Re-emerging of Environmental Health Threats

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Outline

- Introduction
- Historical context
- Factors contributing to re-emerging of environmental health threats
- Global & local responses
- Challenges in addressing environmental health threats

Introduction

- Environmental health is the branch of public health that focuses on the interactions between people and their environment.
- It encompasses how environmental factors—such as air and water quality, climate, and chemical exposures—impact human health and well-being.
- The re-emergence of environmental health threats is a growing concern, driven by various factors including climate change, urbanization, and industrial activities.

Theme: Creating Resilient Communities through Disaster Risk Reduction & Climate Change Mitigation & Adaptation (International Federation of Environmental Health, 2024)

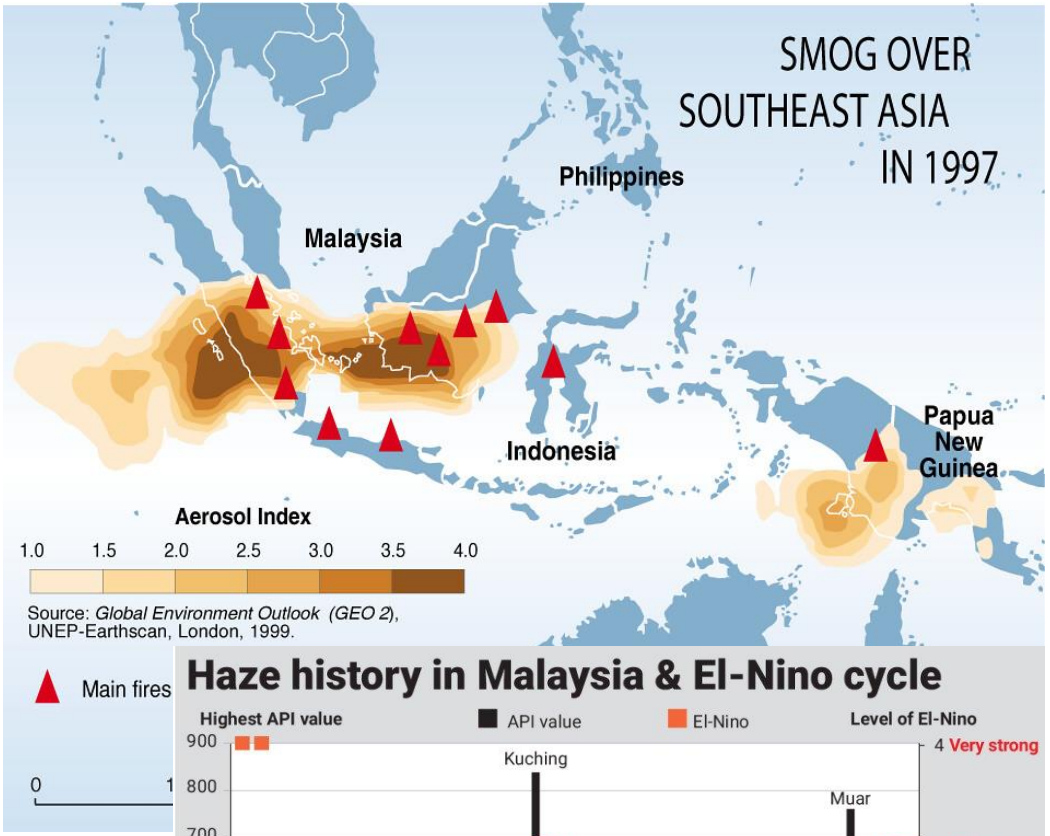
Environmental health is crucial for ensuring that environmental factors do not compromise public health. Addressing environmental risks through science-based policies, public education, and community action is essential for improving health outcomes and quality of life.

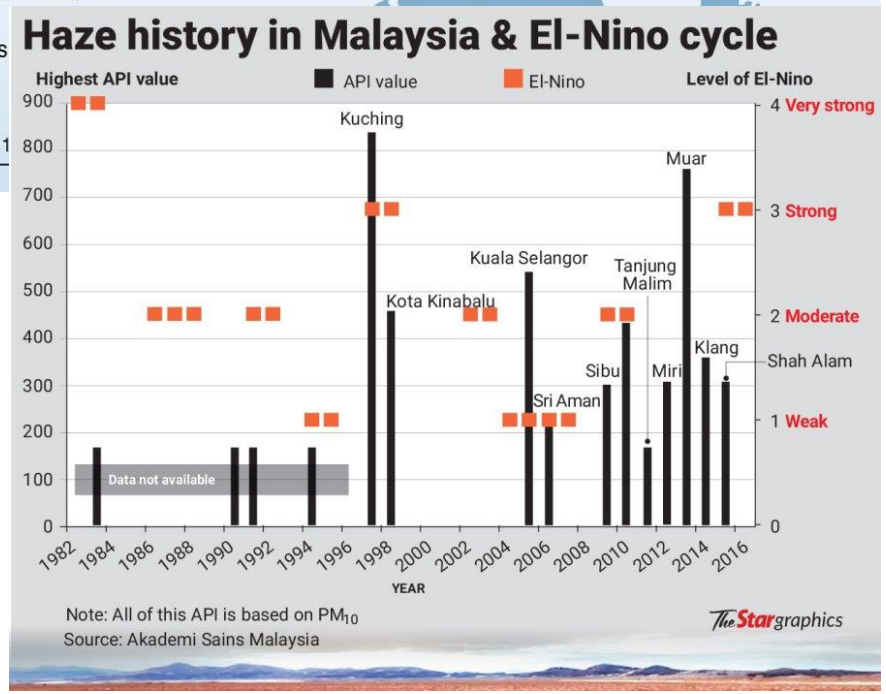
Historical Context

- Past environmental health threats:
  - Air pollution and respiratory diseases.
  - Waterborne diseases (e.g., cholera).
  - Vector-borne diseases (e.g., malaria).

Air Pollution: Haze episodes in Malaysia

- 1997: Sept – Nov; internal & external sources also coincided with El Nino & prolonged dry season. Haze emergency had to be declared in Sarawak (API > 500)
- 2005: Aug; whole part of Klang Valley was badly affected. Haze emergency was declared as API at Pelabuhan Klang & Kuala Selangor were >500
- 2015: Aug - Sep; during SW monsoon, 34 areas recorded unhealthy air quality since 1997; schools were closed at affected areas





Source: https://www.doe.gov.my/wp-content/uploads/2021/09/Chronology-of-Haze-Episodes-in-Malaysia.pdf

Vector-borne diseases

High temperatures

Altered vector activity and bite rates (for example, mosquitoes, ticks and midges)

Increased transmission risk (for example, dengue, tularemia and leishmaniasis)

Altered extrinsic incubation period (for example, mosquitoes and midges)

Increased survival of adult female vectors (for example, mosquitoes)

Floods

Altered suitable aquatic environment for reproduction (for example, mosquitoes, sandflies and midges)

Altered dipteran vector population (for example, mosquitoes, sandflies and midges)

Increased exposure to vector bites (for example, mosquitoes)

Decreased tick vector populations (for example, hard ticks and soft ticks)

Droughts

Increased dipteran vector population (for example, mosquitoes)

Increased transmission risk (for example, West Nile and dengue viruses)

Increased exposure to vector bites (for example, mosquitoes)

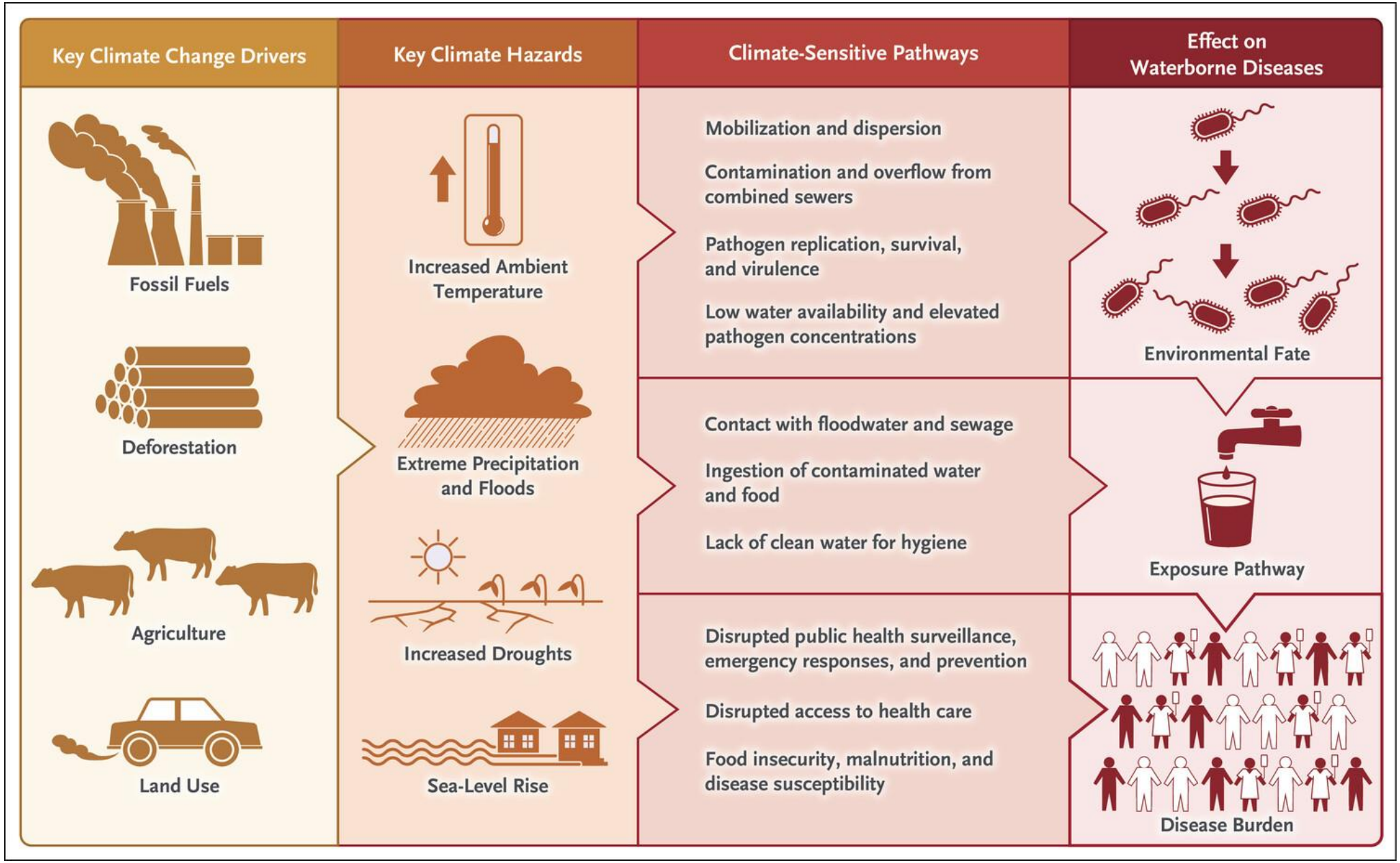
Decreased tick vector populations (for example, hard ticks and soft ticks)

Impact of extreme weather on vectors & vector-borne diseases

de Souza, W. M., & Weaver, S. C. (2024). Effects of climate change and human activities on vector-borne diseases. *Nature Reviews Microbiology*, 1-16.

