Uncovering the Complex Relationship Between Infectious Diseases and Climate Change: Implications for NTDs and VBDs in SEAR and Mitigation Efforts

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NEPAL HEALTH RESEARCH COUNCIL ESTD. 1991

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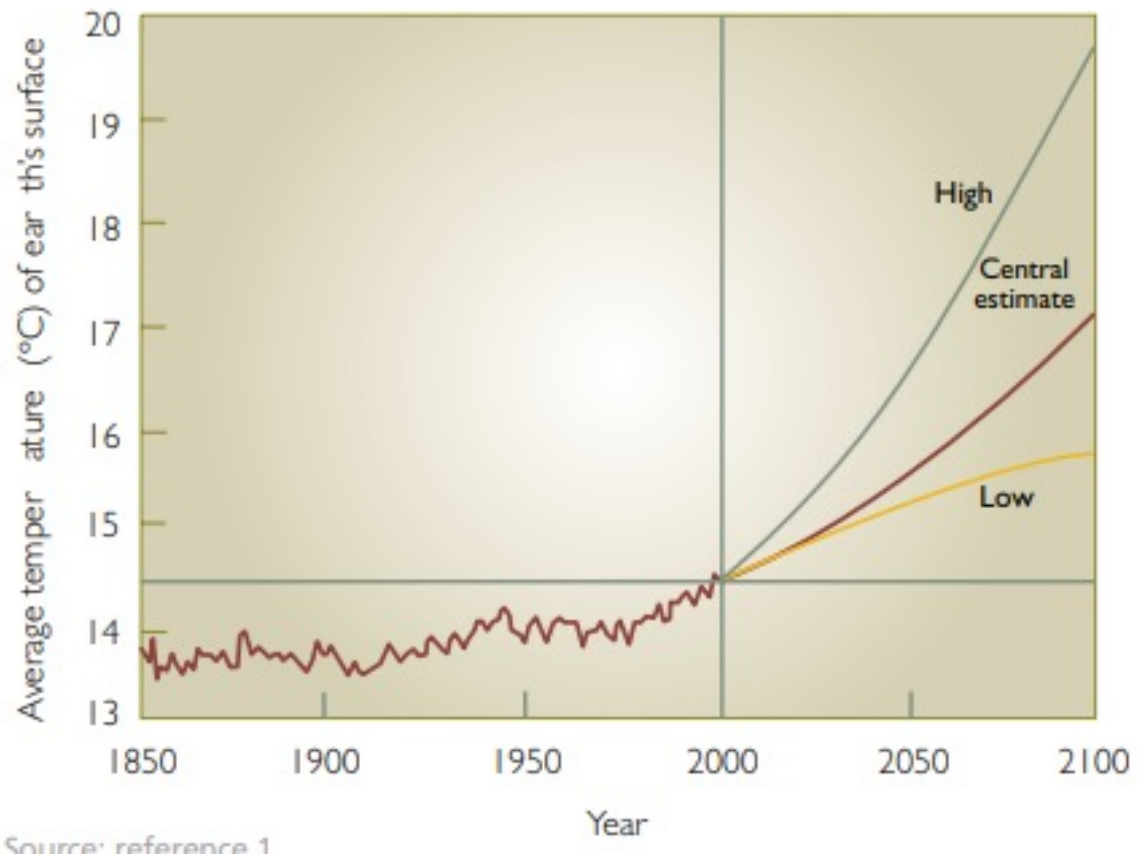
Section 1: Ways Climate Change Impacts Infectious Diseases - The Evidence

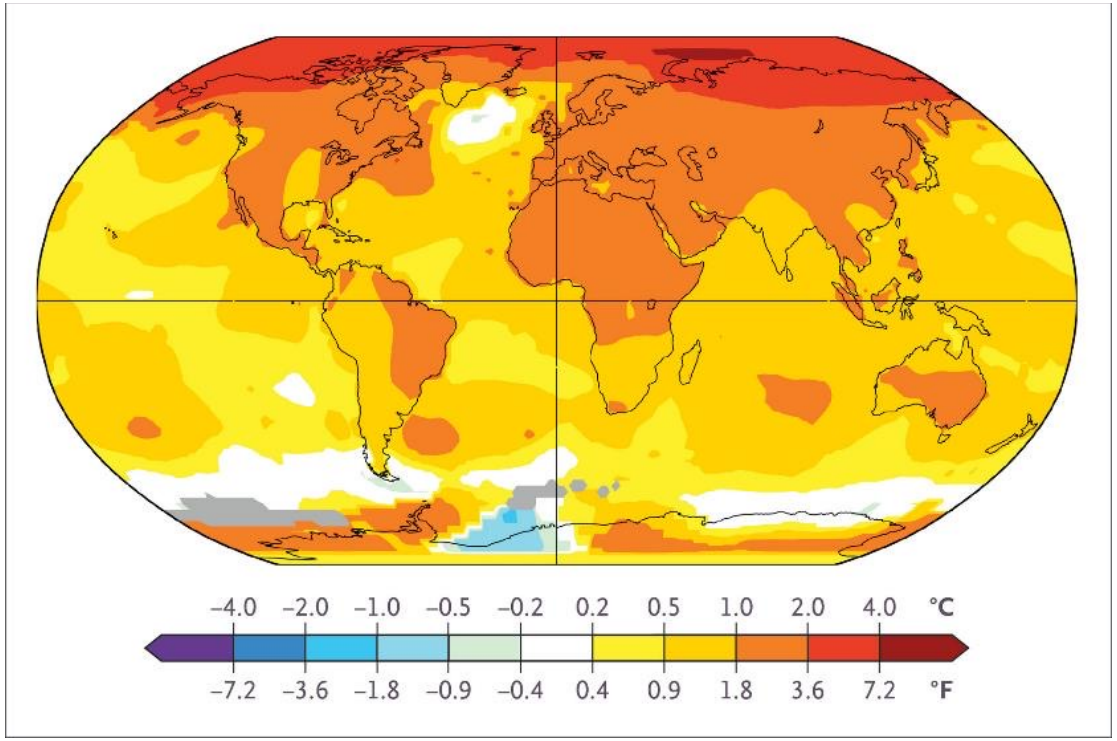
ITM COLLOQUIUM

Global temperature record, since instrumental recording began in 1860, and projection to 2100, according to the IPCC



