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Innovative science
for a cleaner planet

The Importance of Soil Health for a Sustainable Agrifood Systems Within the Framework of One Health

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Laureate Professor

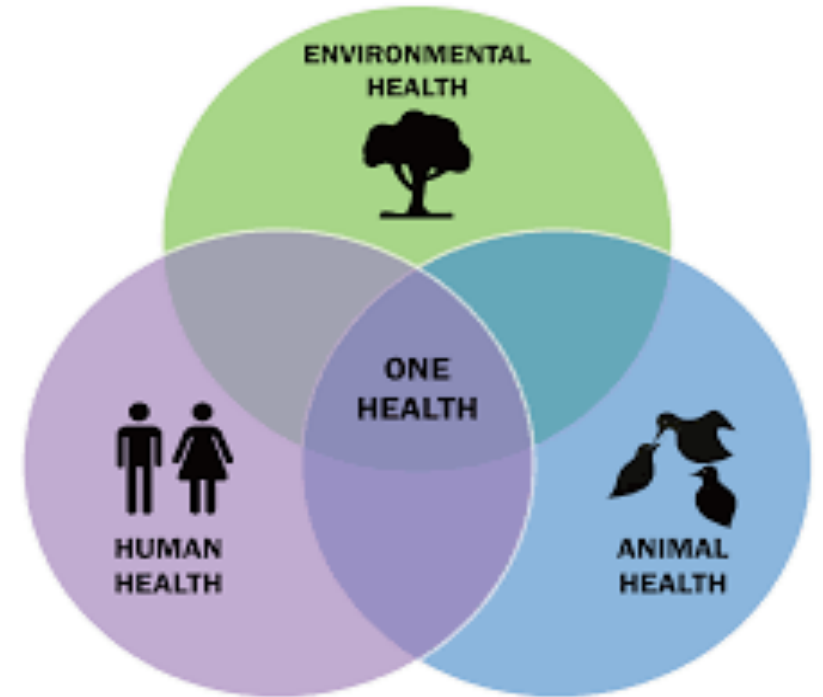
crc for Contamination Assessment and Remediation of the Environment (crcCARE), Global Centre for Environmental Remediation