Water-borne diseases

- Water-borne diseases are closely related to weather and climate.
- Cholera, cryptosporidiosis, and several other significant diseases are spread by fecal contamination of water supplies and are often closely associated with floods and heavy downpours.
- Drought can concentrate disease pathogens in pools and low flows.
- Climate change is causing increased intense rainfall events in many parts of the world and drought in others; it is not surprising that water-borne illness is a growing problem in those areas with the most extreme changes.

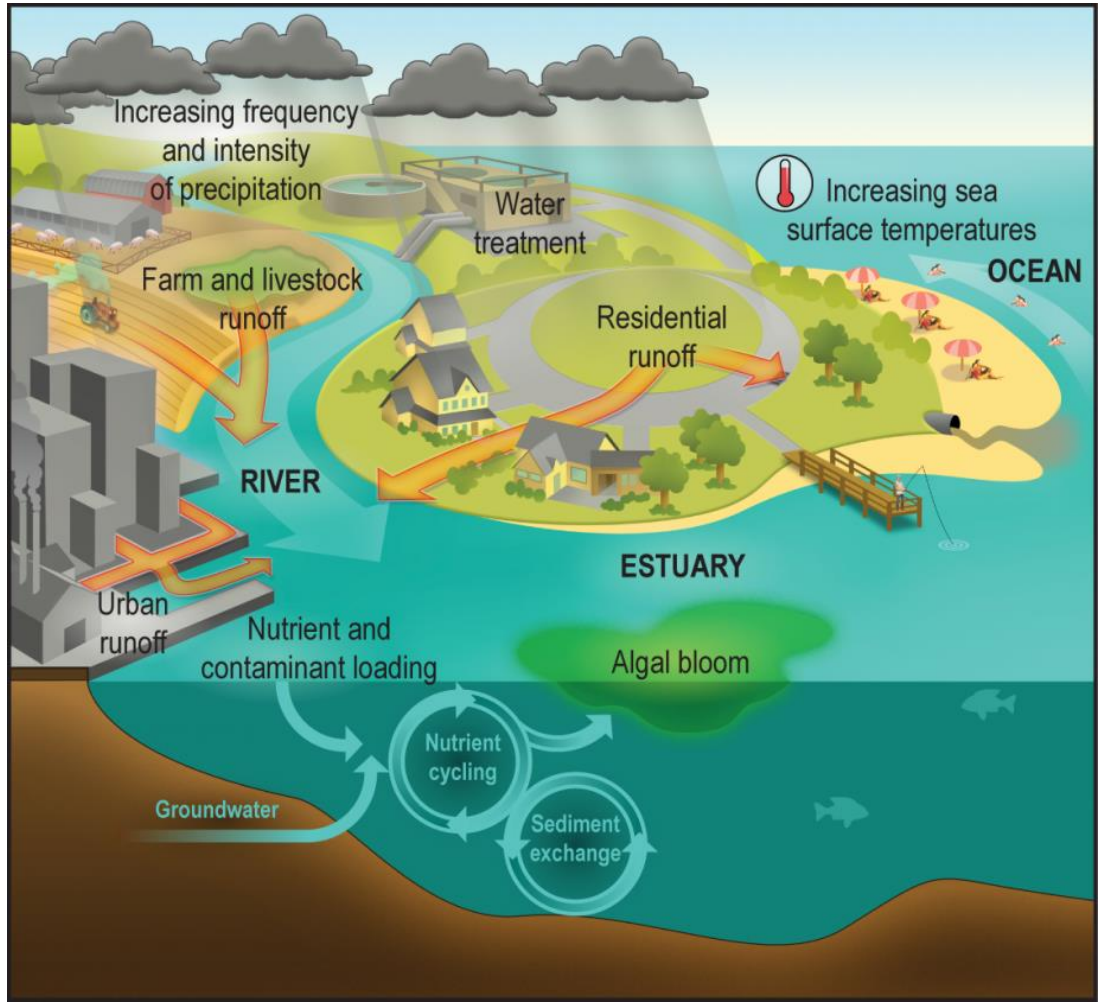


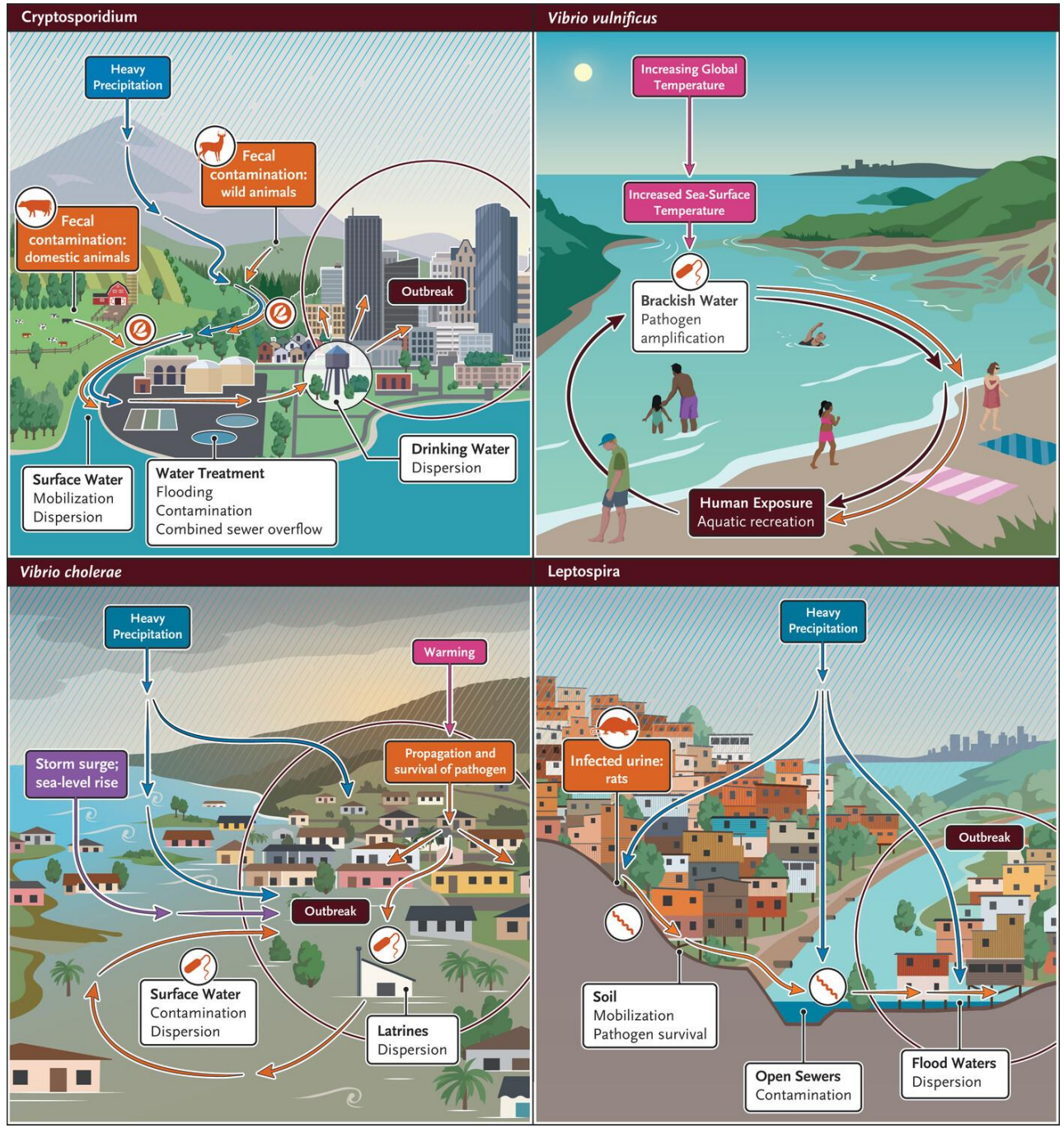
Pathways by Which Climate Change Drives the Burden of Waterborne Diseases.

Semenza, J. C., & Ko, A. I. (2023). Waterborne diseases that are sensitive to climate variability and climate change. *New England Journal of Medicine*, *389*(23), 2175-2187.

The key to understanding the spread of water-borne illness in a changing climate is exposure. As this image shows, various factors (all from human activity) are increasing our exposure to these illnesses.

- increasing frequency and intensity of precipitation events
- increasing sea surface temperatures
- runoff from agriculture and our built environments




Cryptosporidium
Heavy Precipitation
Fecal contamination: wild animals
Fecal contamination: domestic animals
Outbreak
Surface Water
Mobilization
Dispersion
Water Treatment
Flooding
Contamination
Combined sewer overflow
Drinking Water
Dispersion
Vibrio vulnificus
Increasing Global Temperature
Increased Sea-Surface Temperature
Brackish Water
Pathogen amplification
Human Exposure
Aquatic recreation
Vibrio cholerae
Heavy Precipitation
Warming
Storm surge; sea-level rise
Propagation and survival of pathogen
Outbreak
Surface Water
Contamination
Dispersion
Latrines
Dispersion
Leptospira
Heavy Precipitation
Infected urine: rats
Outbreak
Soil
Mobilization
Pathogen survival
Open Sewers
Contamination
Flood Waters
Dispersion

How Does Climate Change Affect Food Safety?