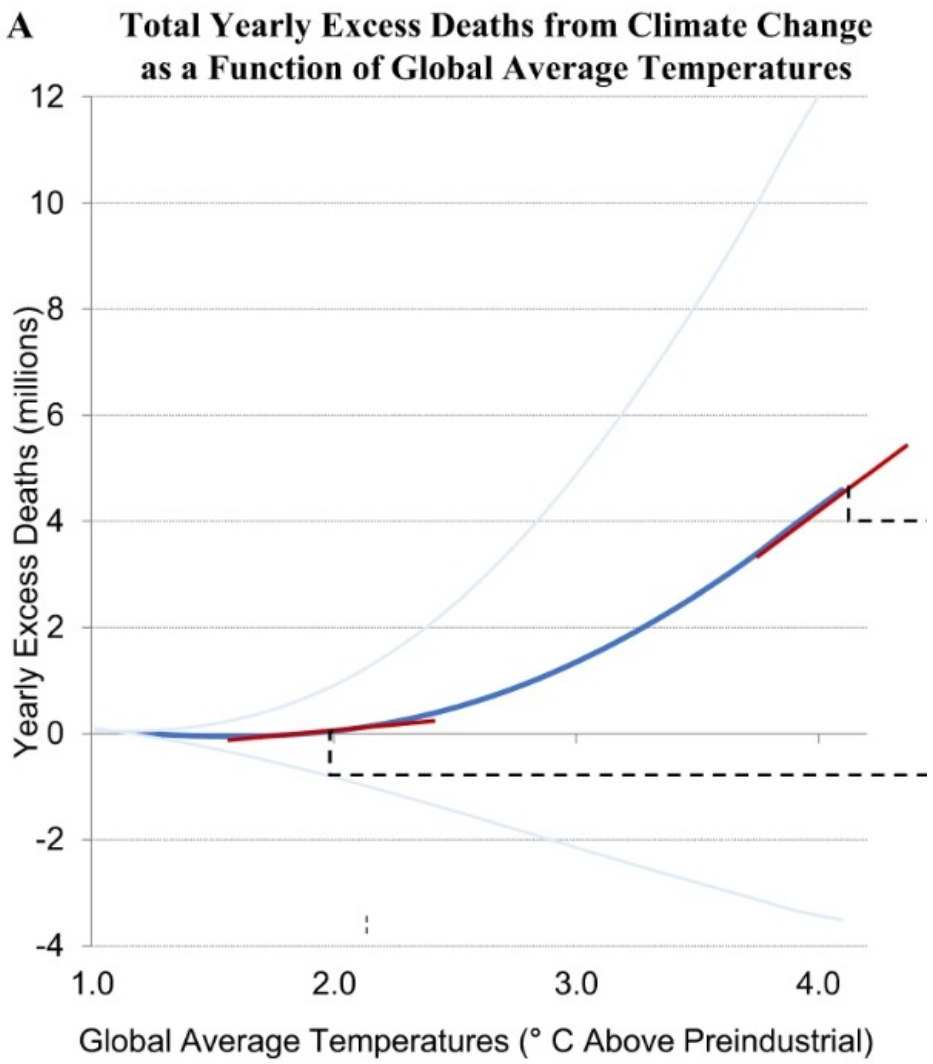
Source: reference 1

Average surface air temperature changes in the last 50 years 2011-2021 as compared with baseline mean temperature from 1956-76



World Health Organization (2003). Climate change and human health : risks and responses : summary. Geneva, World Health Organization..

Excess mortality



Below 2 °C, projected yearly excess deaths from climate change are relatively constant at around 100,000 per year in the central estimate.

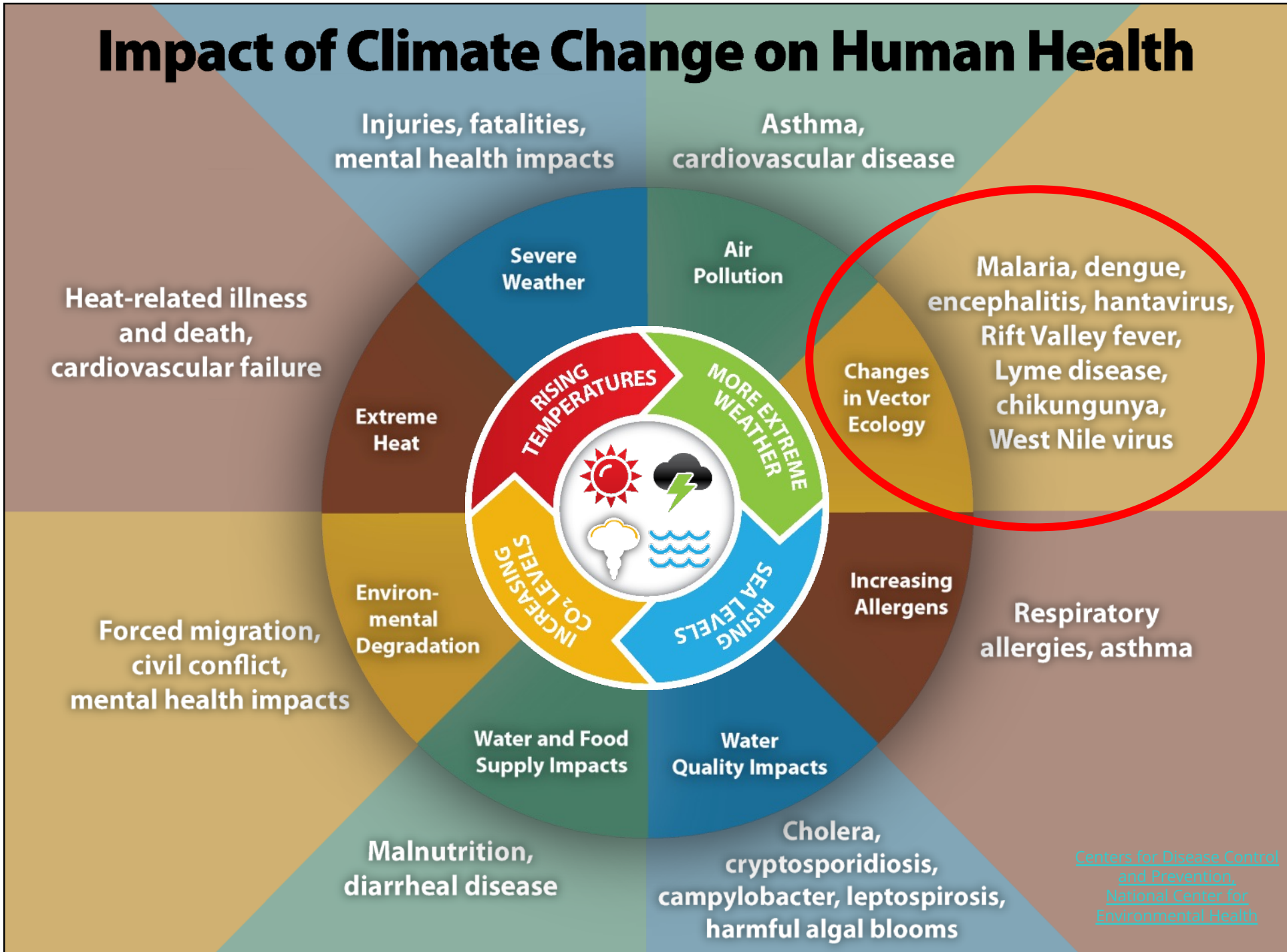
Above 2 °C, projected yearly excess deaths from climate change increase at an increasing rate in global average temperatures, rising to over four million excess deaths at 4 °C.

In total, we find that there are 83 million projected cumulative excess deaths between 2020 and 2100 in the central estimate in the DICE baseline emissions scenario. By the end of the century, the projected 4.6 million excess yearly deaths would put climate change 6th on the 2017 Global Burden of Disease risk factor risk list ahead of outdoor air pollution (3.4 million yearly excess deaths) and just below obesity (4.7 million yearly excess deaths)

Bressler, R. D. (2021). "The mortality cost of carbon." Nature Communications 12(1): 4467.

Between 2030 and 2050, climate change is expected to cause around 250,000 additional deaths per year because of malnutrition, malaria, diarrhoea and heat stress alone.