The University of Newcastle
12 July 2023

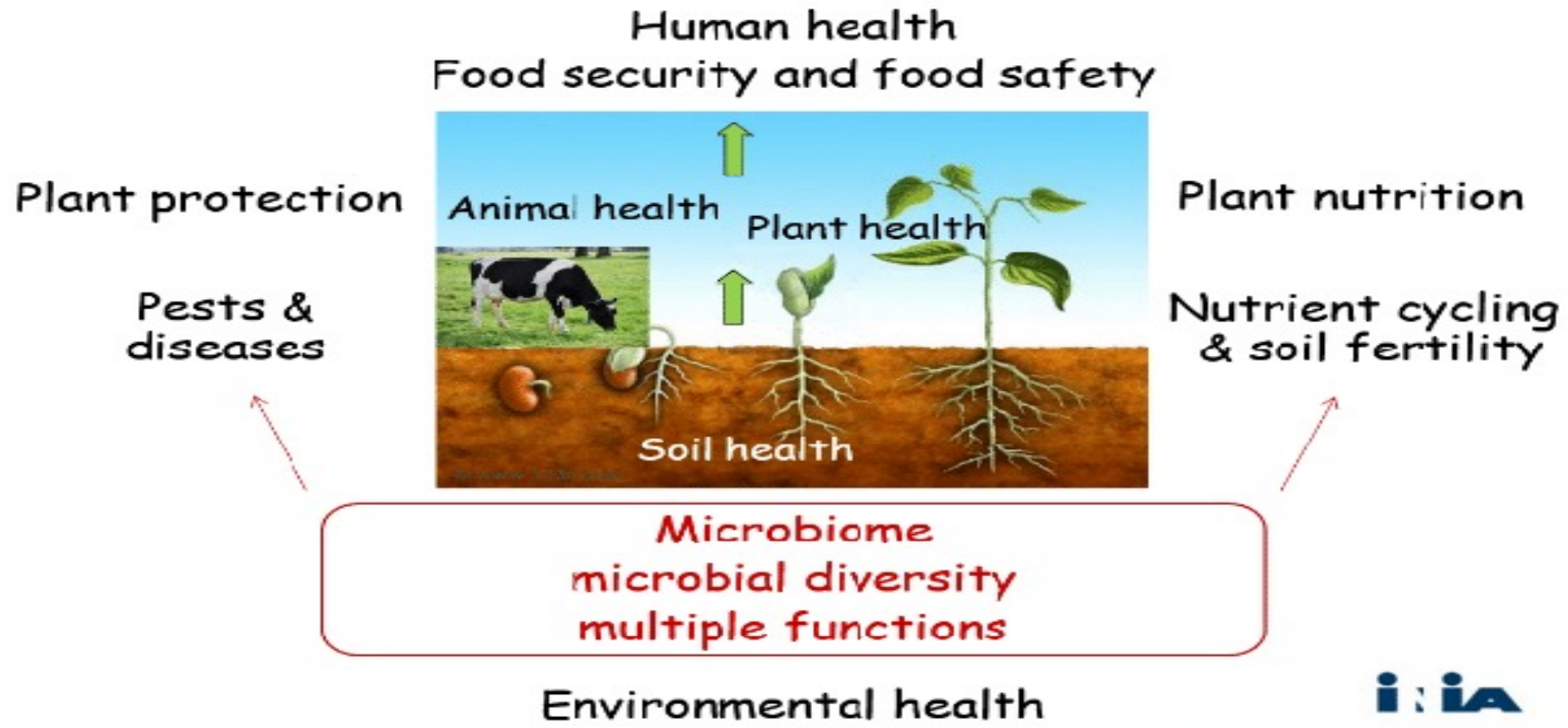
www.crcCARE.com

One Health

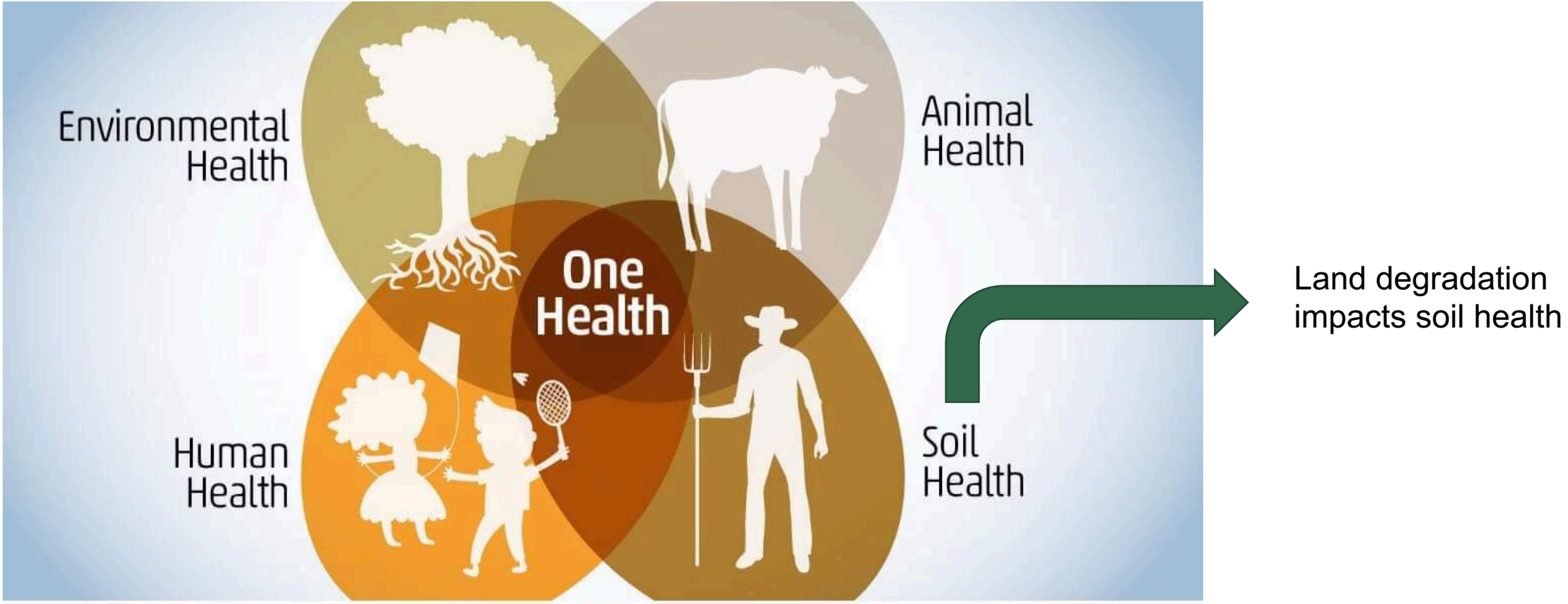
Human health is closely related to animal health and the health of our shared environment.



One health concept



One Health = $f(\text{environment, animal, human}) \cdot (\Delta \text{Soil Health})$



SOILS ARE DYNAMIC AND LIVING

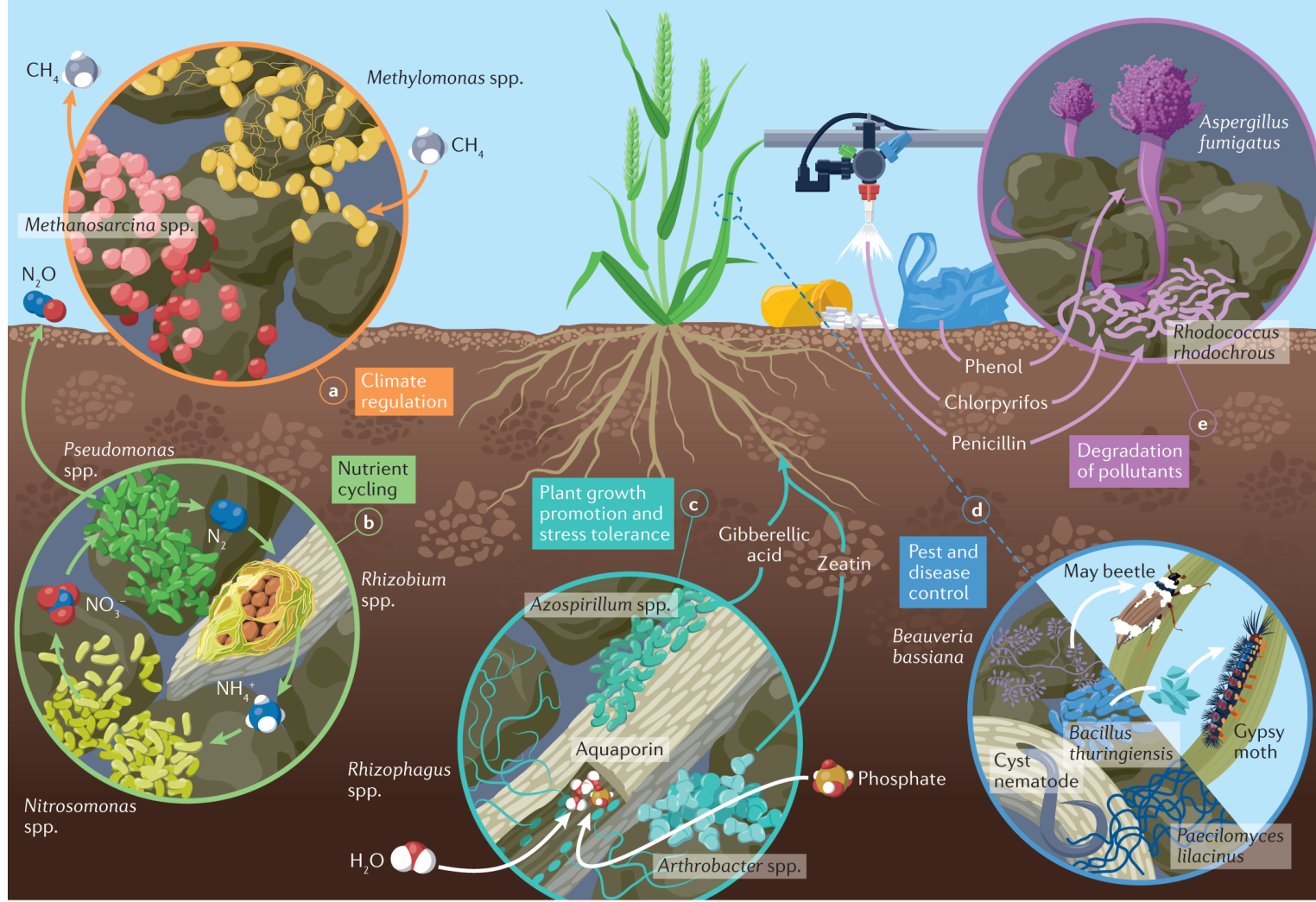
- Soils are home for millions of different organisms
 - Worms, beetles, caterpillars, etc.
 - A teaspoon of soil will contain millions of microbes, protozoa.



“There’s so much more that we need to know to describe the roles of the many different organisms in soils.”

WONDERS OF SOIL-ECOSYSTEM SERVICES

- Soil is the provider of all ecosystem services
 - Biodiversity;
 - Nutrients;
 - Carbon;
 - Food;
 - Water;
 - etc.