Climate change can increase food- and water-borne disease risks in many ways. Many pathogens, such as those responsible for cholera, are sensitive to changing temperatures, rainfall and extreme weather. This diagram summarises some of the main mechanisms:

Contamination of crops by faeces due to high levels of rainfall or flooding

Food scarcity can cause dietary shifts towards more 'unsafe' foods

Water scarcity during droughts can adversely affect hygiene and sanitation

THE GLOBAL CLIMATE & HEALTH ALLIANCE

References

WHO, 2014: Food safety. Fact sheet N. 399 http://www.who.int/mediacentre/factsheets/fs399/en/

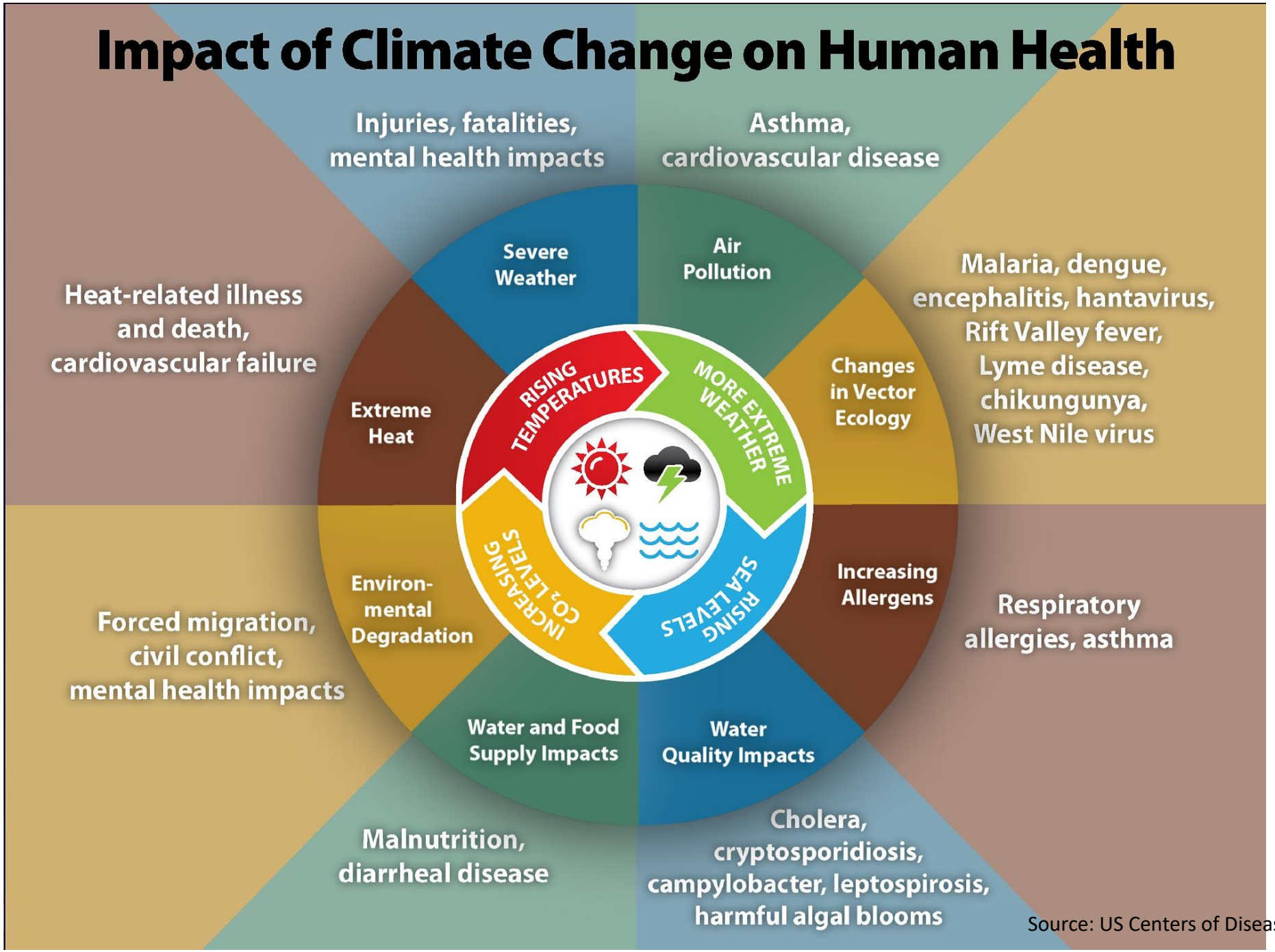
Smith, K.R., et al, 2014: Human health: impacts, adaptation, and co-benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709-754.

Factors Contributing to Re-emergence of EH Threats

- Key Factors**:**
  - Climate change (e.g changes in vector distribution).
  - Urbanization and deforestation.
  - Antimicrobial resistance.

Climate Change-Related Hazards

- Impact of climate change on environmental health.
- Extreme weather events: Droughts, floods, heatwaves, wildfires.
- Health consequences: Food insecurity, displacement, exposure to contaminants.
- Adaptation strategies: Building resilience, early warning systems, sustainable practices



Source: US Centers of Disease Control and Prevention

Notable flood in Malaysia

- December 2014 – Northern and Eastern states of Kelantan, Terengganu, Pahang, Perak and Perlis in Malay Peninsula were hit by flash floods including some areas in Sabah.

- 4 & 5 November 2017 – Northern state of Penang in Malay Peninsula were hit by flash floods caused unusually heavy rains in Tropical Depression 29W, Typhoon Damrey. Flood waters in parts of the city reached 3.7 m (12 ft), submerging entire homes.

- 2020–2021 Malaysian floods – In late 2020 and early 2021, Terengganu, Pahang and Johor were more particularly affected by flash floods.

- 2021–2022 Malaysian floods – In late 2021 and early 2022, Klang Valley (Port Klang, Klang, Setia Alam, Puncak Alam, Kota Kemuning, Shah Alam, Kuala Lumpur, Ampang, Cheras, Hulu Langat, Puchong, Dengkil) hit by a worst flash floods ever seen in 50 years due to Tropical Depression 29W.

MONDAY
19 DEC 2022
1330 HRS UTC +7

FLOODING AND LANDSLIDES IN PENINSULAR MALAYSIA
FLASH UPDATE #1

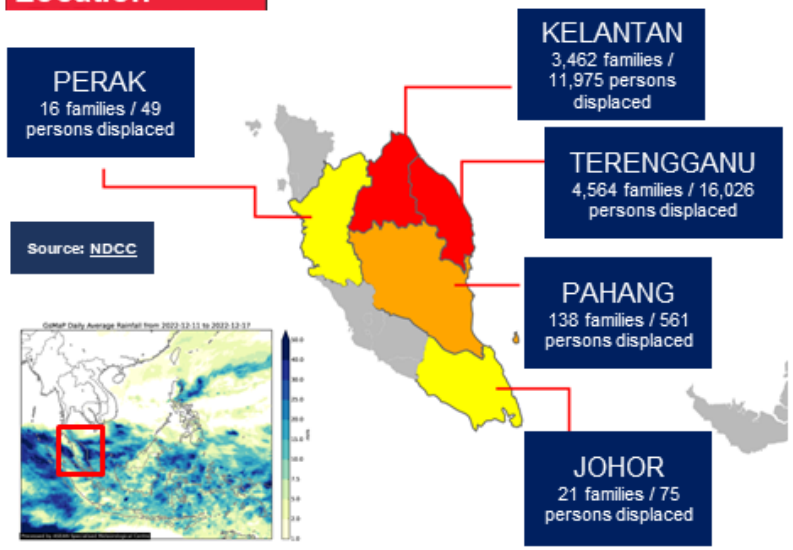
11 ANNIVERSARY

KEY FIGURES

Disclosure(s): Estimations are based on data reported/confirmed by National Disaster Management Organisations of the respective ASEAN Member States (Agensi Pengurusan Bencana Negara (NADMA) and other verified sources.

- **28.7K** DISPLACED
- **24** DEAD
- **308** EVACUATION CENTRES
- **9** MISSING

Number of affected people by flooding
since 18 December 2022, as of 19 December at 1100 HRS UTC+7



- **OVERVIEW:** Northeast Monsoon have caused a series of floods and landslides in several states of Malaysia. On 18 Dec 2022 at 0900 HRS UTC+7, *Jabatan Meteorologi Malaysia* (MET Malaysia) issued **Danger** warning (expected to result to continuous heavy rain with rainfall exceeding 240 mm/day) in Kelantan, Terengganu, and Pahang (Jerantut and Kuantan), and **Severe** warning (continuous heavy rain) in Perlis, Kedah (Langkawi, Kubang Pasu, Kota Setar, Pokok Sena, Padang Terap, Yan, Pendang, Sik and Baling), Perak (Hulu Perak), and Pahang (Cameron Highlands, Lipis, Maran, Pekan and Rompin) until Wednesday, 21 Dec 2022. Landslide was also reported by *Agensi Pengurusan Bencana* (NADMA) Malaysia on 16 Dec 2022 in Batang Kali, Hulu Selangor, Selangor State.
- **IMPACTS:** as of 19 Dec 2022, at 0900 HRS UTC+7, a total of 81 flooded areas and 15 landslides, and 5 roads and 3 bridges in Malaysia were reported by *Jabatan Kerja Raya* (JKR).

  Flooding
  - As of 19 Dec 2022, 1100 HRS UTC+7, NADMA Malaysia has reported **20 districts** in **5 states** affected by floods with a total of **8,201 families/28,686 persons** displaced in 308 evacuation centres including:
    - Johor: **21 families/75 persons displaced** in in 3 evacuation centres over Segamat;
    - Kelantan: **3,462 families/11,975 persons displaced** in 93 evacuation centres over Bachok, Jeli, Kota Bharu, Kuala Krai, Machang, Pasir Mas, Pasir Puteh, Tanah Merah, and Tumpat;
    - Pahang: **138 families/561 persons displaced** in 5 evacuation centres over Kuantan and Raub;
    - Perak: **16 families/49 persons displaced** in 2 evacuation centres over Hilir Perak;
    - Terengganu: **4,564 families/16,026 persons displaced** in 205 evacuation centres over Besut, Dungun, Hulu Terengganu, Kemaman, Kuala Terengganu, Marang, and Setiu.
  - According to the ASEAN Disaster Information Network (ADINet), recent flooding event in Malaysia with comparable severity was in 17 Dec 2021, which is resulted to more than 60K displaced persons in Kelantan, Terengganu, Pahang, Melaka, Negeri Sembilan, Kuala Lumpur, Selangor, and Perak States.

  Landslides
  - As of 18 Dec 2022, a total of **94 people were affected** (at the campsite in Batang Kali, Hulu Selangor, Selangor State when the landslide struck on 16 Dec 2022), of which, **61 persons were rescued alive**, **24 found dead**, and **9 persons still missing** as reported by Angkatan *Pertanahan Awam Malaysia* (APM).
- **RESPONSE:** Government of Malaysia continue to conduct Search and Rescue, and Evacuation Operation for the disaster events in Peninsular Malaysia. APM has activated *Pasukan Respon Bencana Sokongan* (PARAS) to respond to the disaster events caused by the Northeast Monsoon in Malaysia.
- **FORECAST:** *Jabatan Pengairan dan Saliran* (JPS) has released a **Flood** warning for Johor State, particularly for Mersing District (Sg. Mersing) starting from 19 Dec 2022 at 1100 HRS UTC+7, and Johor Bahru District (Sg. Johor, Sg. Tiram) starting from 21 Dec 2022 at 2000 HRS UTC+7.
- The AHA Centre will continue to monitor for further developments and issue necessary updates.

DATA SOURCES
ASEAN: Disaster Monitoring & Response System (DMRS), ASEAN Disaster Information Network (ADINet); Pacific Disaster Center (PDC Global); ASEAN Specialised Meteorological Centre (ASMC);
Malaysia: NADMA, MET Malaysia, NDCC, JKR, APM, JPS;
Verified news media agencies.