[Climate change (who.int)]



Climate change and vectorborne diseases

Temperature

- Expanded geographical range to northern-areas or high-altitude areas
- Increase in the duration of disease transmission seasons
- Increased temperatures change the biting behaviour of mosquitoes (e.g. shifting biting from indoors to outdoors), reducing the effectiveness of barriers such as bed nets

Rainfall

- Increased rainfall can increase the amount of standing water, creating more breeding areas for many vectors and affect the survival and transmission of pathogens

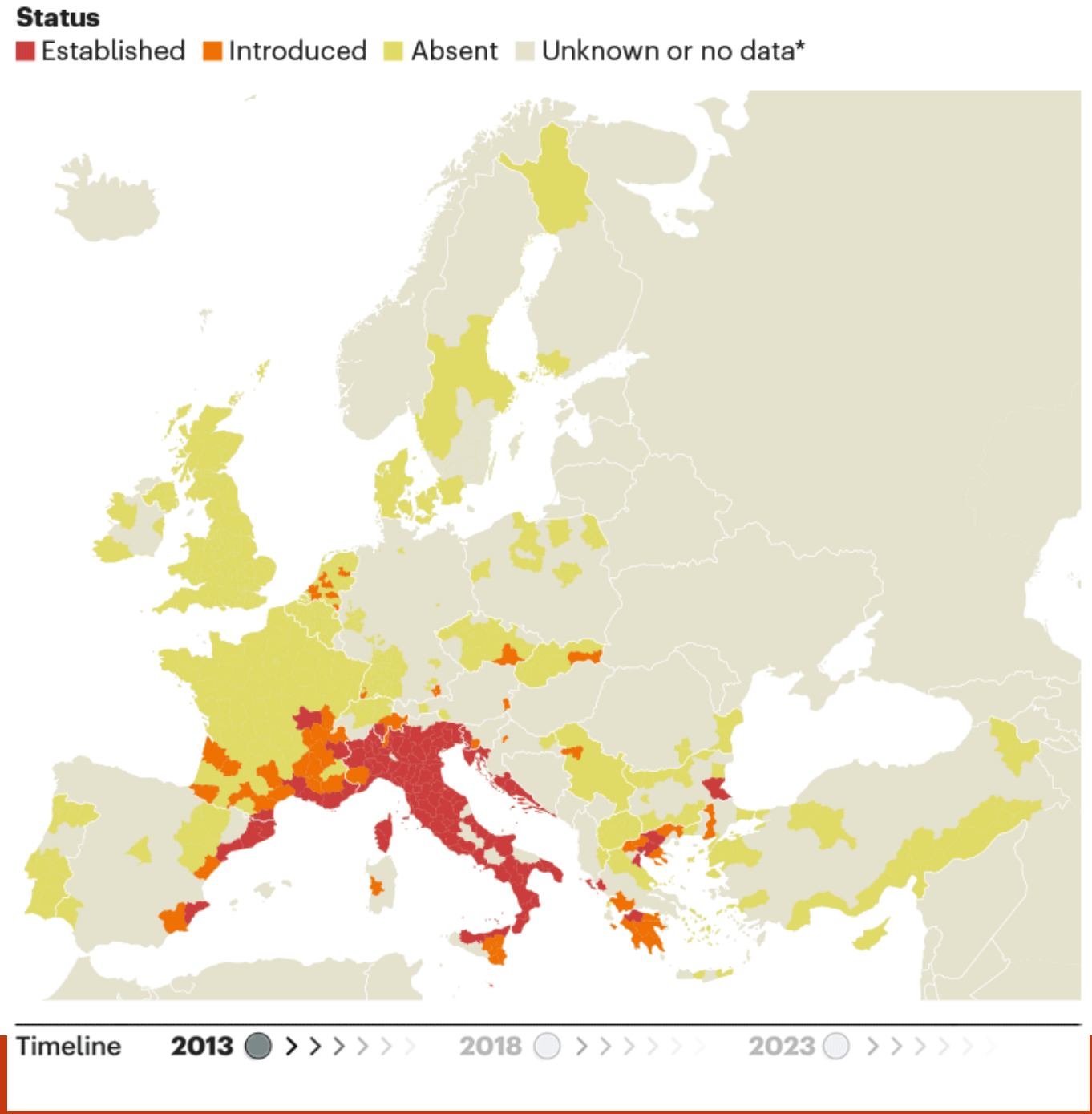
Human Behavior

- More people sleeps outside or stay longer hours outside, increasing exposure to vectors
- Drought may affect water storage, land-use, irrigation practices and population movement

Mosquitoes move North

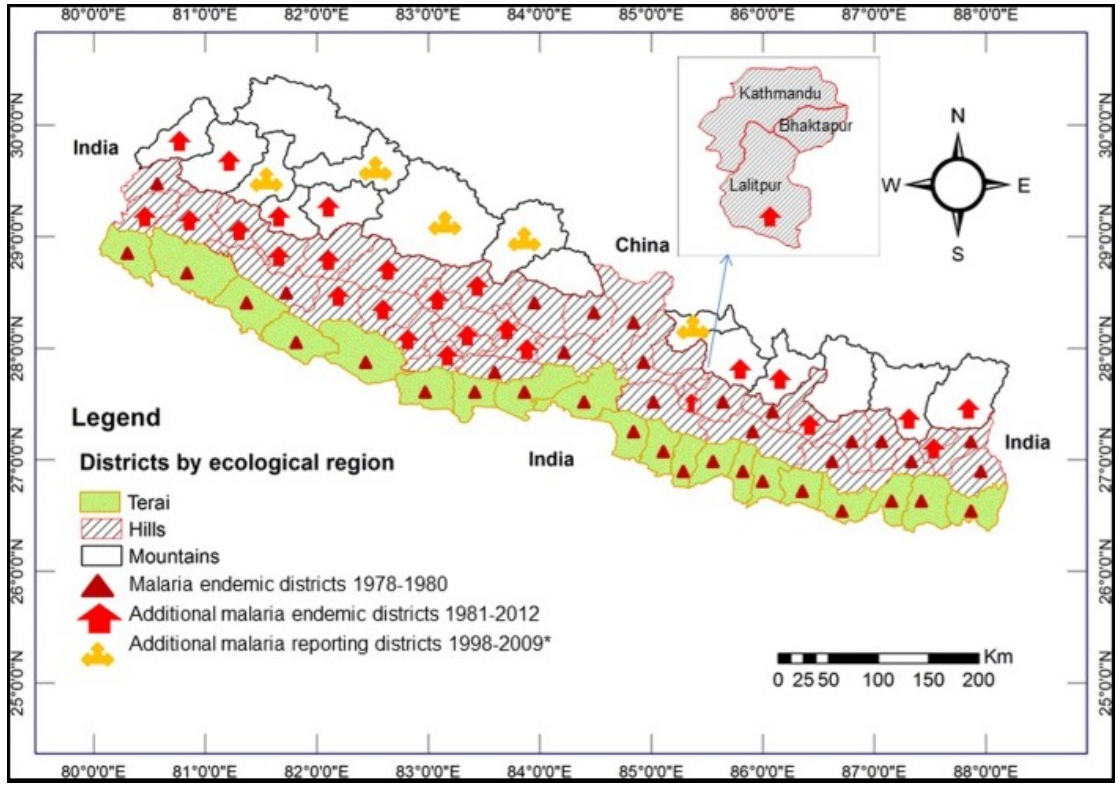
Over the past decade, Aedes albopictus, has made it's home at increasingly higher latitudes, due to climate change. *A albopictus* is a vector of chikungunya and dengue viruses.