Ref: Hartmann and Six, 2023, Nature Rev Earth & Env

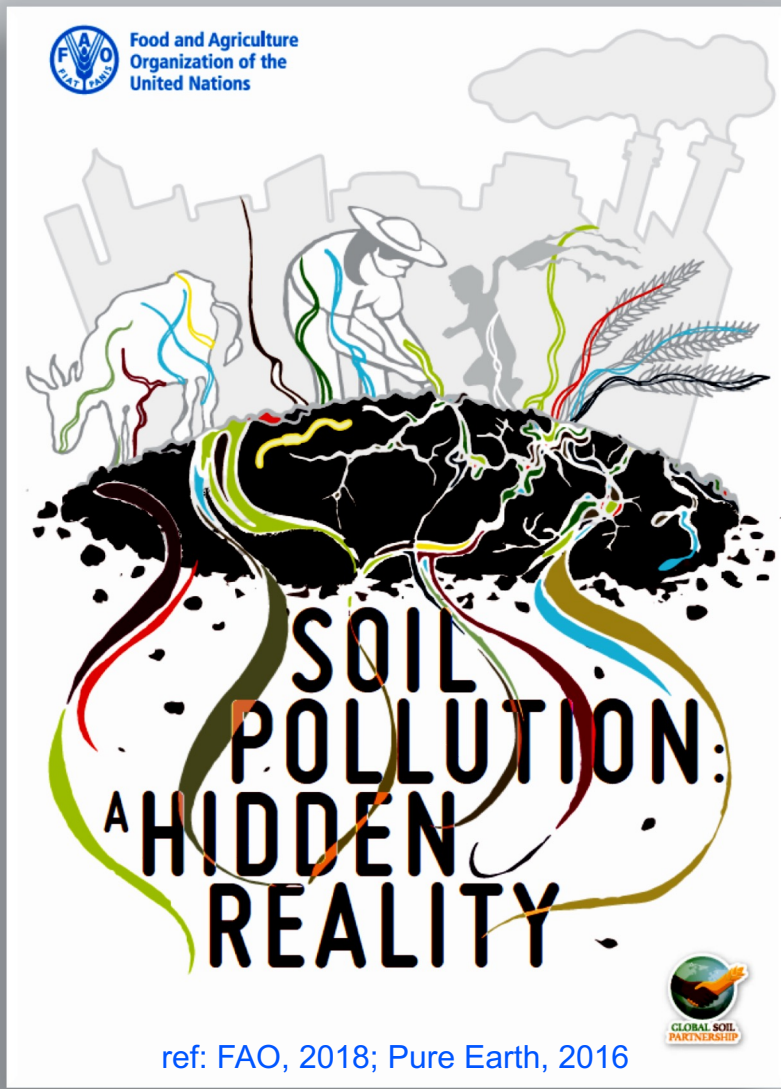
Soil pollution adversely impacts biogeochemical cycling in turn impacts ecosystem services

HUMAN IMPACT ON ENVIRONMENT

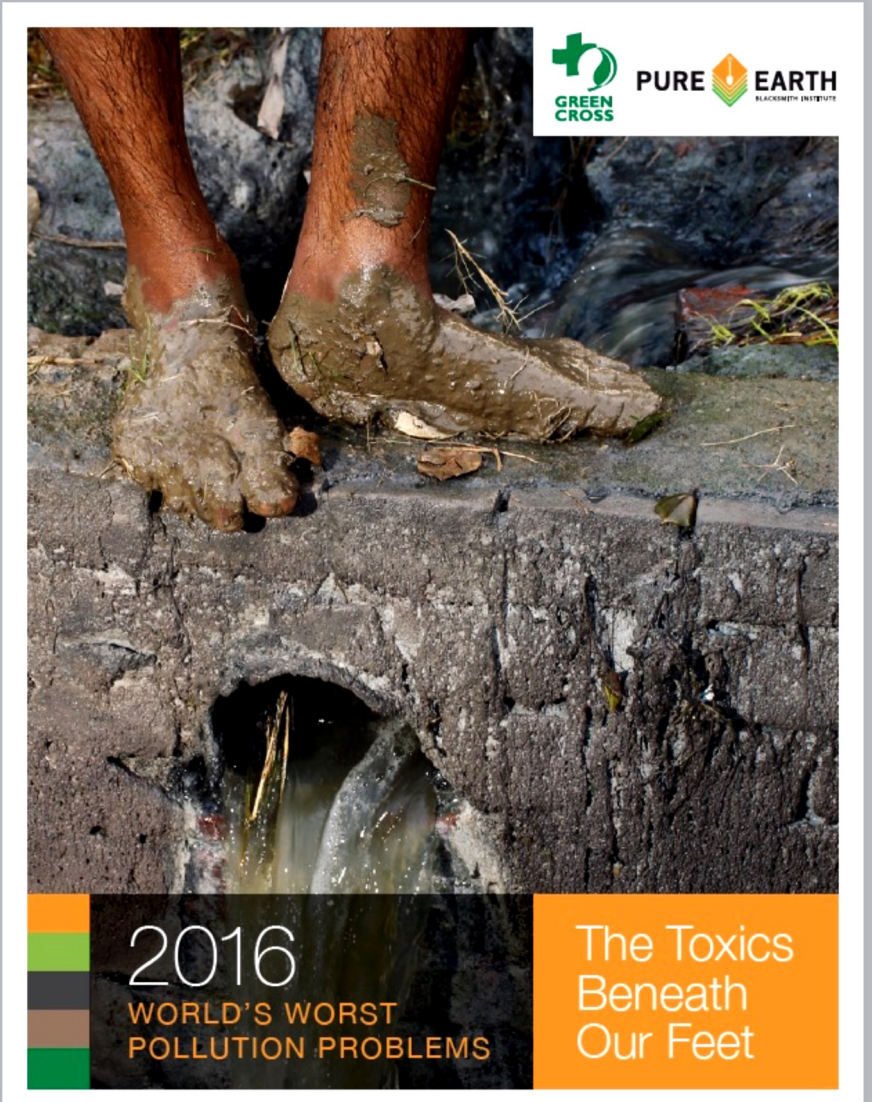


Organic matter in undisturbed soils declines from nearly 160-250 tC/ha to < 10t/ha in heavily disturbed soils