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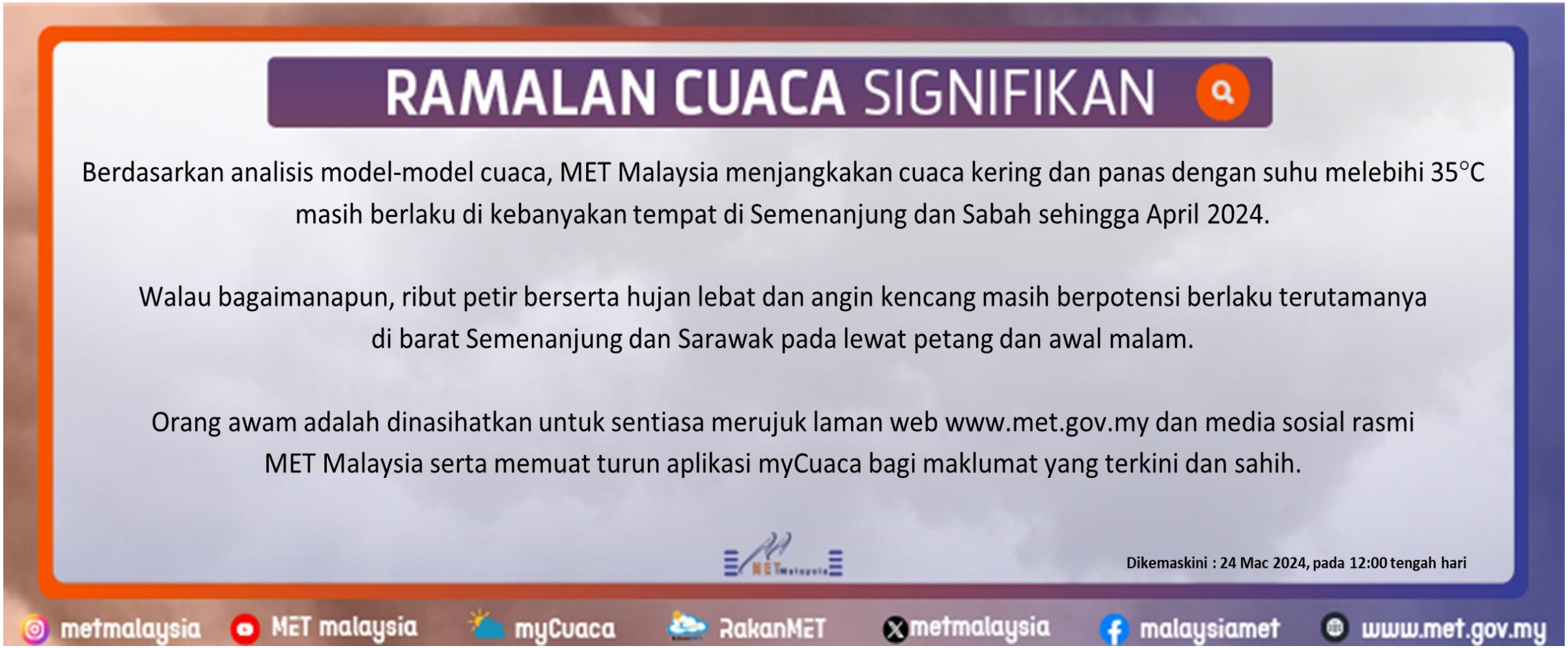
Jl. Raya Pramuka Kav. 38,
Jakarta 13120 Indonesia

Heat wave & El Nino

- El Nino phenomenon happens every 2 – 7 years and may occur for a period of 2 – 18 months
- Average sea surface temperature (SST) may increase due to heating of sea surfaces
- It causes drought in the west of Pacific Ocean (Indonesia & Malaysia); and flood in the east of Pacific Ocean (Ecuador, Central and Southern America)
- Characteristic of El Nino phenomenon: prolonged drought, low air humidity, high evaporation rate and haze occurrence
- El Nino phenomenon during Southwest monsoon may worsen the hot & dry weather situation

Hot Weather Forecast 2024

KEMENTERIAN KESIHATAN MALAYSIA



Hot Weather Warning Level

MINISTRY OF HEALTH MALAYSIA

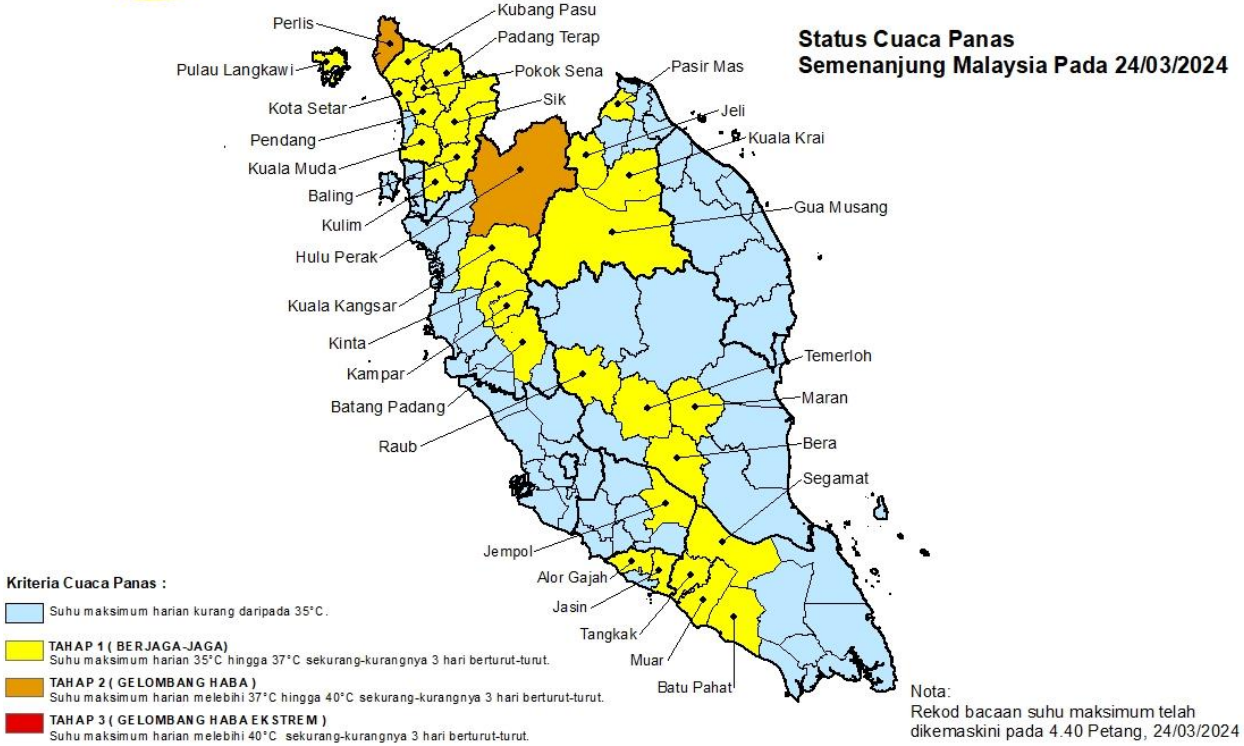
Tahap	Status	Suhu
Tiada Amaran (0)	-	Suhu di bawah 35 ^{0}C
Amaran Pertama (1)	Berjaga – jaga (Amaran Gelombang Haba)	Suhu tertinggi harian melebihi 35 ^{0}C hingga 37 ^{0}C selama tiga hari berturut-turut
Amaran Kedua (2)	Gelombang Haba	Suhu tertinggi melebihi 37 ^{0}C untuk tiga hari berturut-turut – pengistiharan *heatwave* oleh Kementerian Sains, Teknologi dan Inovasi (MOSTI)
Amaran Ketiga (3) Kecemasan/ Bencana	Kecemasan Gelombang Haba	Suhu tertinggi harian melebihi 40 ^{0}C untuk 3 hari berturut-turut – Pemakluman kepada Agensi Pengurusan Bencana Negara (NADMA) bagi pengistiharan kecemasan

Jawatankuasa Teknikal Pelan Tindakan Gelombang Haba Kebangsaan – 21 Mac 2016

Latest Hot Weather Status (24 Mac 2024)