https://www.nature.com/articles/d41586-023-03476-7#:~:text

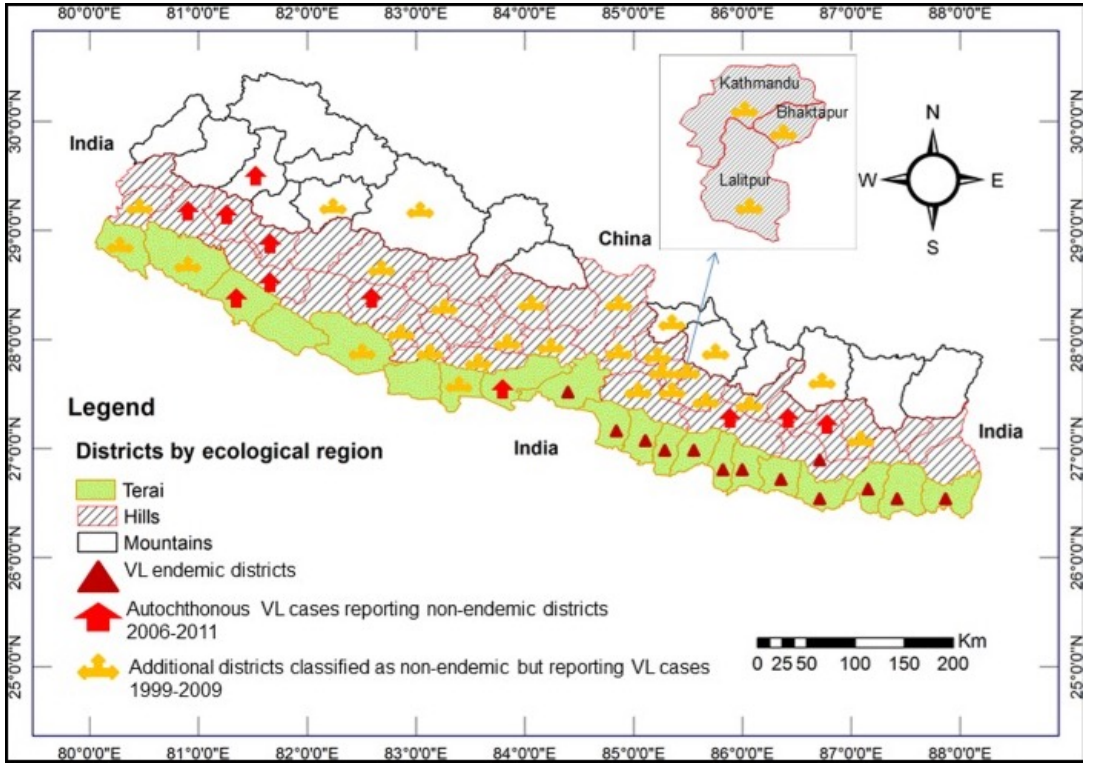


Climate Change and Spatiotemporal Distributions of Vector-Borne Diseases in Nepal

Malaria



Kala-azar



Dhimal, M., et al. (2015). "Climate Change and Spatiotemporal Distributions of Vector-Borne Diseases in Nepal--A Systematic Synthesis of Literature." PLoS One 10(6): e0129869.

Temperature may affect disease through impacting the life cycle of pathogens

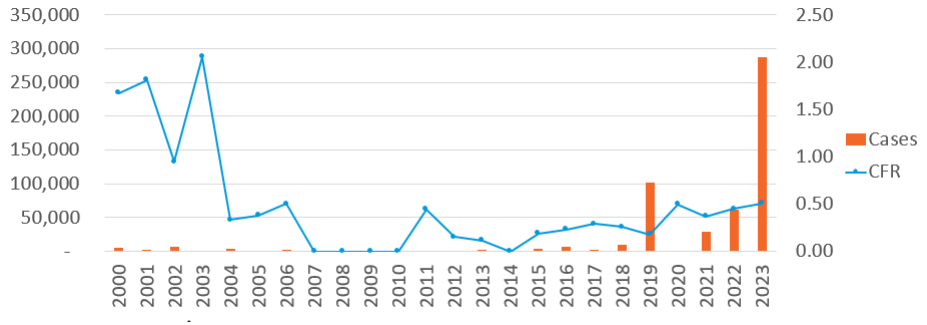
A pathogen needs a certain temperature range to survive and develop.

- maximum temperature of 22–23 °C for mosquito development and minimum temperature of 25–26 °C for Japanese Encephalitis Virus (JEV) transmission
- Excessive heat can increase the mortality rates for some pathogens. The development of malaria parasite (*Plasmodium falciparum* and *Plasmodium vivax*) ceases when temperature exceeds 33°–39 °C
- Rising temperature can influence the reproduction and extrinsic incubation period (EIP) of pathogens
  - EIP for *P. falciparum* reduces from 26 days at 20 °C to 13 days at 25 °C
  - EIP for the dengue virus has been found to be inversely associated with ambient temperature
  - Lower ambient temperature is likely to lengthen EIP, which may in turn decrease the transmission of diseases such as dengue because fewer mosquitoes can live long enough.

- Extended periods of hot weather can raise the average temperature of water bodies and food environment → agreeable environment for microorganism reproduction cycles and algal blooms (i.e. *Vibrio* spp., *Campylobacter* spp.)

Precipitation and Humidity change impacts pathogens

- The relationship between precipitation and vector abundance is complex and context specific. Increased precipitation could provide more vector breeding sites; however, drought could also provide more breeding sites due to an increase in the use of containers for rainwater collection and storage — prime breeding sites for *A. aegypti*.
- Humidity change also impacts the pathogens of infectious diseases.
- Cold temperature and low relative humidity are favorable to the spread of influenza virus
- Humidity affects malarial parasite development in Anopheline mosquito - Temperature and humidity during rainy season in Yangon and Singapore favor dengue virus propagation in mosquitos, contributing to the outbreaks of dengue hemorrhagic fever in these regions.



Bangladesh

Wu, X., et al. (2016). "Impact of climate change on human infectious diseases: Empirical evidence and human adaptation." Environment International 86: 14-23
Patz, J., et al. (2003). "Climate change and infectious diseases." Climate change and human health: risks and responses 2: 103-132..
Thu, H. M., et al. (1998). "The effect of temperature and humidity on dengue virus propagation in Aedes aegypti mosquitos." Southeast Asian J Trop Med Public Health 29(2): 280-284.

Ecological System Changes

- Climate change can disrupt ecosystems and alter the interactions between vectors, hosts, and pathogens, affecting disease transmission dynamics.

