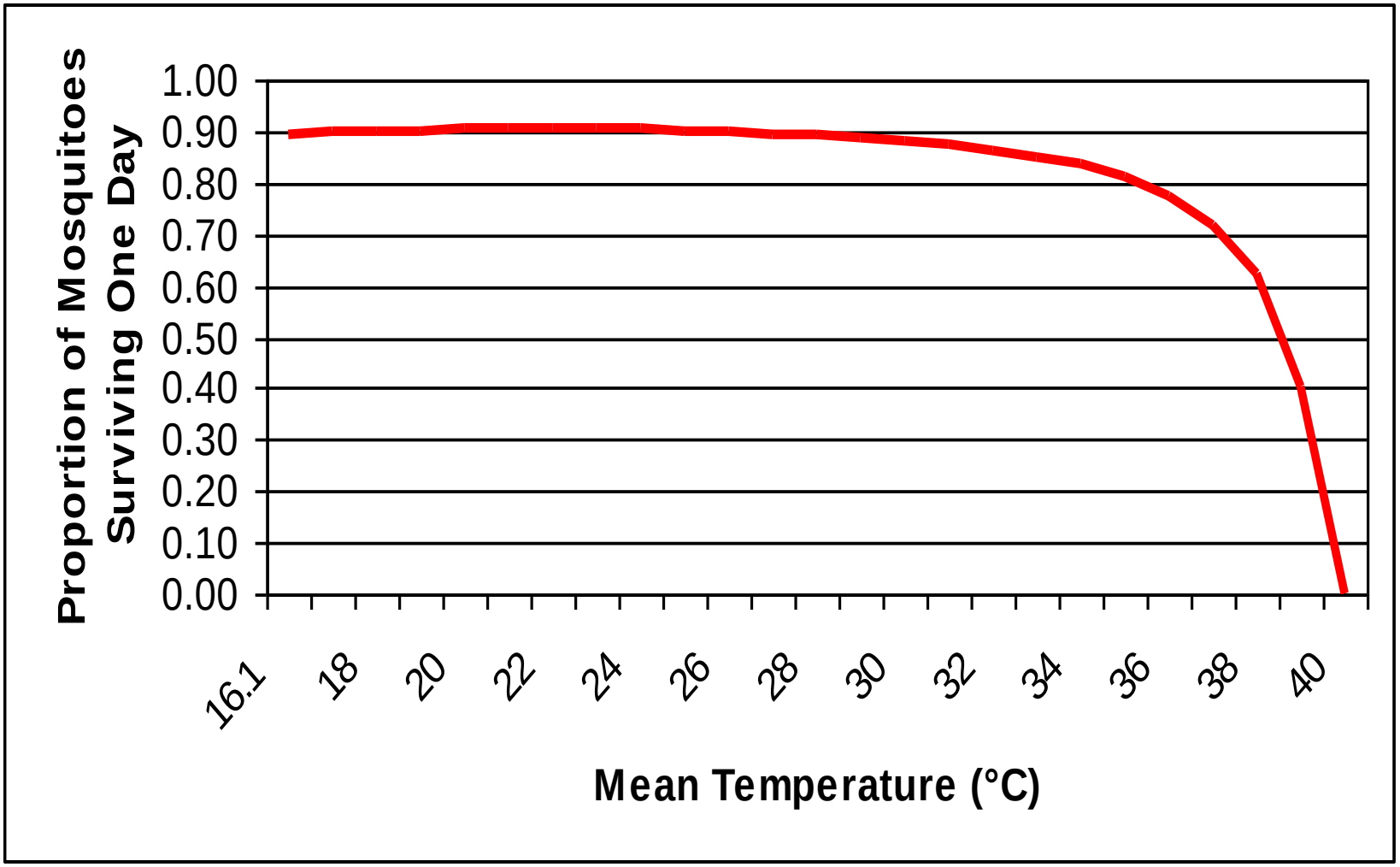
Disease	**Pathogen**	**Minimum Temp**	**Maximum temp**	**Vector**	**Minimum temp for vector**
Malaria	*Plasmodium falciparum*	16–19 C	33–39	*Anopheles*	8–10 (biological activity)
	Plasmodium vivax	14.5–15 C	33–39	*Anopheles*	8–10 (biological activity)
Dengue	Dengue virus	11.9 C	not known	Aedes	6–10
Chagas disease	*Trypanosoma cruzi*	18 C	38	Triatomine bugs	2–6 (survival) 20 (biological activity)
Schistosomiasis	Cercaria	14-2	>37	Snails (*Bulinus and* others)	5(biological activity) 25±2(optimum range)
Lyme disease	*Borrelia burdorferi*	Not yet determined	Not yet determined	Ixodes ticks	5–8