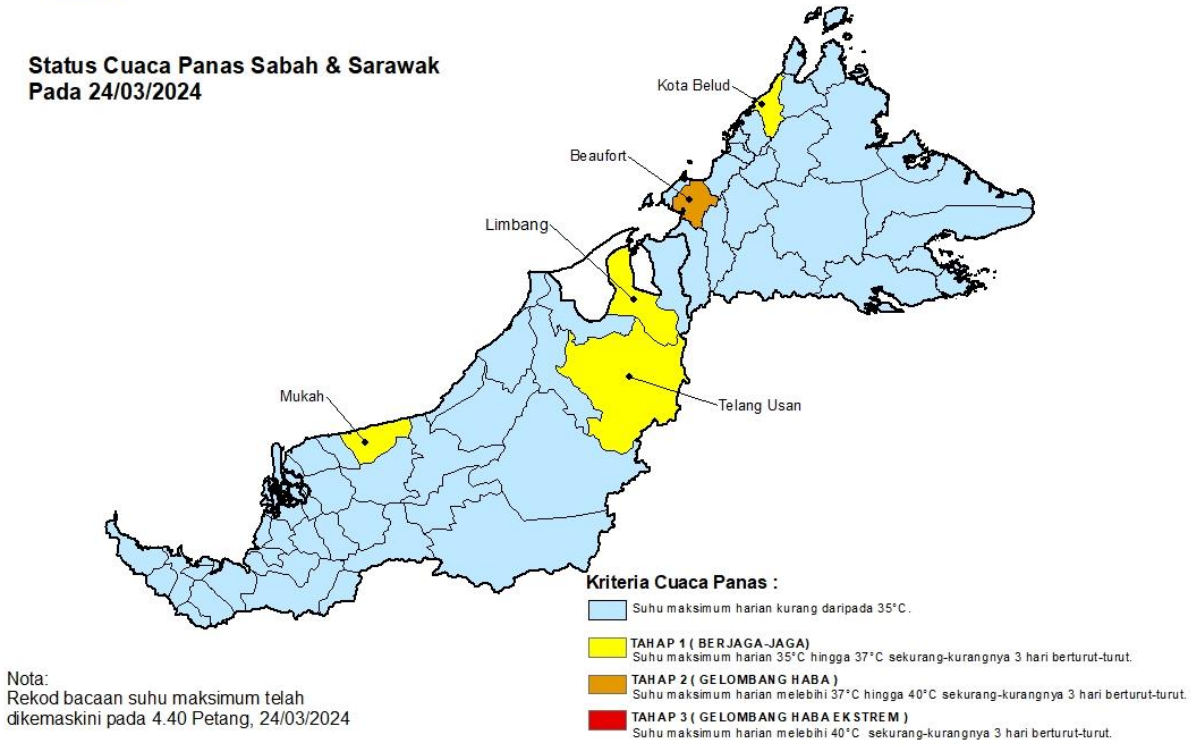
KEMENTERIAN KESIHATAN MALAYSIA

JABATAN METEOROLOGI MALAYSIA
KEMENTERIAN SUMBER ASLI DAN KELESTARIAN ALAM



Nota:
Rekod bacaan suhu maksimum telah dikemaskini pada 4.40 Petang, 24/03/2024

JABATAN METEOROLOGI MALAYSIA
KEMENTERIAN SUMBER ASLI DAN KELESTARIAN ALAM



Nota:
Rekod bacaan suhu maksimum telah dikemaskini pada 4.40 Petang, 24/03/2024

Health Hazard Related to El Nino & Hot Weather

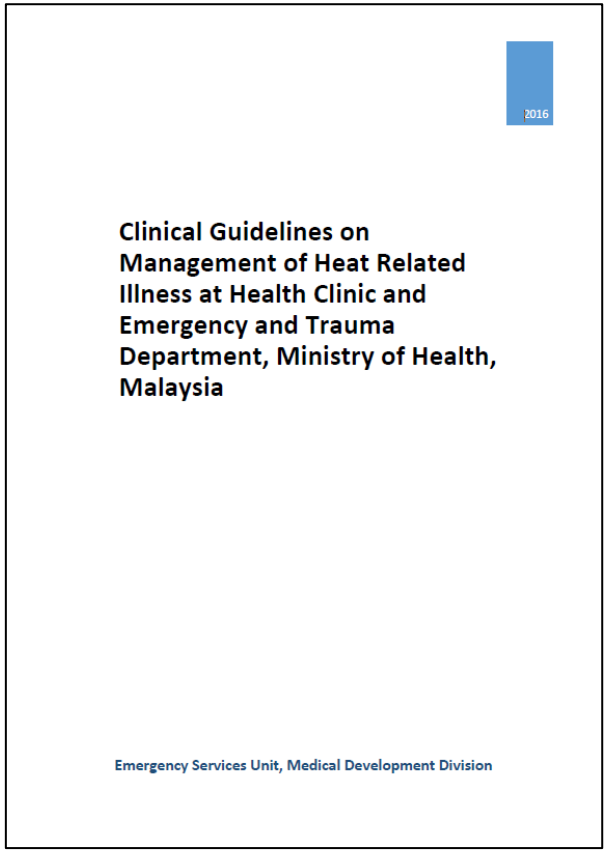
KEMENTERIAN KESIHATAN MALAYSIA

Health Hazard	Risk of Disease
Hot Weather - Heat Waves	Heat related illness: Heat Cramp, Heat Exhaustion, Heat stroke
Forest & Peat Burning - Localised haze - Transboundary haze	Increased diseased caused by haze • Conjunctivitis • Respiratory diseases: Asthma, URTI • Other chronic respiratory diseases
Drought & Lack of Clean Water Supply - Clean water supply reduced - Water storage may increase risk of aedes breeeding	• Increased FWBD during drought • Dengue fever • Clean water supply to community & healthcare facilities

MOH Guidelines

KEMENTERIAN KESIHATAN MALAYSIA

Prevention and control preparedness



Preparedness in providing treatment to patients

Water supply contigency plan for healthcare facilities

D10-11 Guidelines: Drinking water quality monitoring during water crisis/ disaster July 2015

Water supply to healthcare facilities & public

#ClimateChange

WHO IS AT RISK OF CLIMATE CHANGE?

Those **living in poverty**, as well as **women, children** and the **elderly.**

Outdoor workers and people **living with chronic medical conditions.**

Children are the most vulnerable due to long exposure to environmental risks.

Those living in **megacities, small island developing states** and other **coastal, mountainous and polar regions**.

Countries with **weak health systems** will be least able to prepare and respond.

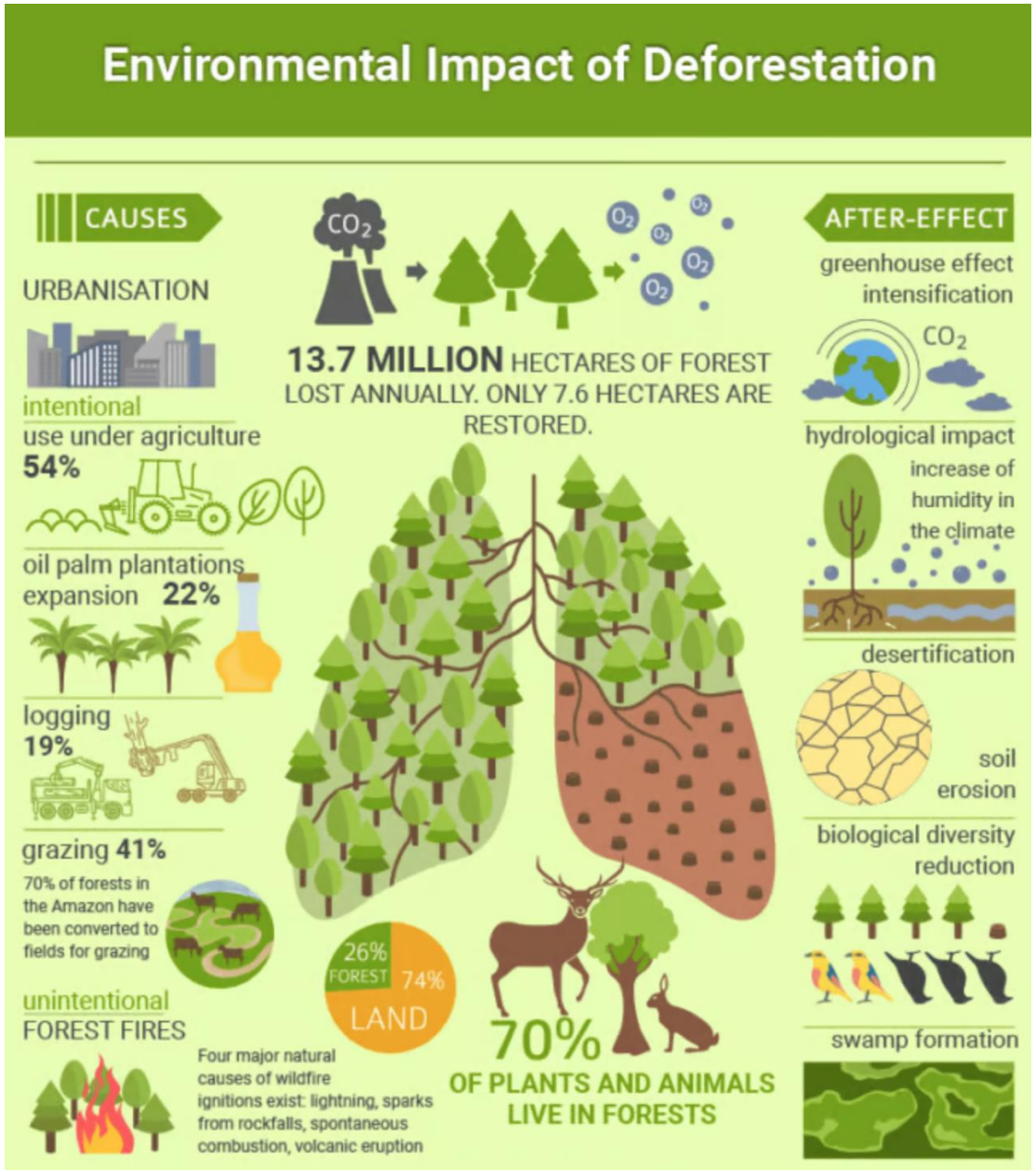
World Health Organization

Urbanization & deforestation

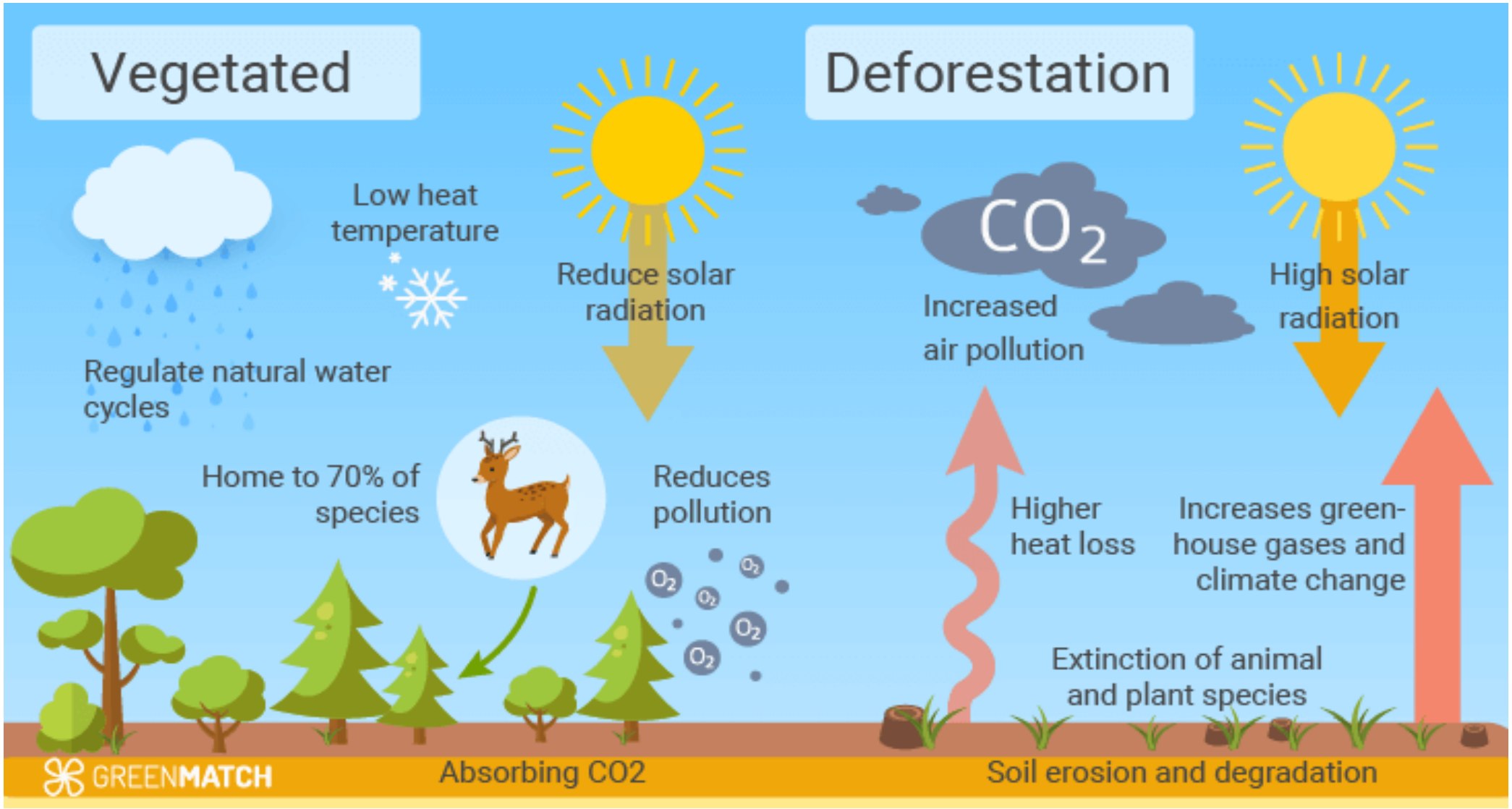
- Urbanization is the concentration of population into cities & towns, mainly due to economic development & modernization
- Deforestation is undeniably detrimental to the environment. It leads to biodiversity loss, exacerbates **climate change**, degrades soil, disrupts water cycles, and increases carbon emissions.