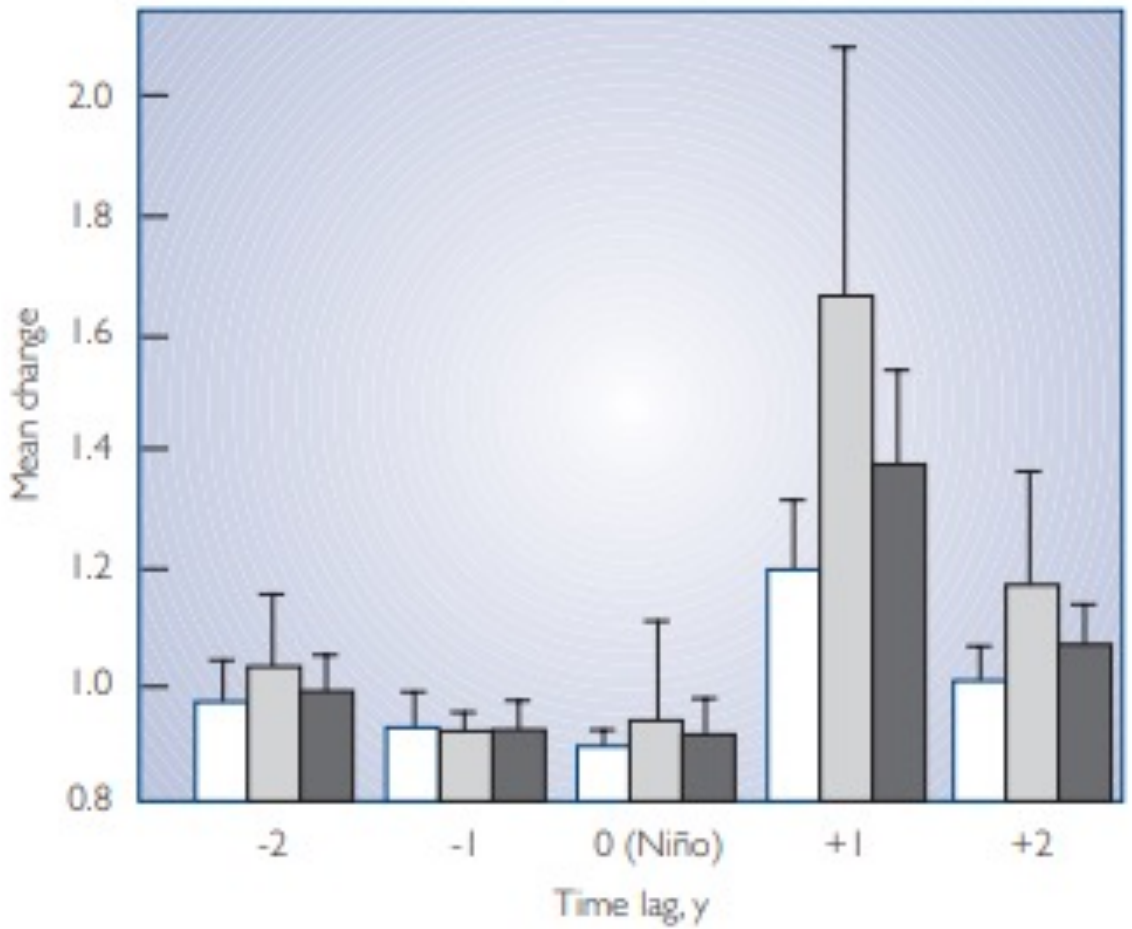


FIGURE 6.2 Relationship between reported malaria cases and El Niño in Venezuela. Average relative change in malaria incidence two years before (−1 and −2 years), during (year 0) and two years after El Niño event (+1 and +2) years). Data are for malaria deaths at the coast 1910–1935 (open bars), malaria cases for the whole country 1975–1995 (grey bars), and the average of both (black bars), with lines indicating the SEs. *Source: reproduced from reference 34.*

Patz, J., et al. (2003). "Climate change and infectious diseases." Climate change and human health: risks and responses 2: 103-132.
Bouma, M. J. and C. Dye (1997). "Cycles of malaria associated with El Niño in Venezuela." Jama 278(21): 1772-1774.

Section 2: Effect on NTDs and VBDs in SEAR and Impact on SDGs

ITM COLLOQUIUM

Malaria in South-East Asia Region

- The second largest contributor to the global malaria burden, accounting for 42% of the estimated burden of malaria outside the WHO African Region.
- Region achieved excellent progress in reducing its malaria burden, representing the largest decline among all regions. Between 2010 and 2021:
  - total malaria cases reduced by 78%;
  - total malaria deaths were reduced by 76%,
- The only WHO Region that reached the GTS 2020 milestones of a 40% reduction in malaria case incidence and mortality, compared to 2015 baseline.
- Malaria endemic in 9 of 11 countries. Maldives & Sri Lanka are malaria-free. 3 countries account for 99.7% of cases in the region - India, Indonesia & Myanmar.

Certified malaria-free

Maldives (2015)

Sri Lanka (2016)

E-2025 (Elimination by 2025)

Timor-Leste*

Bhutan

Nepal

DPR Korea

Thailand

Candidates for 2030

Bangladesh

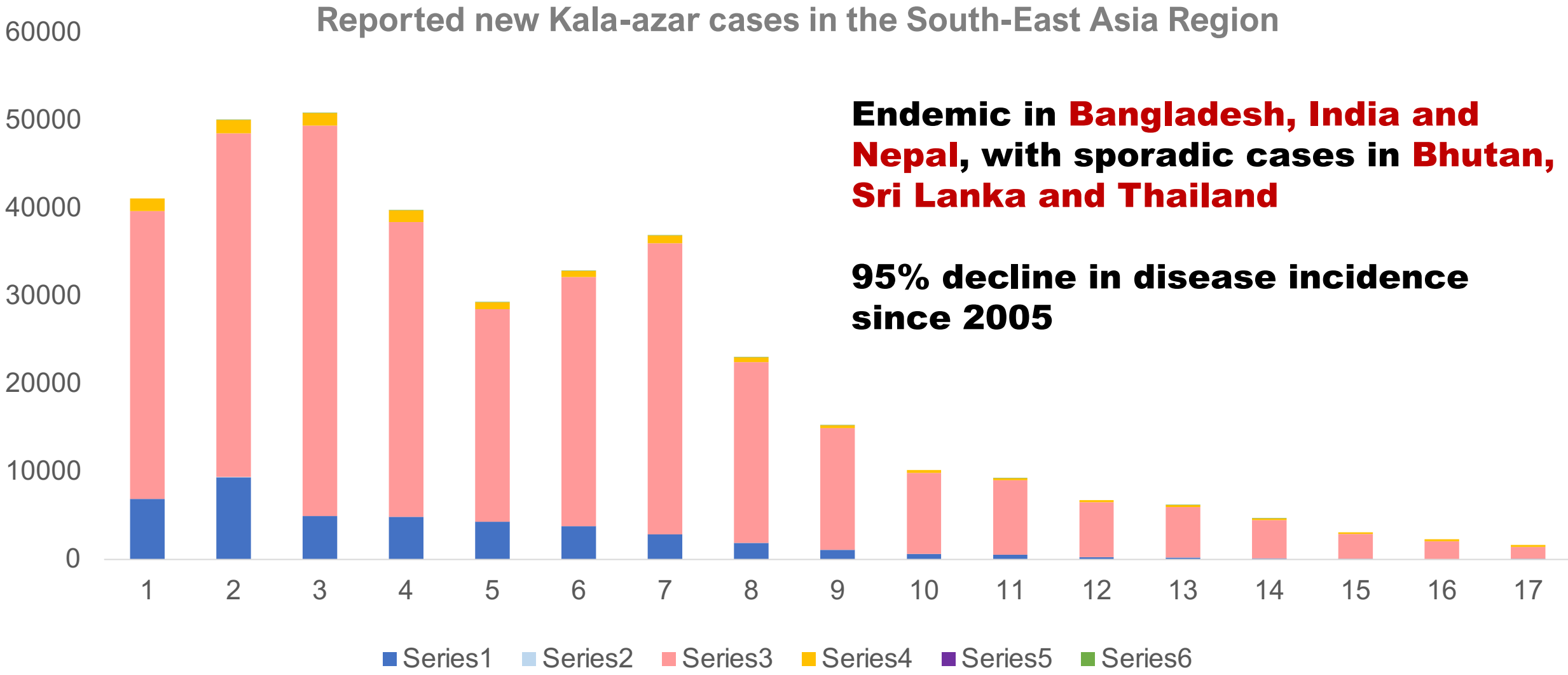
Myanmar

Indonesia

India

Kala-azar elimination in the South-East Asia Region

2002 → 2004 → 2005 → 2006 → 2007 → 2009 → 2010 → 2012 → 2014 → 2015 → 2017 → 2020 → 2022