Proportion of malaria cases and anomalies in maximum temperture: Kenya

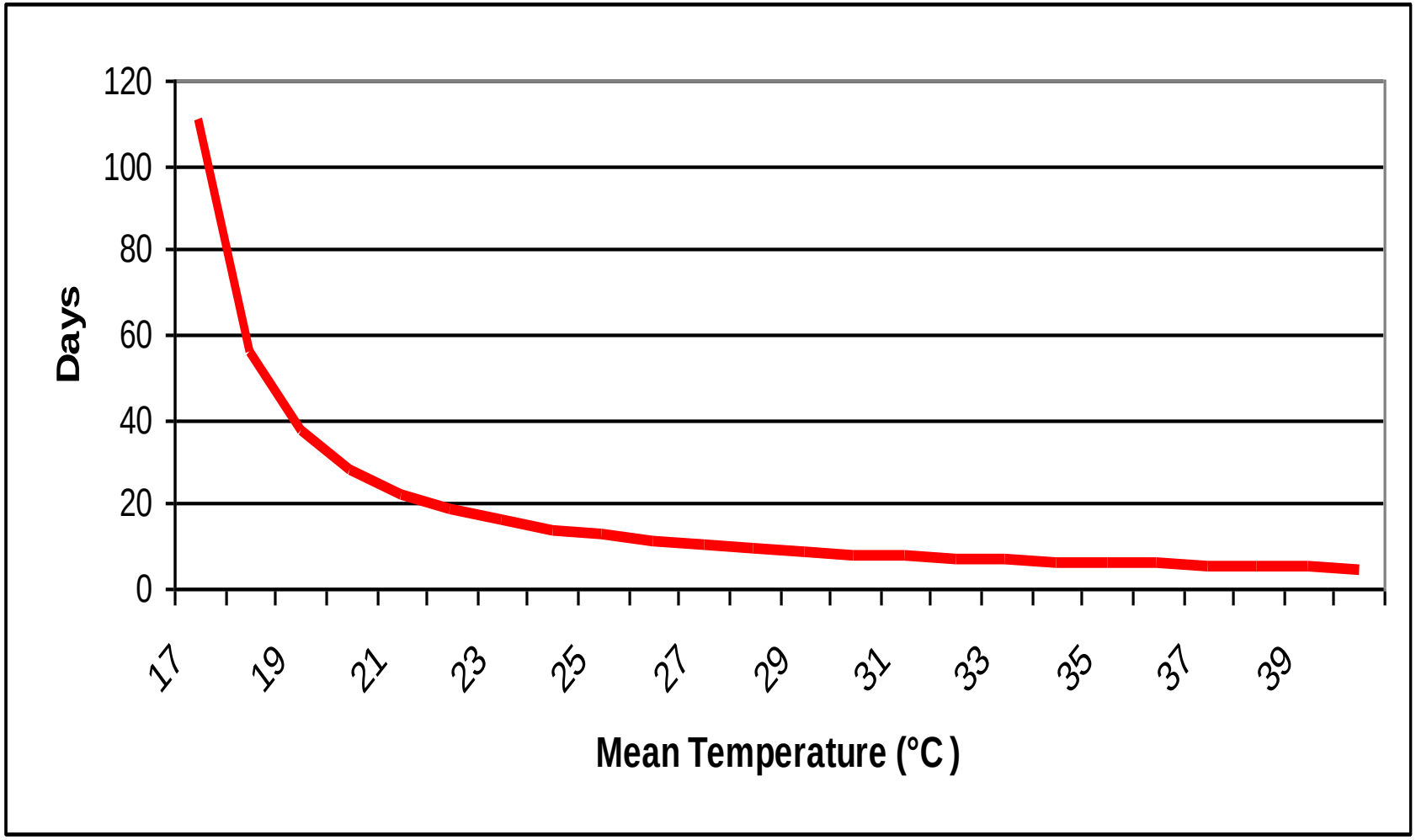


Source is Dr. Andrew Githeko, Kenya Medical Research Institute.