Urbanization & deforestation

- Air quality: eliminates a natural filter for particulate matter, which compromises various chemical that can cause lung & heart diseases.
- Fires from deforestation releases mixture of toxic pollutants that posing a direct threat to human health.
- Disrupt water cycle, leading to changes in rainfall patterns and increased risk of droughts & floods.
- Threatens biodiversity loss with countless species going extinction



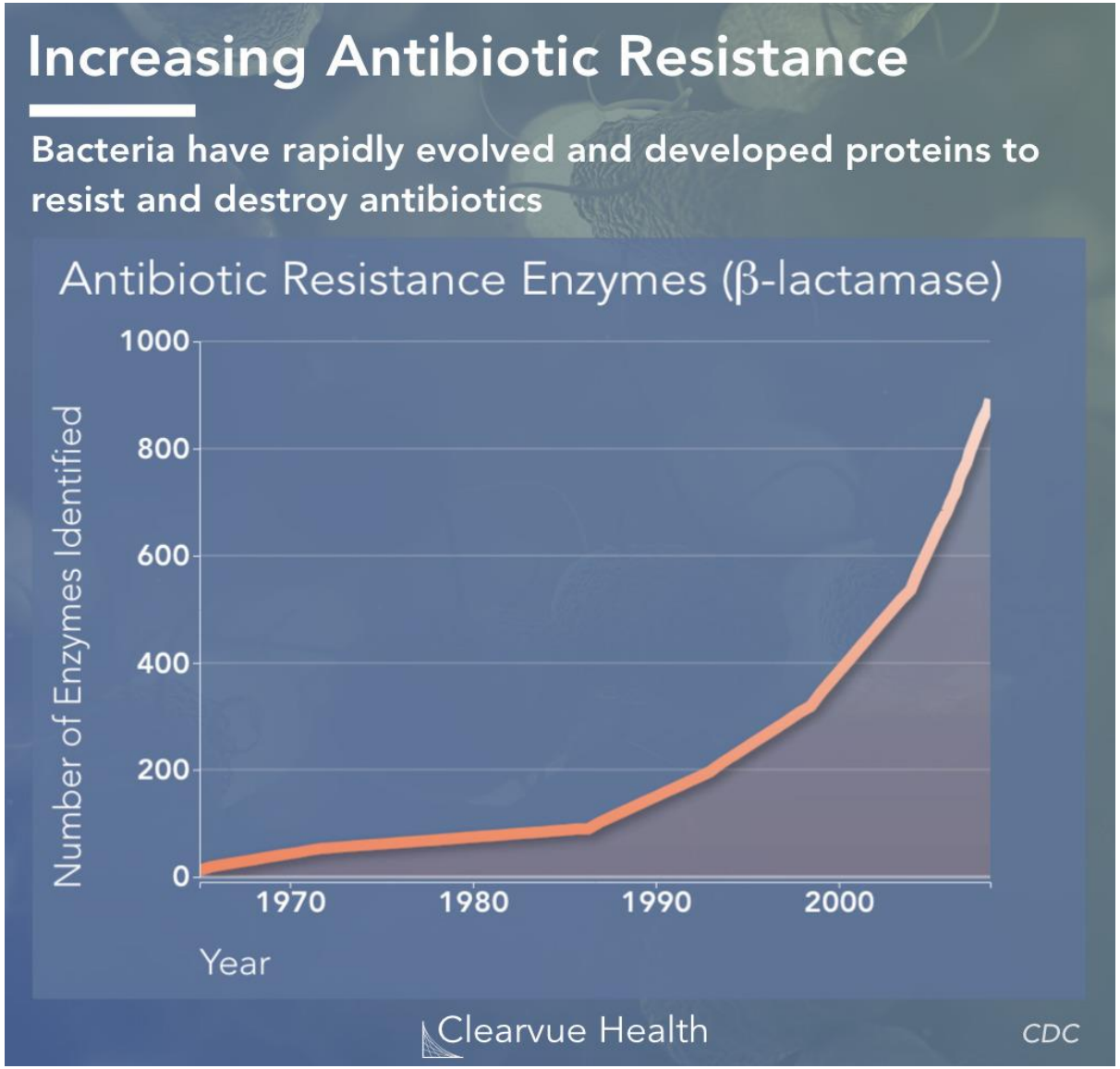
Urbanization & deforestation



Antimicrobial Resistance (AMR)

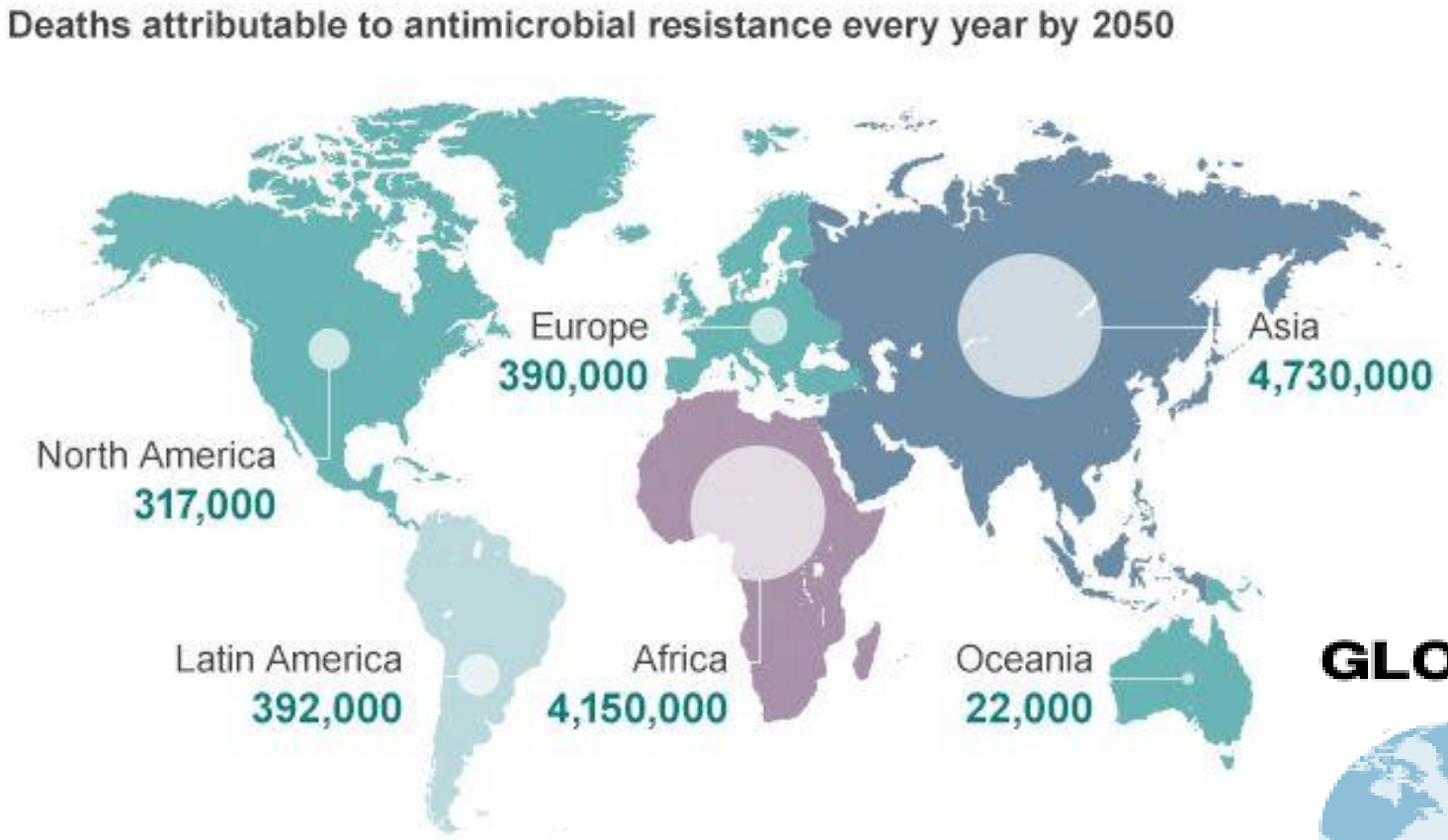
- Top 10 threats to global health (Geneva Environmental Network 2023)
- Misuse & overuse of antibiotics in human health, food-animal production, agricultures
- Pollution & poor waste management also contributes to the escalating problems.

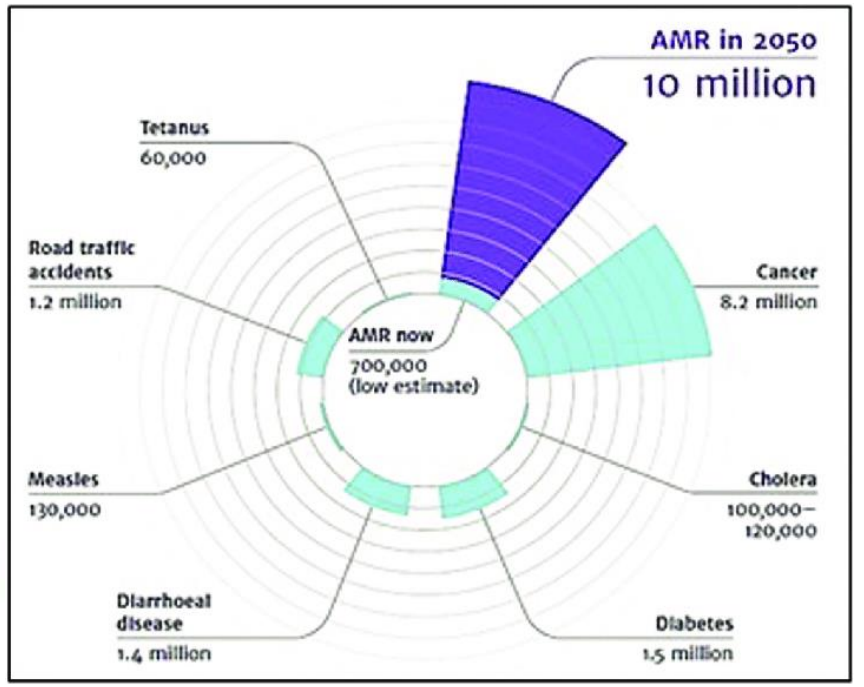
- AMR – defined as when microorganisms such as bacteria, viruses, fungi & parasites change in ways no longer responding to medicine, therefore making infection harder to treat & increasing the risk of disease spread, severe illness & death (WHO, 2020)