Soil contamination: the unseen



Chemical Pollutants in soil



SOIL CONTAMINATION



Mine drainage site



Bhopal gas disaster site



Polluted site next to farmhouse



Agriculture: Diffuse Pollution



MANY DIFFERENT POLLUTANTS

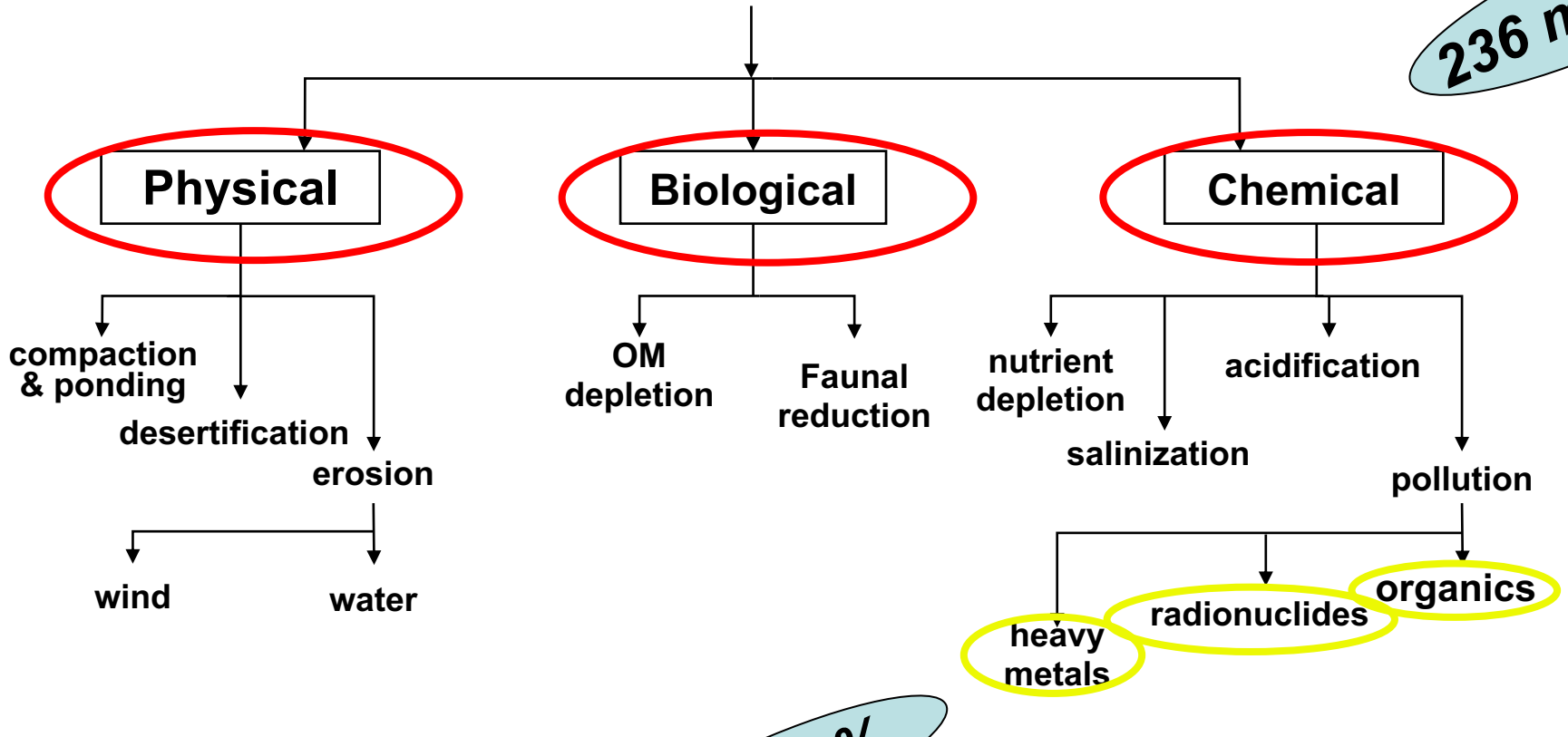
- Nutrients
- Pathogens
- Endocrine Disrupting Chemicals
- Pharmaceuticals & Personal Care Products
- Industrial Chemicals
- Recently emerged contaminants
- Emerging contaminants

Previously unknown or unrecognised contaminants are now classed as “Emerging Contaminants” and these are often not included in the legislation.