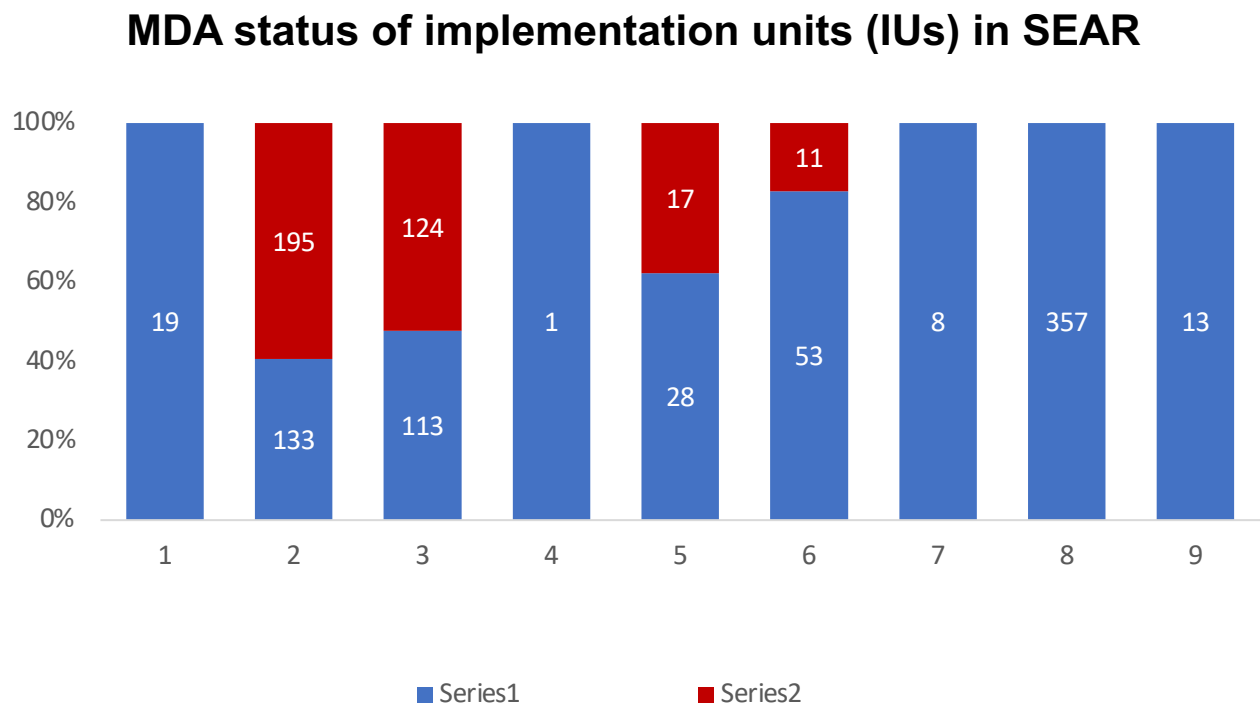


Endemic in Bangladesh, India and Nepal, with sporadic cases in Bhutan, Sri Lanka and Thailand

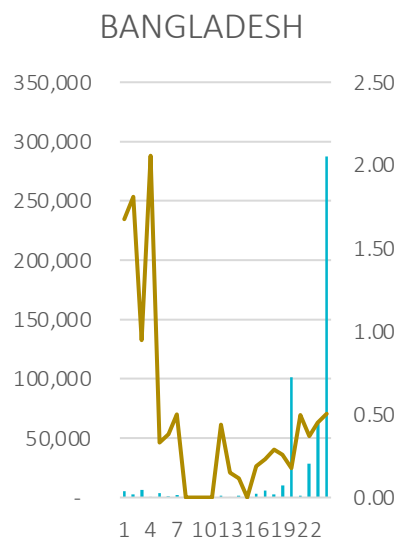
95% decline in disease incidence since 2005

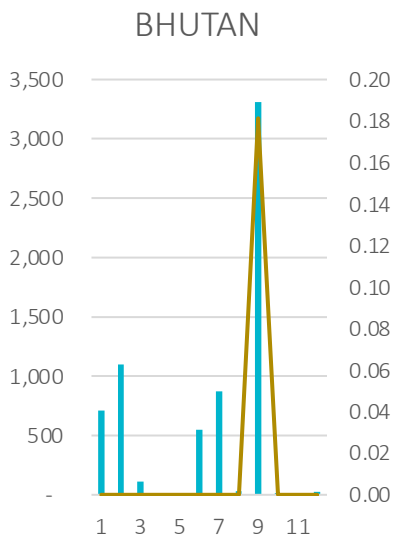
Progress in LF elimination in SEAR

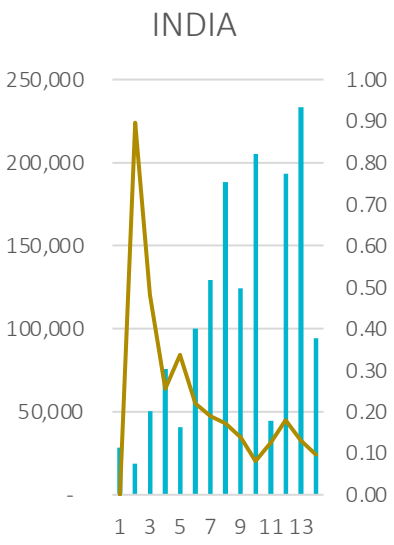
- **4**/9 endemic countries validated for having **eliminated LF as PHP** (Bangladesh,Maldives, Sri Lanka, Thailand)
- Timor-Leste is under post-MDA surveillance nationwide
- In the remaining 4 countries, **48% of all implementation units have already stopped MDA** and the rest IUs are rolling out or preparing for IDA

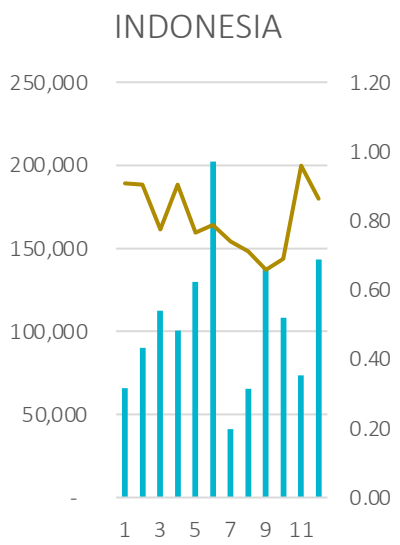


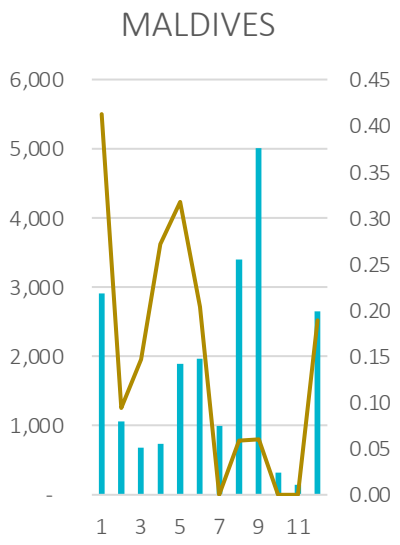
Trend of Dengue Incident Cases and Case Fatality Rate in South-East Asia