Relationship between Temperature and Daily Survivorship of Anopheles

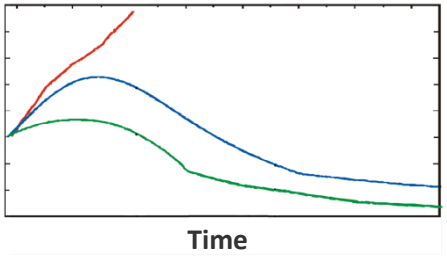


Relationship between Temperature and Time Required for Parasite Development



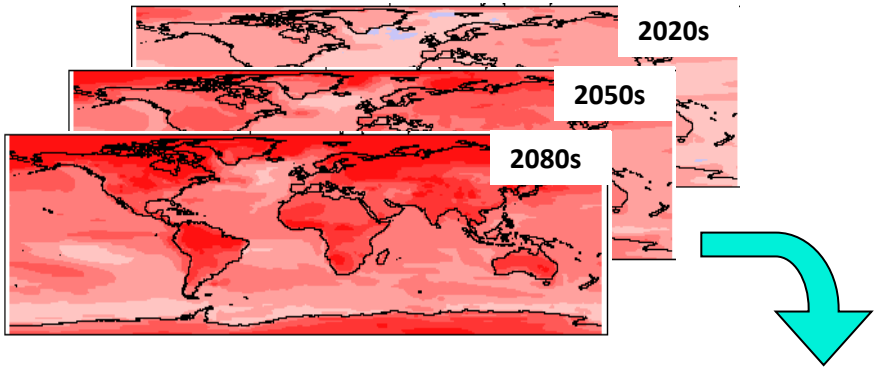
Comparative Risk Assessment

Greenhouse gas emission scenarios



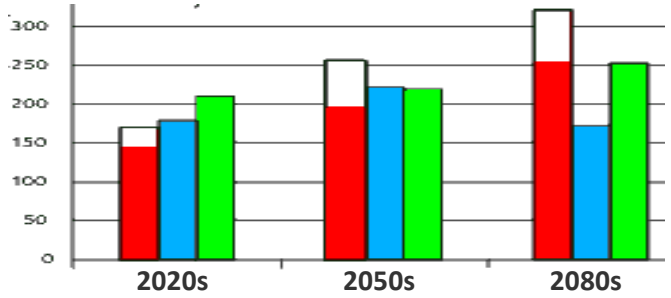
Global climate modelling:

Generates series of maps of predicted future climate



Health impact model:

Estimates the change in relative risk of specific diseases



Campbell-Lendrum et al., 2003

Health Impacts of Floods

- **Immediate deaths and injuries**
- **Nonspecific increases in mortality**
- **Infectious diseases – leptospirosis, hepatitis, diarrheal, respiratory, and vector-borne diseases**
- **Exposure to toxic substances**
- **Mental health effects**
- **Increased demands on health systems**

Philip Wijmans, LWF/ACT Mozambique, March 2000

Estimating the Global Health Impacts of Climate Change

- What will be the *total* potential health impact caused by climate change (2000 to 2030)?