Number of new chemicals released annually exceeds 2,500

SOIL DEGRADATION

236 million ha



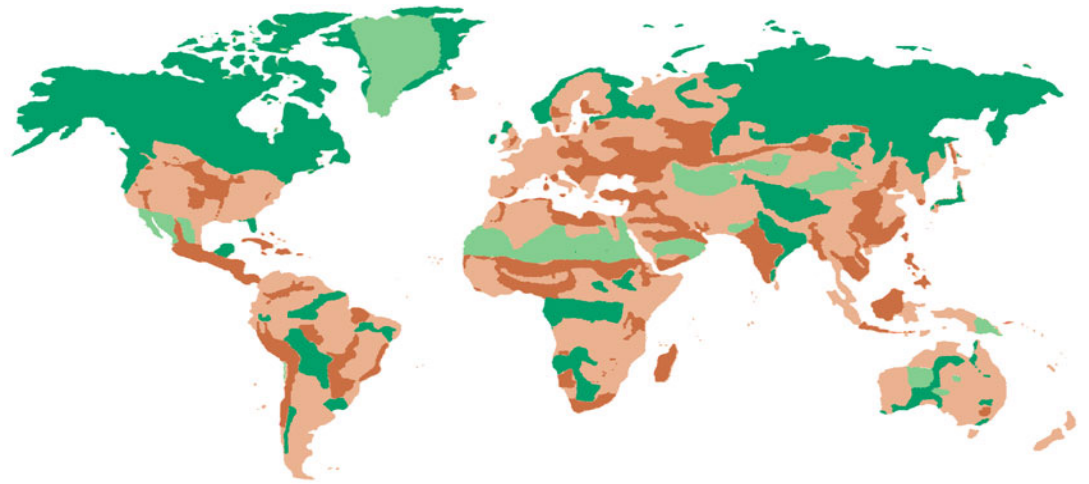
> 40-60%

Diffuse Pollution

The costs associated with soil degradation exceed 50 billion € per year

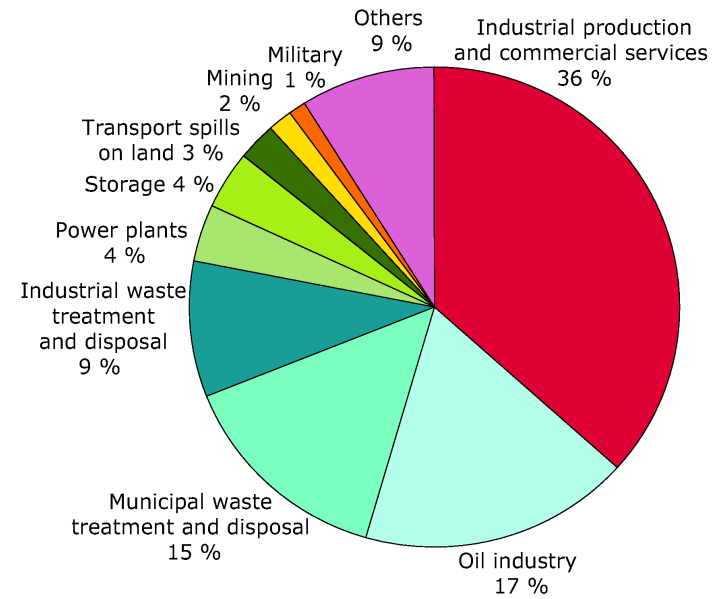
SOIL CONTAMINATIONS

Areas of concern for soil degradation



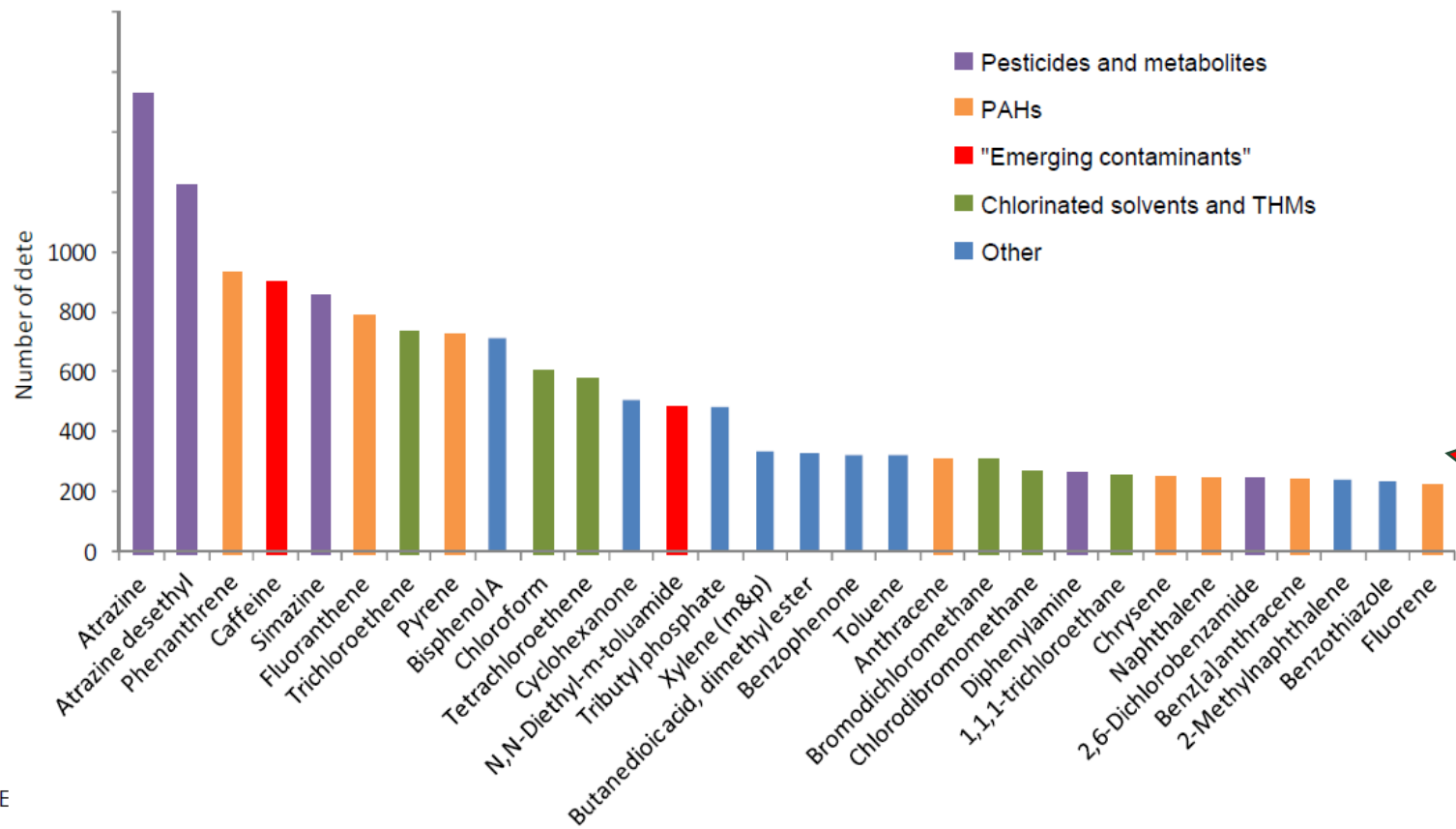
■ Serious concern ■ Stable land
■ Non-vegetated land ■ Some concern

2013
Source: WRI/UNEP



Soil contaminations
Europe Environment Agency

TOP 30 MICRO-ORGANICS IN GROUNDWATER SCREENING DATA 1993-2012 (BGS)



Contaminants are not easily removed by drinking water treatments

RECEPTORS IN THE ENVIRONMENT

Receptors at Risk

- **Human Health:**

General Public; Industrial or Commercial Employees; Residents, Site Trespassers; Site Workers

- **Environmental:**

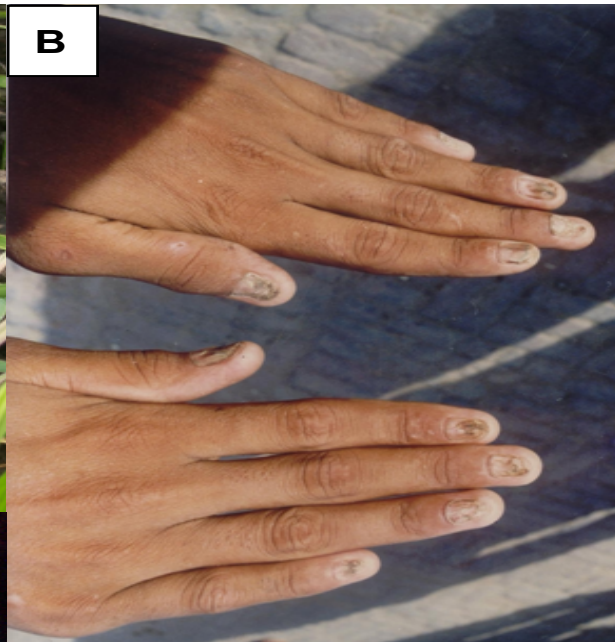
Wildlife, Terrestrial, Aquatic and Benthic Organisms
Habitats of Threatened or Endangered Species



The Impact of Pollutants- One Health

Dhillon (2023)

Environment



Human

Animal

Birds

- Evidence of the presence of low levels of pharmaceuticals in water and growth hormones in meat
- Pharmaceuticals including recreational drugs are designed to be biologically active at low levels.
- Use of pharmaceuticals is anticipated to increase as the population gets older
- Use of clandestine drugs also expected to increase.
- Demonstrated evidence of risks to humans and the environment are uncertain .