- The cumulative number of unique beta-lactamase enzymes identified (CDC 2019)

Epidemiology of AMR





Total deaths projected by 2050 attributable to antimicrobial resistance (AMR) every year compared to other major causes of death. (Thakur, Kumar 2019)

In Asia

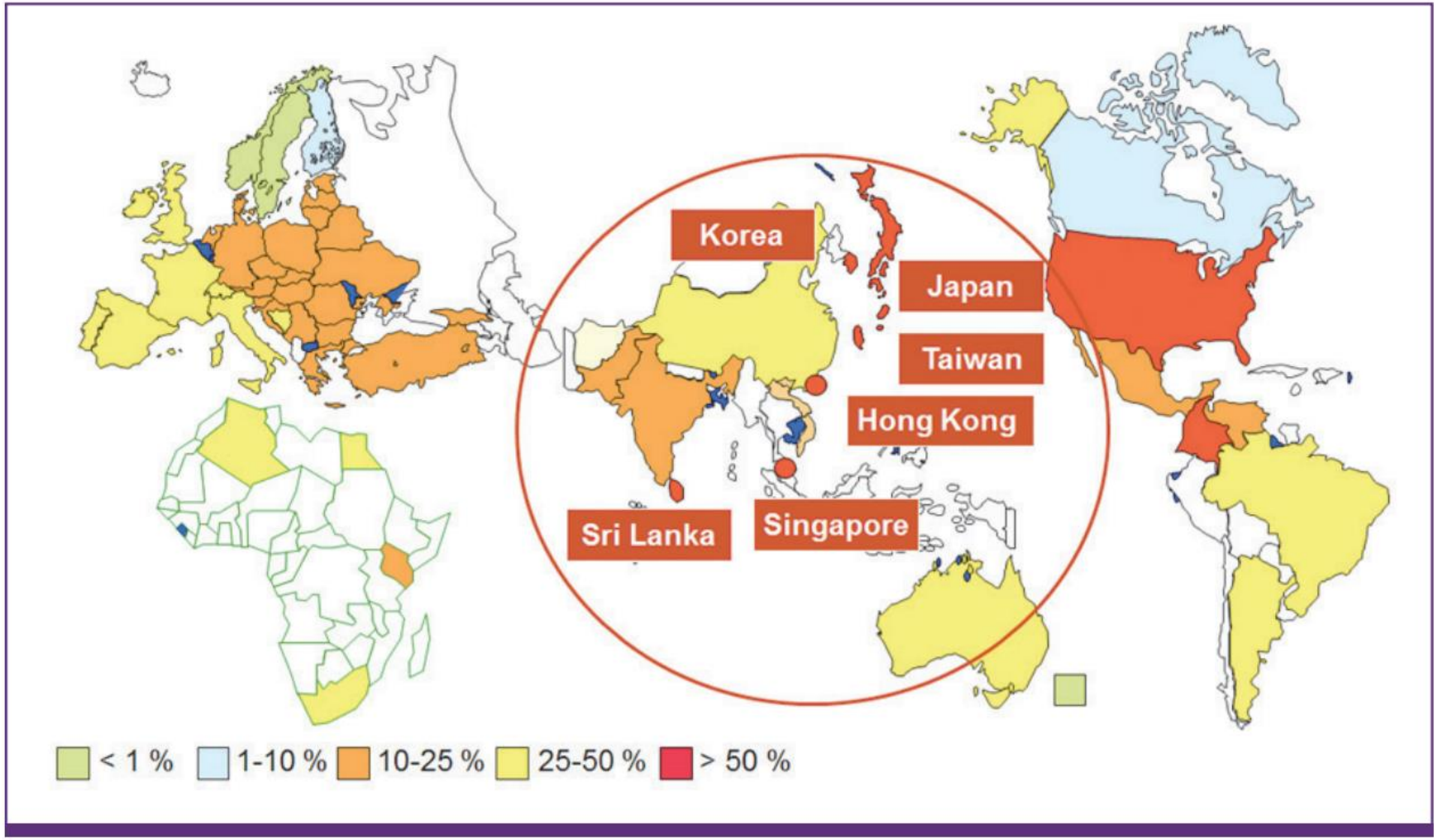


Figure 1. Prevalence of methicillin resistance among *S. aureus* isolates.
Some Asian countries have shown the highest prevalence rates of MRSA.

Kang, C. I., & Song, J. H. (2013). Antimicrobial resistance in Asia: current epidemiology and clinical implications. Infection & chemotherapy, 45(1), 22.

AMR & the environment

- The environment is both a vehicle for spreading AMR microbes and a culprit of antimicrobial pollutants, which negatively impact biodiversity and ecosystems (UNEP, 2022) & it's strictly linked.

- The spread of antimicrobials and the consequent increases in antimicrobial resistance occurs especially through unsound release of residues into the environment (UNEP, 2017)

- Environmental degradation and pollution factors connected to the triple planetary crisis of climate change, biodiversity loss and pollution alter microbial diversity and facilitate the development, transmission and diffusion of AMR (UNEP, 2022)

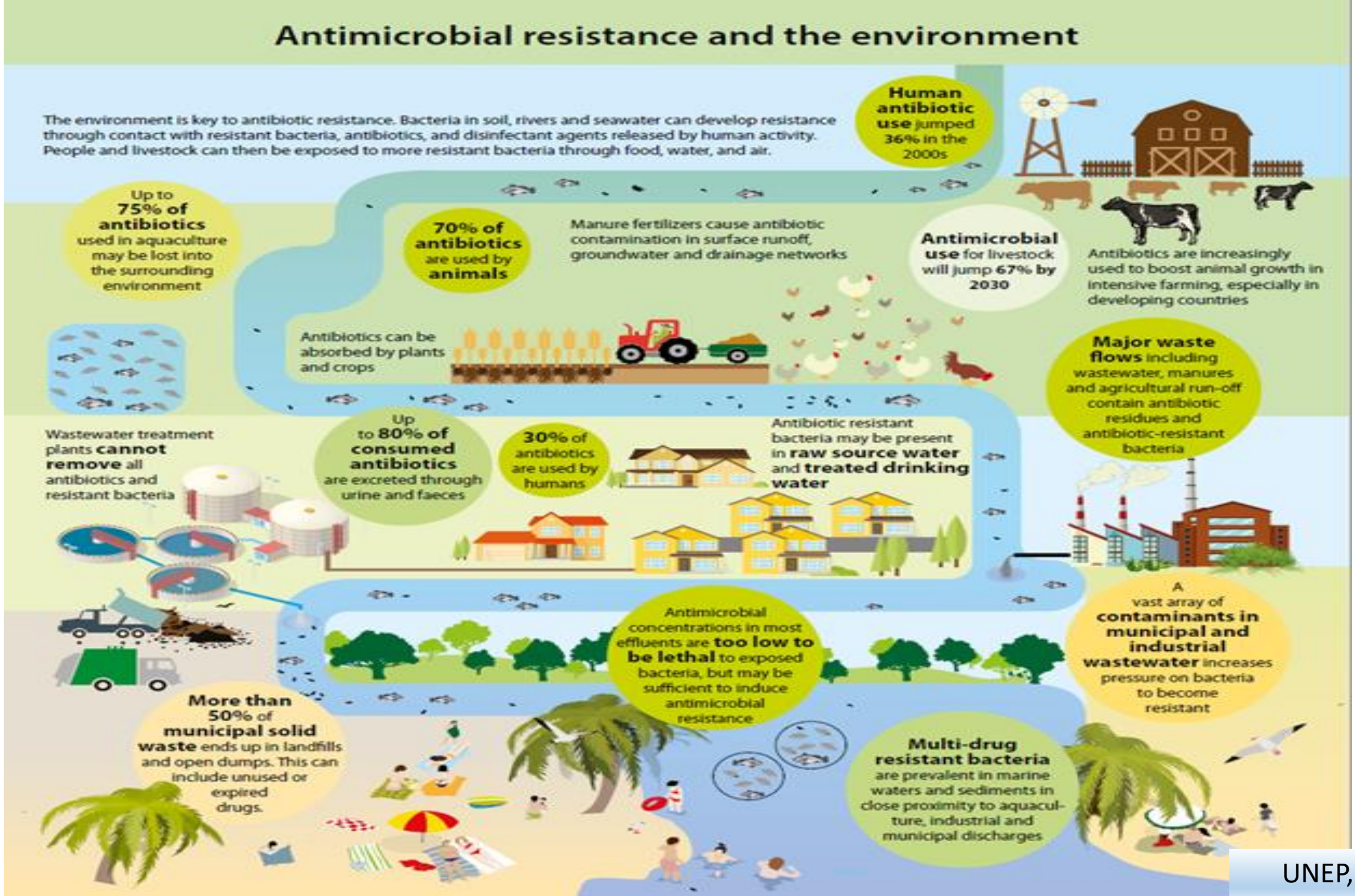
Relationship between AMR & triple planetary crisis

- **Climate change**. High temperatures and concentrations of oxygen and carbon dioxide in the environment can also influence the survival and proliferation of bacteria and the rate at which they acquire resistance.

- **Biodiversity loss**. The use of antimicrobials can lead to the loss of biodiversity, which used to protect us from the spread of antimicrobial resistance.

- **Pollution and waste**. The discharge of pollutants into the environment can contribute to the development and spread of antimicrobial resistance.

Antimicrobial resistance and the environment



UNEP, 2020

Antimicrobial Resistance (AMR) Conclusion

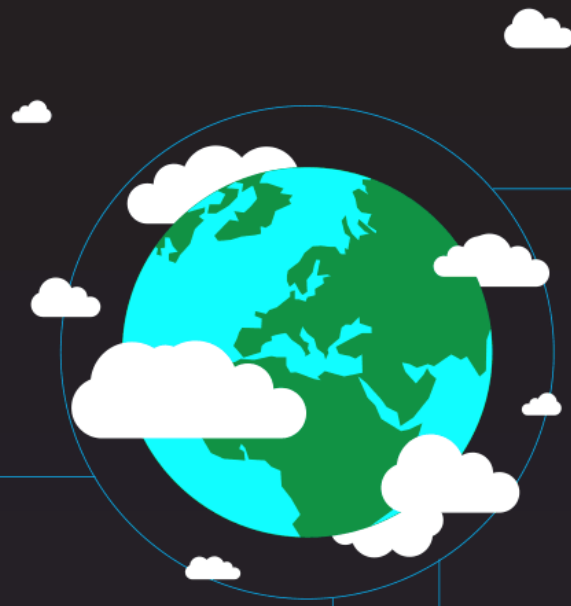
- The impact of antimicrobial pollutants on AMR in the environment is complex & necessitates further evidence
- The pollution waterways, soils and air are certainly contributing to environmental degradation, as well as increasing level of AMR
- ‘One Health’ approach plays an important role in the dynamic between environment & AMR

Air Pollution

- Sources of air pollution: Industrial emissions, vehicle exhaust, burning of fossil fuels.
- Health effects of air pollution: Respiratory problems, heart disease, cancer.
- Mitigation strategies: Reducing emissions, promoting cleaner technologies, improving air quality monitoring.