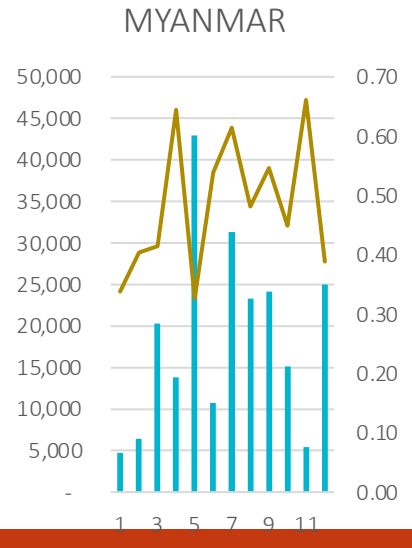


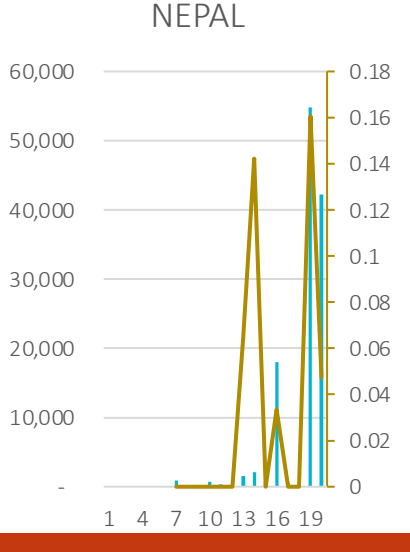


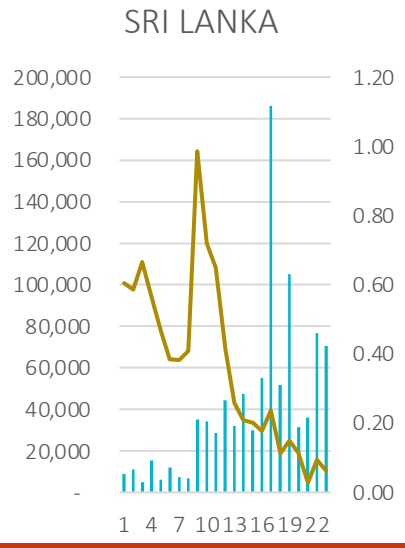


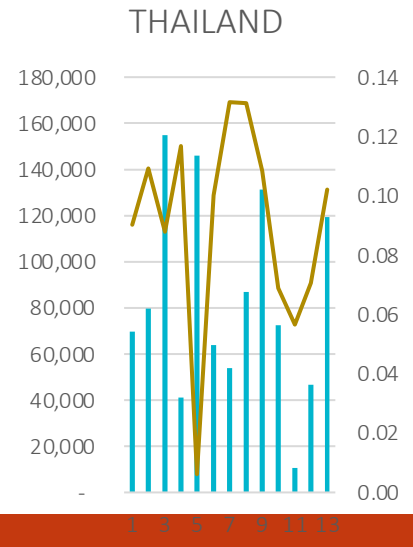


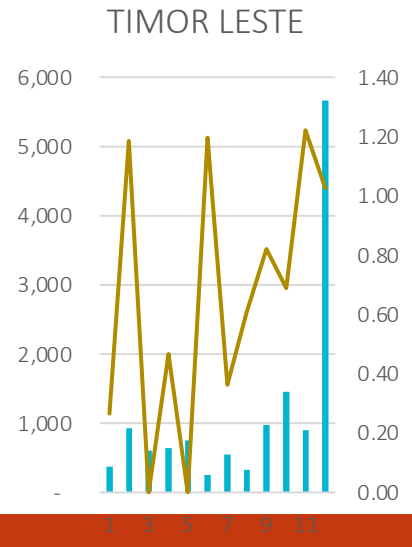










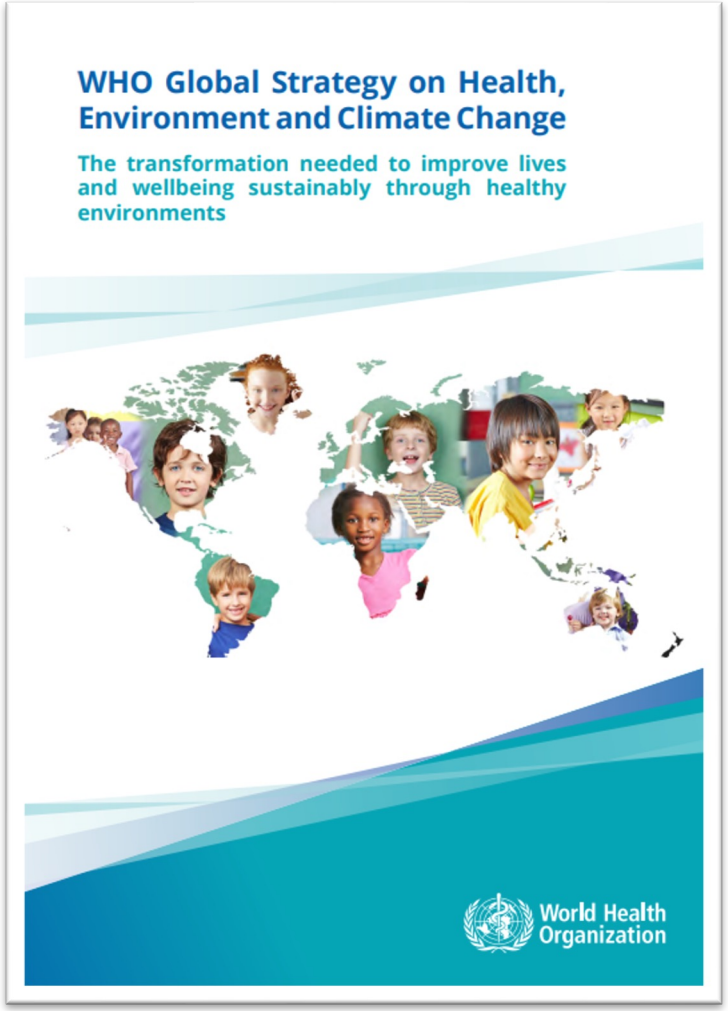


Section 3: Mitigation Efforts Required from the Health Programs Perspective

ITM COLLOQUIUM

Mitigation strategies

- Improve evidence to inform future trends for planning and programme implementation
- Identify at-risk populations
- A shift towards primary preventive actions and the promotion of healthy choices. Adoption of a One Health approach, a holistic, cross-sectoral and multidisciplinary approach
- Strengthen healthcare systems, improve communicable disease surveillance systems and monitoring
- Strengthen health sector leadership, governance and coordination roles
- Health in All Policies approach includes community engagement, coverage of health in environmental and labour regulations and safeguards,