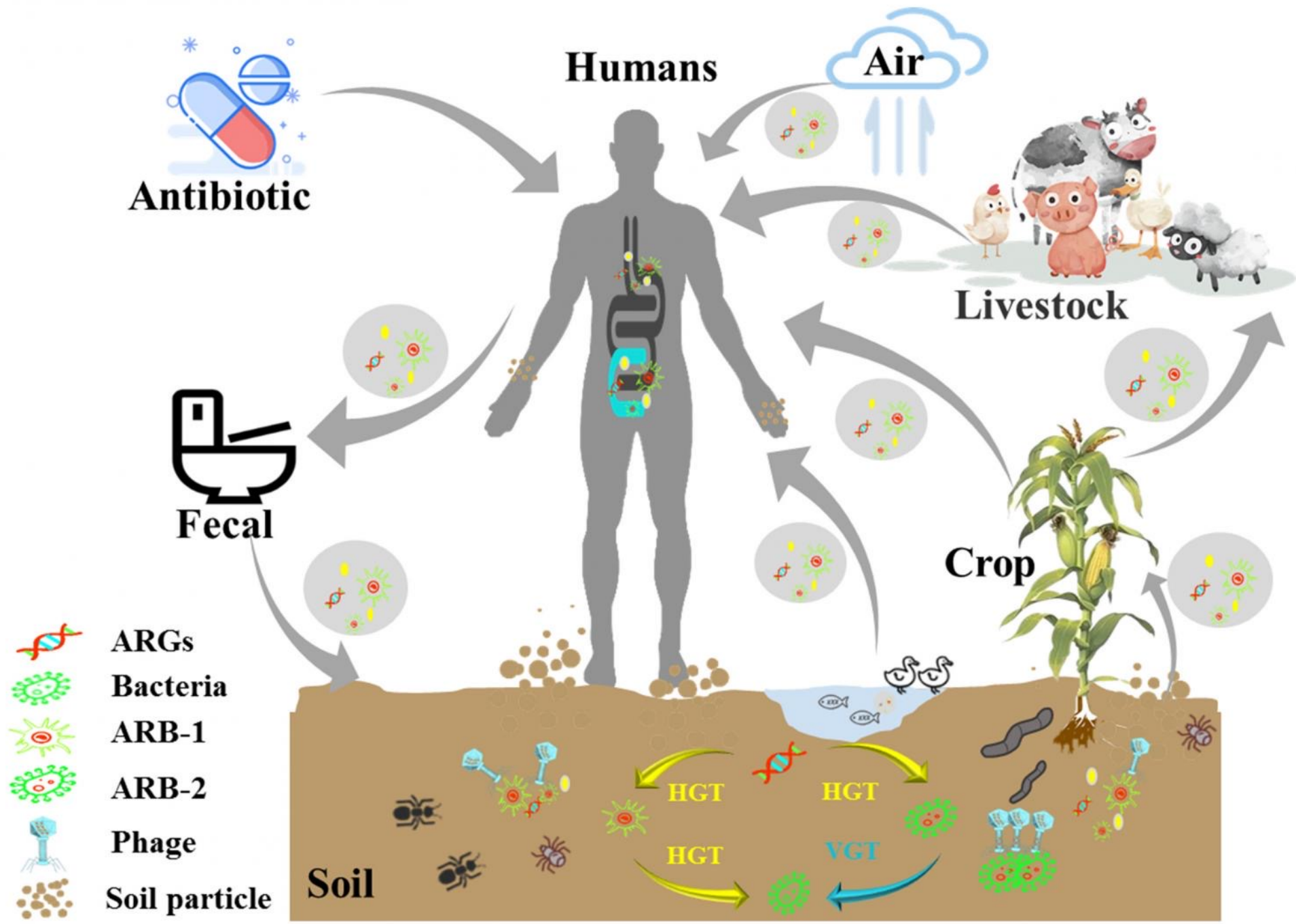
MANY DISASTERS: FEW SOLUTIONS



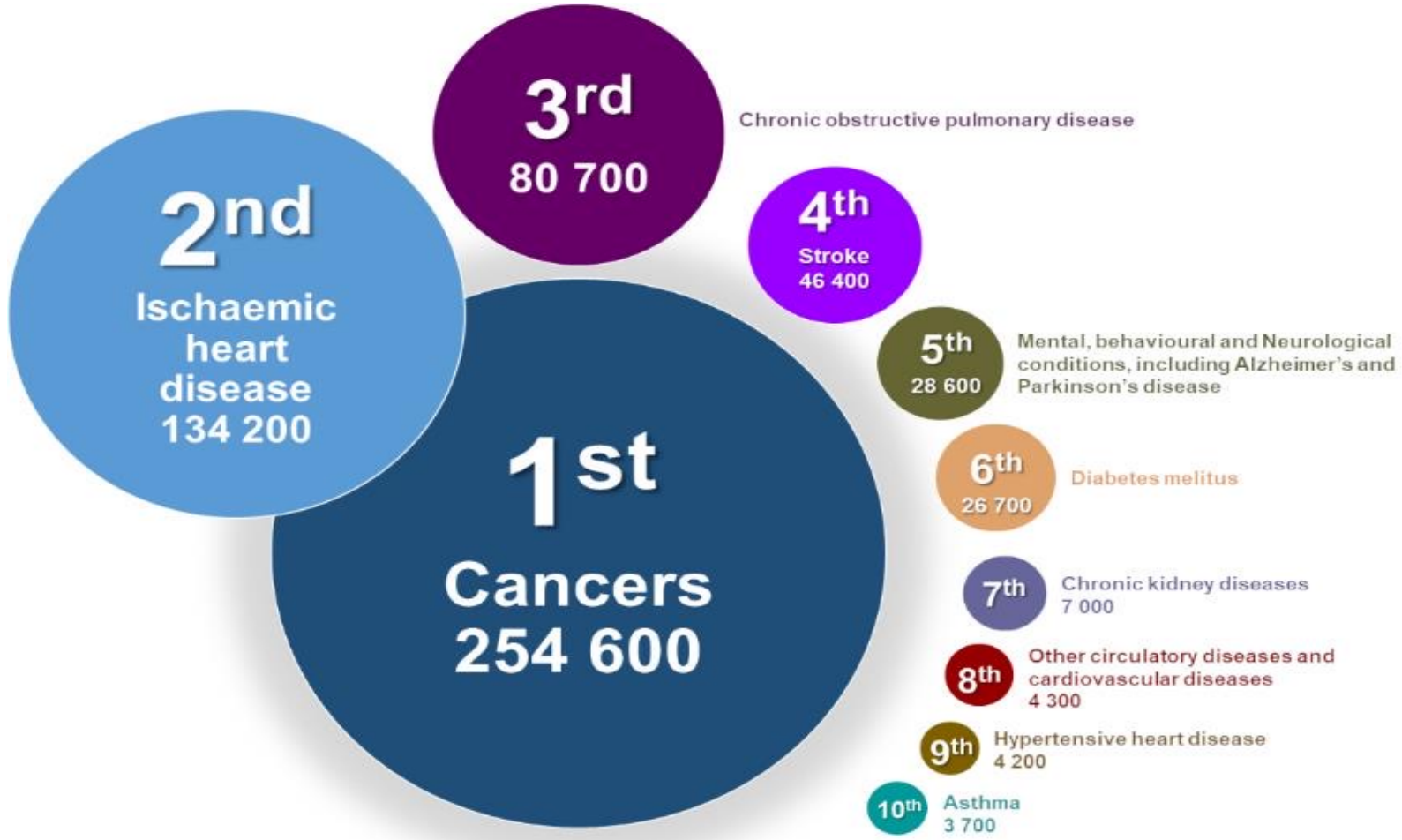
Arsenic

Antimicrobial resistance in soil?