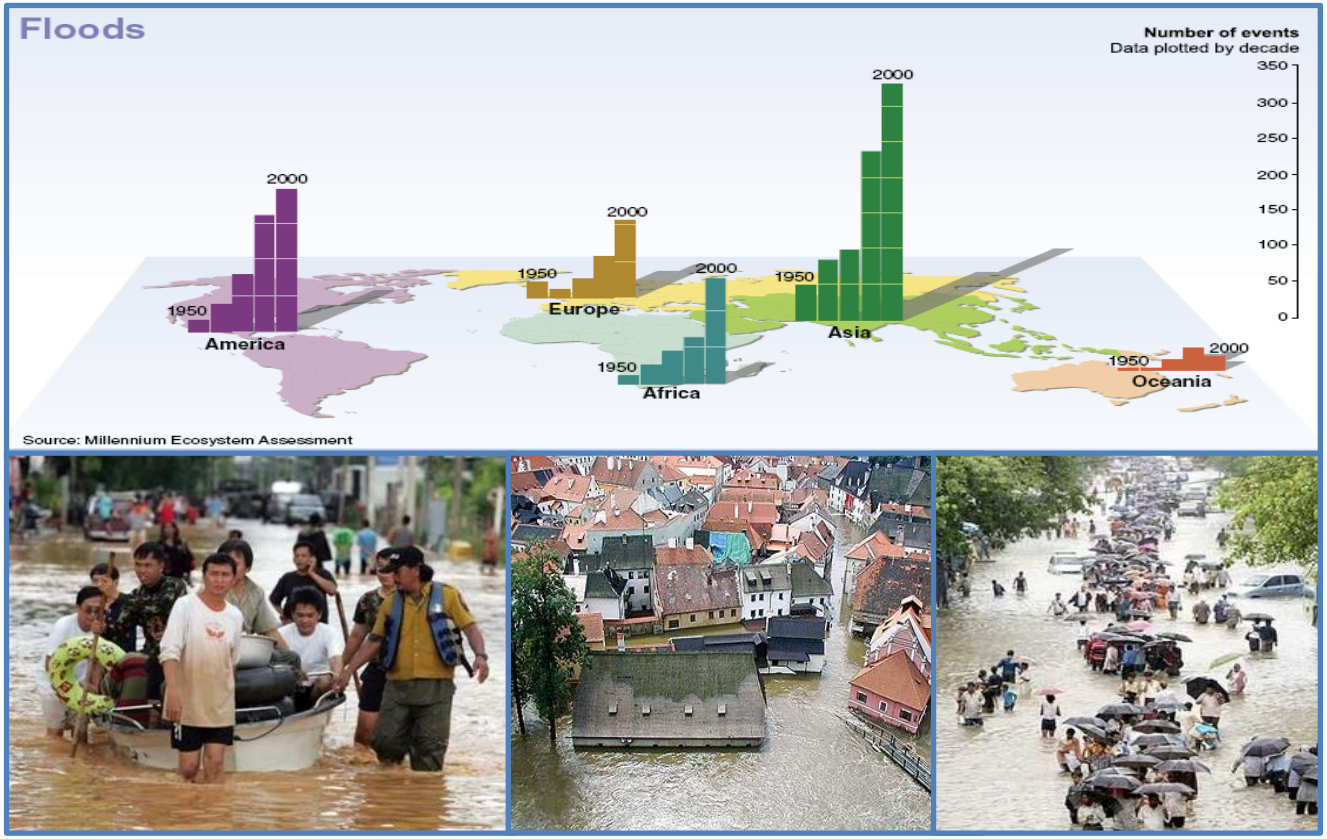
- How much of this could be avoided by reducing the risk factor (i.e. stabilizing greenhouse gas (GHG) emissions)?

Campbell-Lendrum et al., 2003 (pdf available)

Conclusions

- Climate change may already be causing a significant burden in developing countries
- Unmitigated climate change is likely to cause significant public health impacts out to 2030
  - Largest impacts from diarrhea, malnutrition, and vector-borne diseases
- Uncertainties include:
  - Uncertainties in projections
  - Effectiveness of interventions
  - Changes in nonclimatic factors