WHO Response

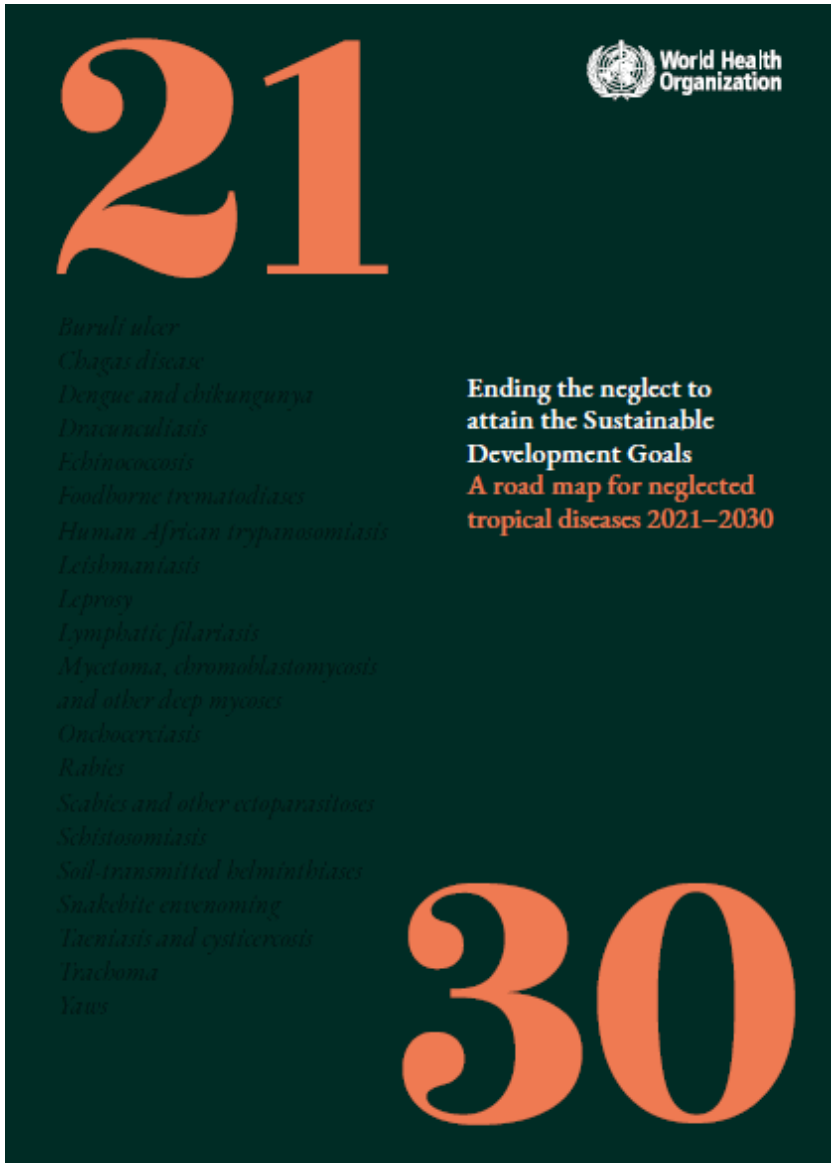
- **Advocacy and partnerships**
  - coordinating with partner agencies within the UN system
  - ensuring that health is properly represented in the climate change agenda,
  - providing and disseminating information on the threats that climate change
  - opportunities to promote health while cutting carbon emissions
- **Monitoring science and evidence**
  - coordinating reviews of scientific evidence and dev. Global research agenda
  - assessing country's preparedness and needs
- **Supporting countries to protect human health from climate change**
  - assisting countries build capacity to reduce health vulnerability to climate change
  - improving the resilience and adaptive capacity of health systems to deal with the adverse health effects of climate change
- **Building capacity on climate change and human health**
  - assisting countries to build capacity to reduce health vulnerability to climate change
  - promoting health while reducing carbon emissions

Advocacy

- During the 70th RC in 2017, Member States of SEAR adopted **Male' Declaration on building health systems resilience to climate change**
- At 72nd RC in 2019, Member States adopted the **regional plan of action for global strategy on health, environment and climate change 2020-2030**.
- During COP26, SEARO launched the first-of-its kind **online advocacy toolkit on climate change and health** (https://apps.searo.who.int/wsh)
- During the recently concluded G20 Summit in India, the **declaration** also made **commitments to address health impacts of climate change**
- During 28th session of the Conference of the Parties (COP28) in Dec 2023, there will be a first health ministers' session in which a **ministerial declaration** will be adopted.

COP28 UAE

Human health at the heart of climate change- first ever health day in the COP process



Global Arbovirus Initiative
New global initiative launched by WHO in 2022

Region's Flagship Priority on eliminating NTDs and other diseases on the verge of elimination.

Sustain

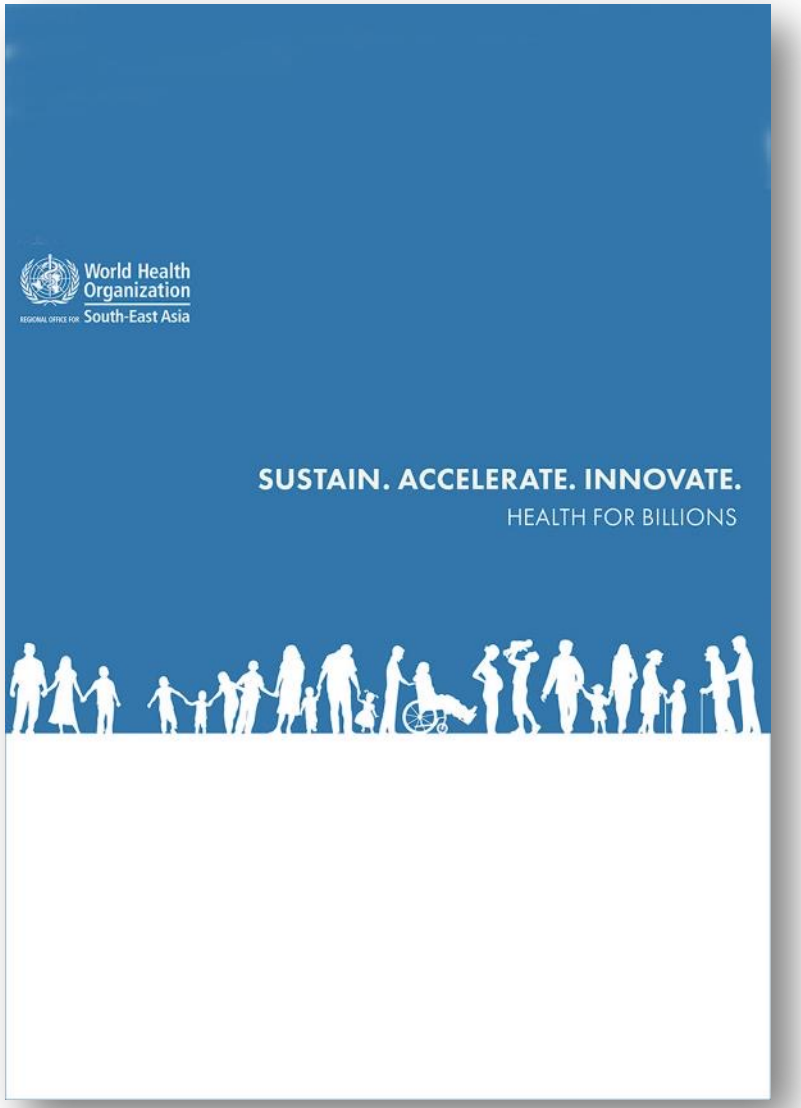
Elimination of Lymphatic Filariasis as a public health problem in Maldives, Sri Lanka and Thailand; Yaws free India; and Trachoma elimination in Nepal.

Accelerate

Efforts to further reduce leprosy, eliminate Kala-Azar, Lymphatic Filariasis and Trachoma as public health problems, and achieve yaws free status in remaining endemic areas.

Innovate

For newer guidelines, treatment regimens and strategies to #EndNTDs at the earliest.



" Together we must sustain our gains, accelerate sustainable progress and innovate to advance health of billions across WHO South-East Asia Region "

Dr Poonam Khetrapal Singh on her vision for second term as Regional Director beginning 1 February 2019.

#colloq23

Thank you!

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