- *One health that matters!*
- *Risk posed as Soil-water-air connected.*



Top 10 non-communicable diseases causing deaths attributable to the environment (Source: EEA – Healthy environment, healthy lives, 2018 based on WHO (2016))



ECOLOGICAL IMPACTS

Masculinization of Gambusia & Environmental Androgen Exposure

Eastern mosquitofish, *Gambusia holbrooki*

<p>anal fin</p>	<p>elongation anal fin total anal fin</p>	<p>gonopodium anal fin total anal fin</p>

EXPOSURE TO EDC- IMPACT ON ECOSYSTEM HEALTH



Catfish with deformities (above)
and tumors (right)



Program Review, Feb. 25 – 28, 2002

Ensuring Clean Soil Ensures Productive Soil and sustainable One Health

Human Health



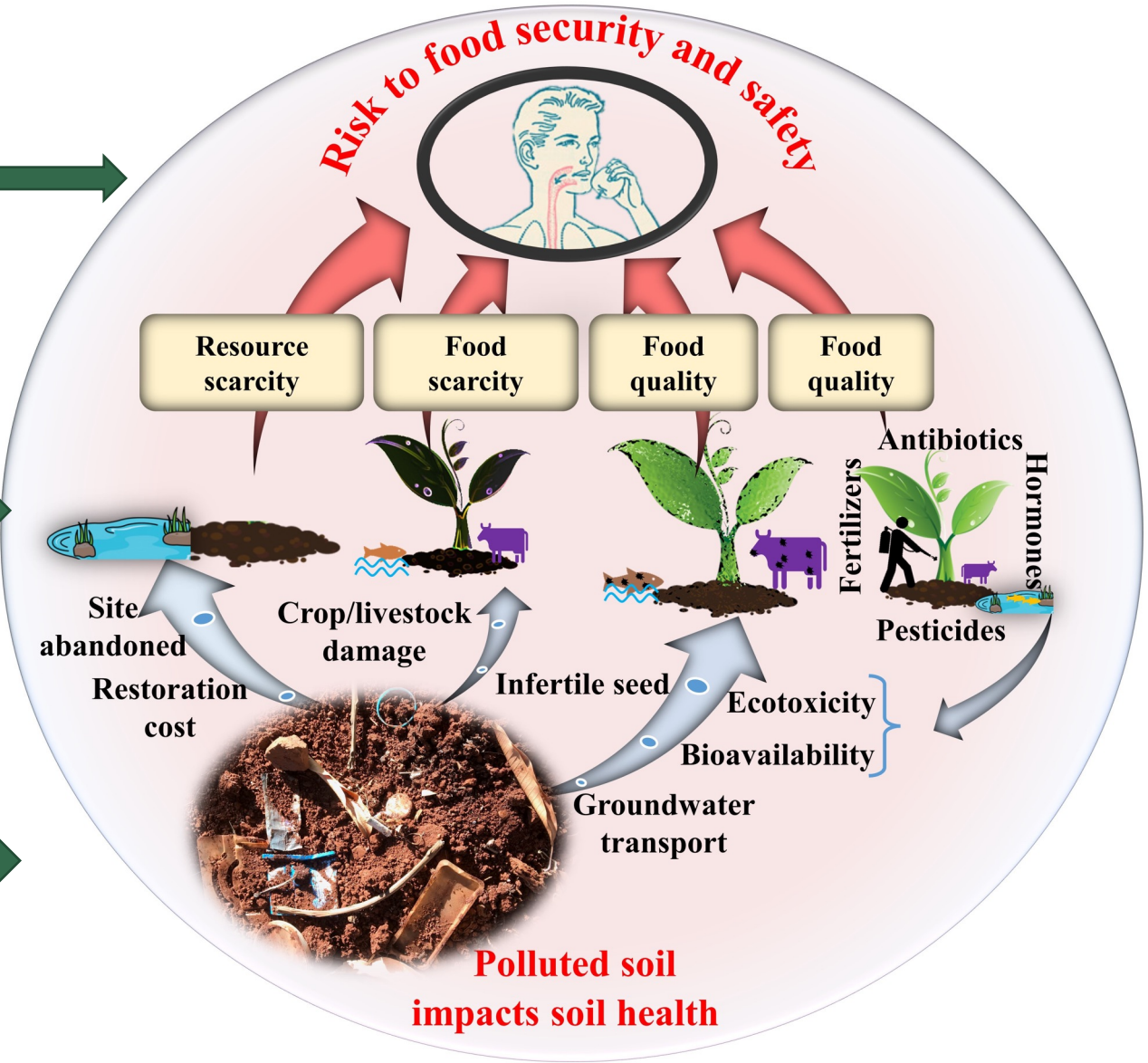
Animal Health



Environment
Health



Soil Health

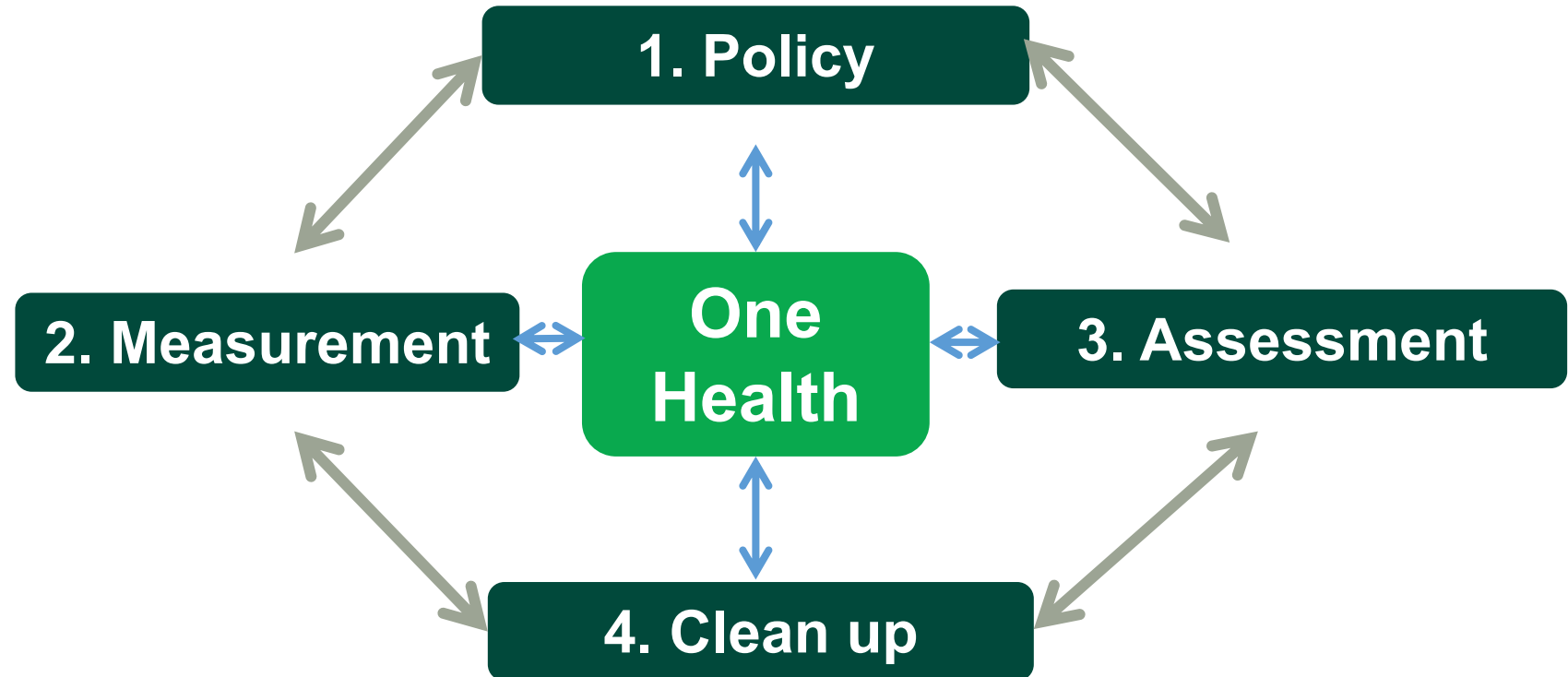


IMPACTS: REGIONAL TO GLOBAL



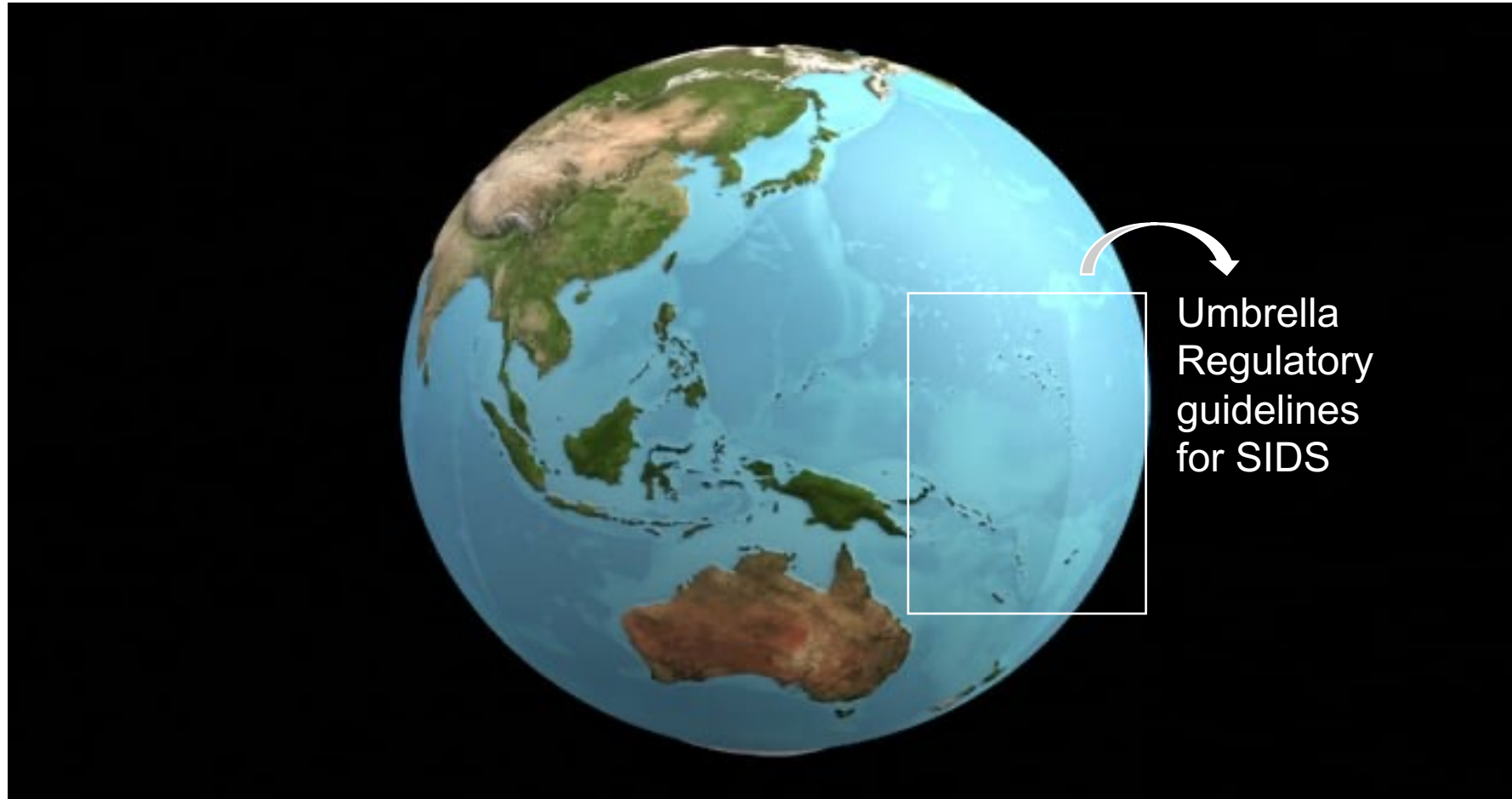
One Health Sustainability: What is needed?

- Regulation
- Technology
- Finance
- Capacity
- Stakeholder support.



Need for a collaborative, multi-sectoral, and transdisciplinary approach working at the local, regional, national, and global levels

Regulatory Policies



CLEAN-UP CHALLENGE: NAVIGATING REGIONS TO GLOBAL?

Most developing countries in the region are still struggling to cope with soil pollution.

Major gaps has been identified:

- (a) From agrisystem perspectives diffuse pollution of farmed soils;
- (b) Register of potentially contaminated sites;
- (c) Human capacity to deal with contaminants;
- (d) Lack of awareness;
- (e) Soil pollution exclusive guidelines;
- (f) Soil Health Indicators- smart phone system.