Campbell-Lendrum et al., 2003

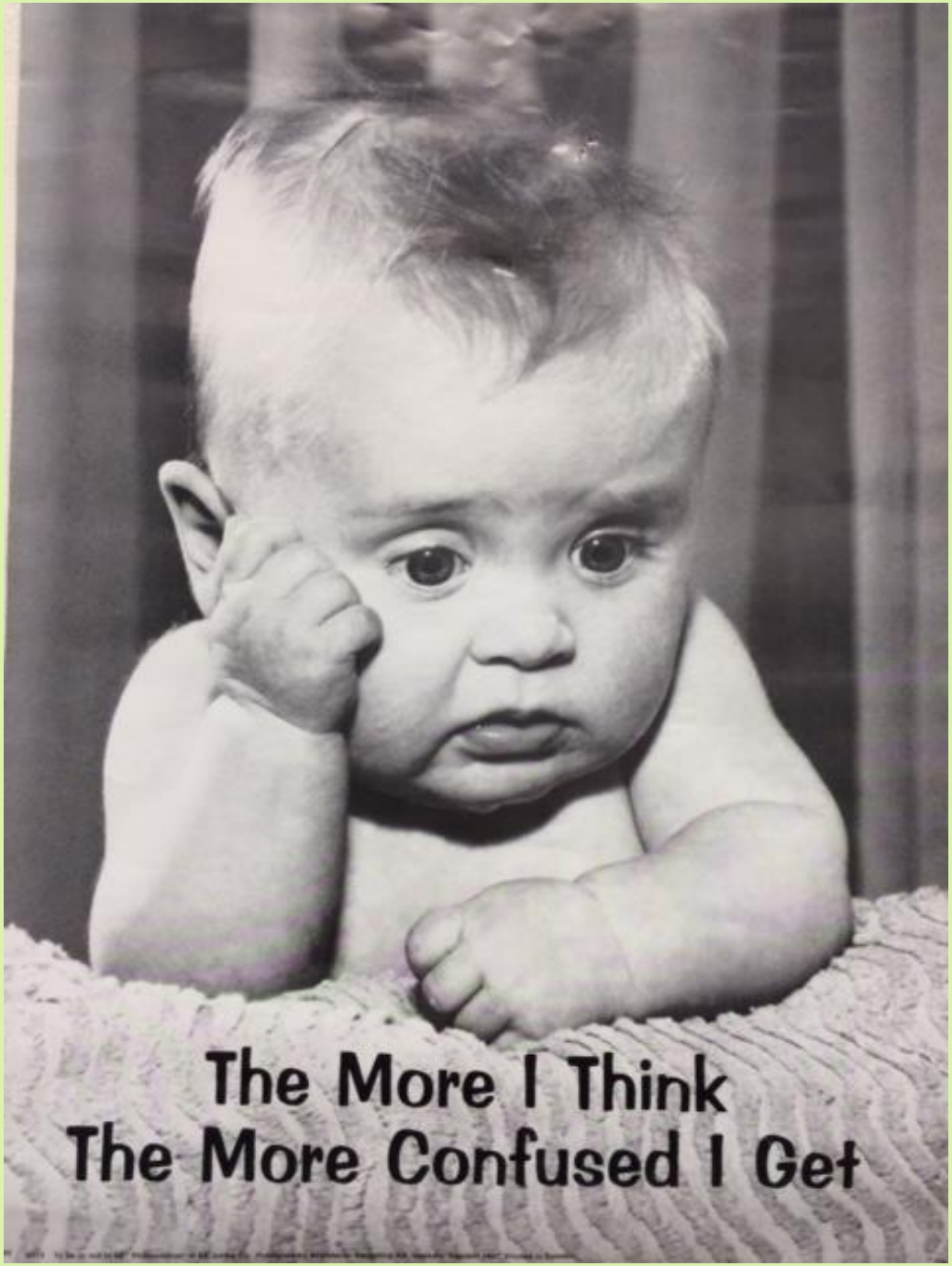


- Globally, over 1 billion people lack access to safe drinking water
- 2.5 billion lack access to adequate sanitation
- Estimated that 5 million people globally, primarily kids, die from water-related diseases annually

Projected impacts of climate Change (Source:IPCC,2007)

Disease-Region	Results
Malaria-Global	>220-400 m additional pop at risk with A2 scenario by 2020 to 2080;reduced if >3 consecutive months are considered.
Malaria-Africa	16-28% increase in person-months of exposure(including 5-7% increase in altitudinal by 2020-2080. Limited latitudinal expansion.
Malaria-Zimbabwe	Highlands become more suitable for transmission with 1.4 to 4.50 C increase.
Malaria- Britain	Increase in risk of local malaria transmission 8-15% with 1-2.5 0C avg T rise by 2050. Indigenous transmission unlikely.
Malaria-Portugal	I n crease in No of days suitable for survival of malaria vector. Risk is very low if no vector

Malaria-Australia	Receptive zone expands southward by 2050. Absolute risk of reintroduction very low
Malaria-India	Projected shift to southwest and northern states. TWs widen in northern and wetsern states; shorten in southern states by 2050.
Dengue-Global	Global at risk 3.5 billion with CC; 5-6 billion with popln. growth & CC(baseline 1.5 billion)
Dengue-N.Z'land	Potential Risk of outbreaks in more regions
Dengue-Australia	Climate suitability increase southwards with 1.8 to 2.8 0Cincrease.
Lyme disease-Canada	Northward expansion; tick abundance increase 30-100% by 2020
Tick borne Encep.	Pushed towards northeast under low to high degree of CC by 2050


The More I Think
The More Confused I Get

Our Way of managing waste and reducing VBD

- Anthropogenic warming has had a discernible influence on many physical and biological systems.
- Impacts of CC will vary regionally, they are likely to impose net annual costs which will increase over time.
- Adaptation will be necessary to address impacts from warming which is unavoidable
- Future vulnerability due to CC depends not only due to CC but also on development pathway.
- Sustainable development can reduce vulnerability;CC can impede sustainable devlopment.

POST GRADUATE DIPLOMA IN PUBLIC HEALTH ENTOMOLOGY PROPOSAL BY

Department of Zoology,
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All India Institute of Medical Sciences
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