AIR POLLUTION

The dangers of smog, smoke and particles to human health



In 2012,

7 million people

died as a result of air pollution

Indoor air pollution was linked to 4.3 million deaths in 2012 in households cooking over coal, wood and biomass stoves. There are around 2.9 billion people around the world who live in homes with these kinds of stoves.

Outdoor air pollution was linked to 3.7 million deaths in 2012.

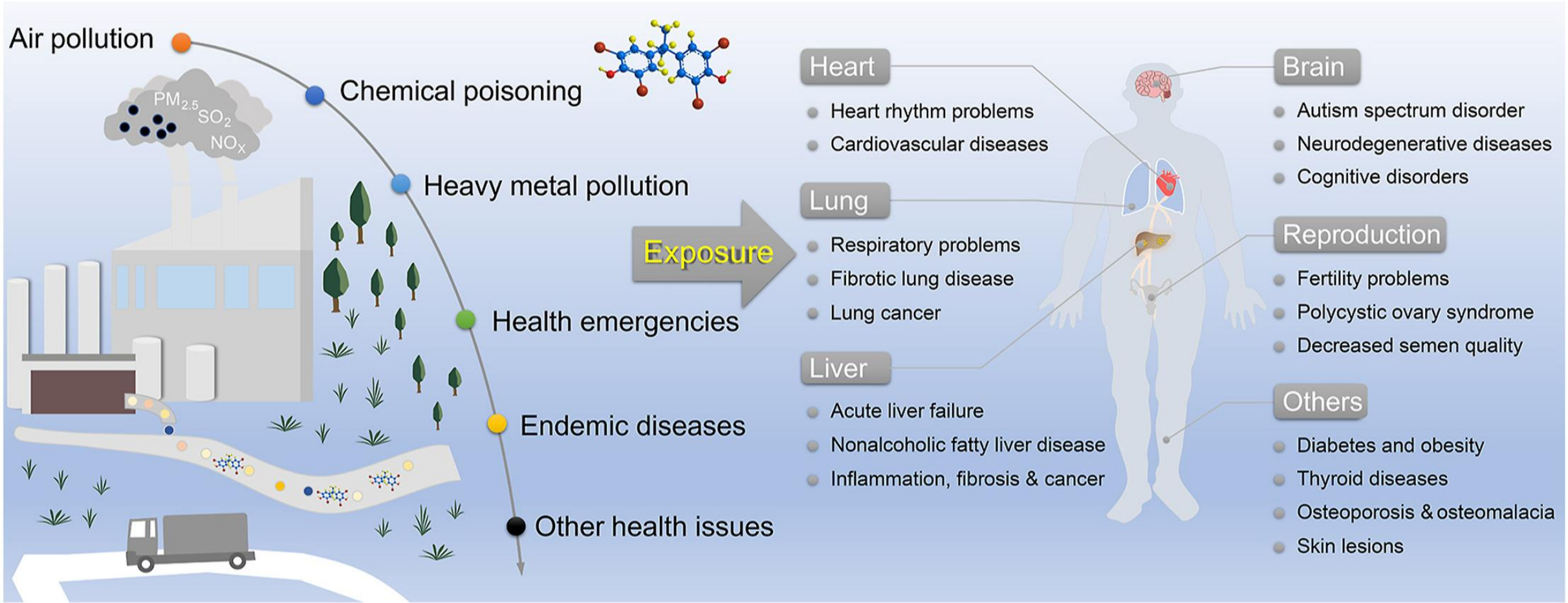
"The health impacts of local air pollution, particularly from road transport, are much larger than previously thought."

OECD

88% of these premature deaths occurred in low- and middle-income countries

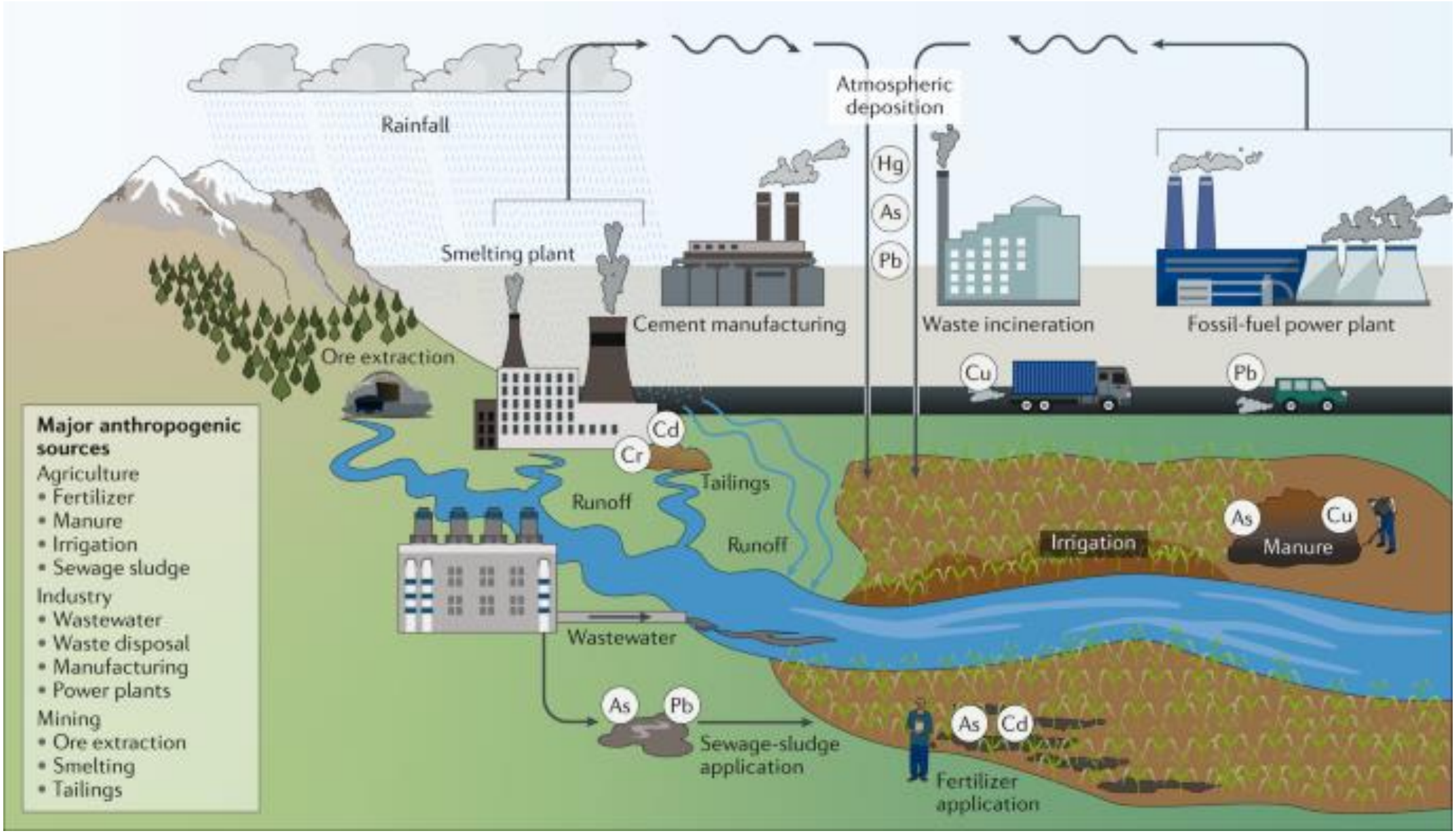
"Air pollution is now the world's largest single environmental health risk."

World Health Organization


Air pollution
$PM_{2.5}$ SO_2 NO_X
Chemical poisoning
Heavy metal pollution
Health emergencies
Endemic diseases
Other health issues
Exposure
Heart
Heart rhythm problems
Cardiovascular diseases
Lung
Respiratory problems
Fibrotic lung disease
Lung cancer
Liver
Acute liver failure
Nonalcoholic fatty liver disease
Inflammation, fibrosis & cancer
Brain
Autism spectrum disorder
Neurodegenerative diseases
Cognitive disorders
Reproduction
Fertility problems
Polycystic ovary syndrome
Decreased semen quality
Others
Diabetes and obesity
Thyroid diseases
Osteoporosis & osteomalacia
Skin lesions

Heavy Metal Contamination

- Sources of heavy metal contamination: Industrial waste, mining, agricultural practices.
- Health risks associated with heavy metal exposure.
- Remediation efforts: Cleanup of contaminated sites, pollution prevention measures.


Rainfall
Atmospheric deposition
Hg
As
Pb
Smelting plant
Cement manufacturing
Waste incineration
Fossil-fuel power plant
Ore extraction
Cu
Pb
Cd
Cr
Tailings
Runoff
Runoff
Irrigation
As
Cu
Manure
Wastewater
As
Pb
Sewage-sludge application
As
Cd
Fertilizer application
Major anthropogenic sources
Agriculture
• Fertilizer
• Manure
• Irrigation
• Sewage sludge
Industry
• Wastewater
• Waste disposal
• Manufacturing
• Power plants
Mining
• Ore extraction
• Smelting
• Tailings

Kim Kim River Toxic Pollution (2019)

- A total of 2.43 tonnes of hazardous waste were dumped.
- Hazardous wastes have identified as benzene, acrolein, acrylonotrile, hydorgen choloride, methane, toulene, xylene, ethylbenzene & d-limonene.

Ref: Ibrahim, M. F., Hod, R., Toha, H. R., Mohammed Nawi, A., Idris, I. B., Mohd Yusoff, H., & Sahani, M. (2021). The impacts of illegal toxic waste dumping on children's health: A review and case study from Pasir Gudang, Malaysia. International journal of environmental research and public health, 18(5), 2221.

Global and Regional Responses

- **WHO Initiatives:**
  - International Health Regulations (IHR).
  - Collaborations with national health organizations.
- **Local Responses:**
  - Case studies of successful interventions.
  - Importance of community engagement.
  - Sustainable practices (recycling, zero plastic, river protection etc.)

Challenges in Addressing Re-emerging Threats

- Barriers:
  - Limited resources in low-income countries.
  - Political and economic instability.
  - Awareness, misinformation and public health communication issues.

Conclusion

- The complexity of issues related to emerging environmental health threats mandates the policy makers, health sector leaders, implementers & committee to improve epidemiological surveillance system for early intervention and prevention of negative outcome.

Thank you