**Regional is
big factor!**

ACHIEVING ONE HEALTH- WHO IS RESPONSIBLE?

- Collectively we are responsible?
- What's needed?
 - Global connections and collaborations
 - working at the local, regional, national, and global levels
 - Knowledge transfer between countries
 - Resources- for SIDS and other developing countries enabling INSOP and FAO deliver policy framework and capacity to deliver one health
 - For example- policy guidance framework for SIDS, Africa and South America-
 - Resources for research on one health linked to pollution and soil health

What won't work?

- Short-term consultancy

CONCLUDING REMARKS

- Optimum delivery of One health requires optimum soil health
- Soil pollution plays a significant and key negative factor impacting soil health and as a consequence every component on 'One Health'
- Confronted with more than **10 million** potentially contaminated **sites**;
- **Pollutant in soil is** linked to water and air
- The **heath burden is higher** than any other causalities
- **Regulation could play** central **role** managing;
- **Global initiative** is needed to tackle pollution at local, regional levels.
- **Need for an accord** like Paris Climate Change- for Soil pollutants

Leonardo Da Vinci, 1452-1519

The fertile earth, following the law of growth, will eventually lose the water hidden in her breast, and this water, passing through the cold and rarified air, will be forced to end in the element of fire. Then the surface of the earth will be burned, and that will be the end of all terrestrial nature.



Thank you

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