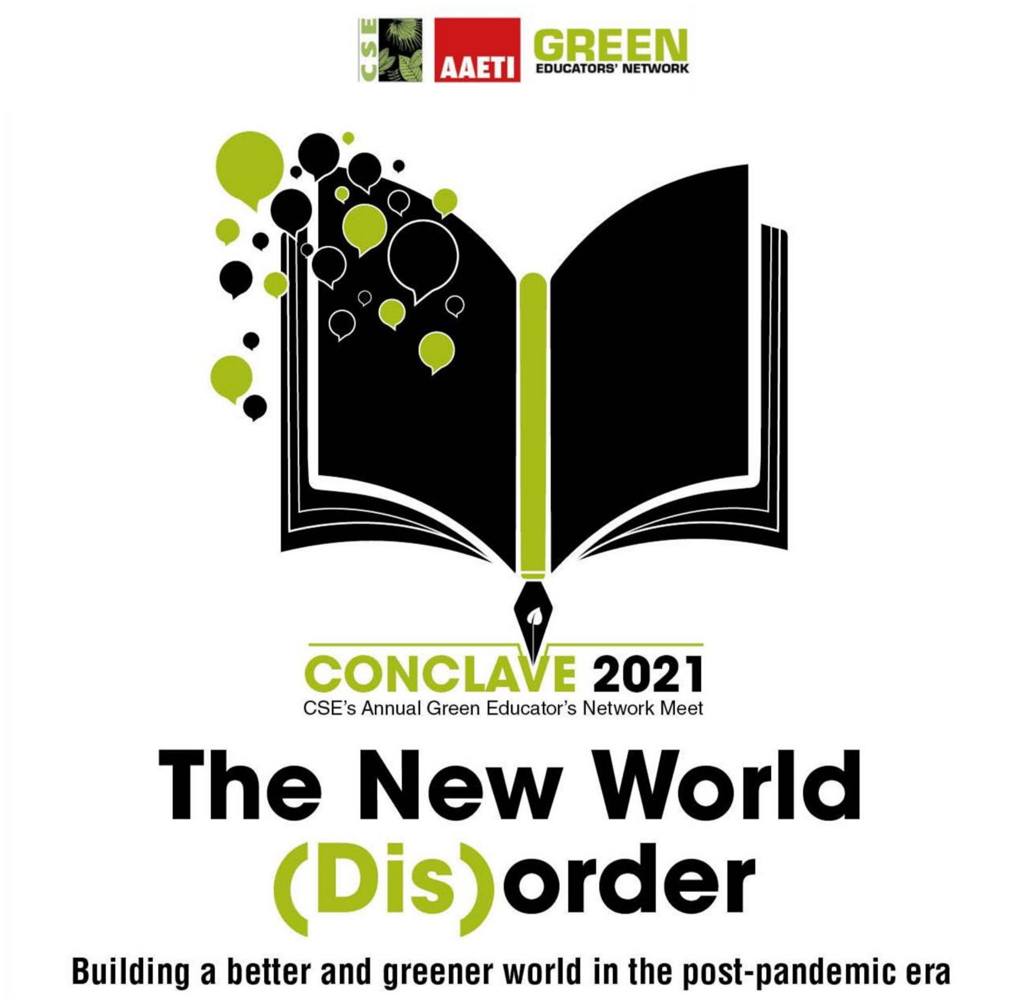
Zoonoses-Intensive food systems-AMR



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1. **Brief overview of Zoonoses**
2. Intensification of Food Systems and Zoonoses
3. Antimicrobial Resistance (AMR) and linkages with intensification and Zoonoses

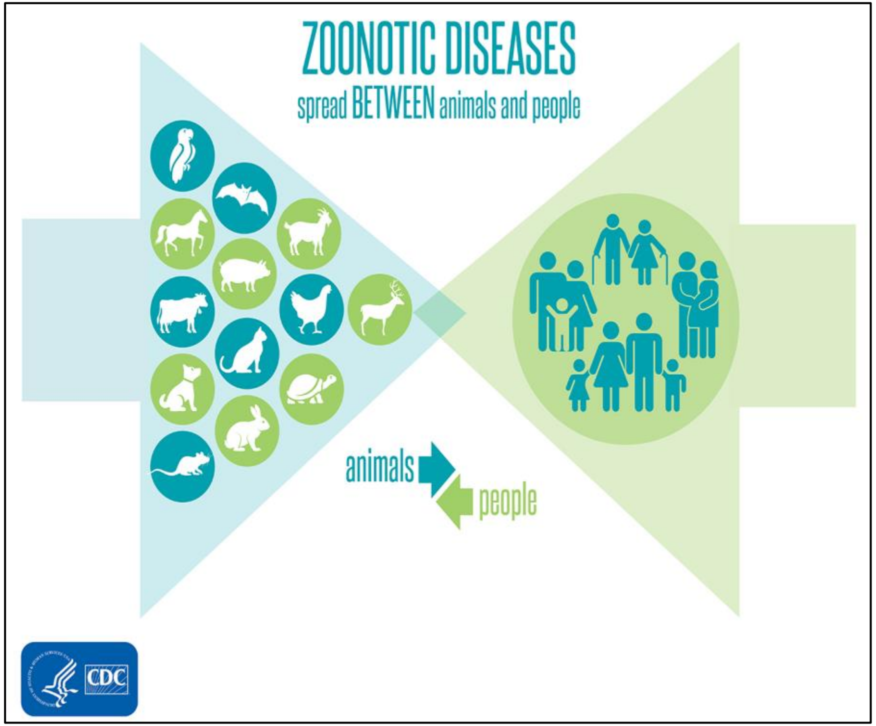
Zoonoses

- Zoonotic diseases (also known as zoonoses) are caused by germs that **spread between animals and people** (CDC)

- A zoonosis is an **infectious disease** that has **jumped** from a non-human animal to humans (WHO)

- A disease that is **transmissible** from a **vertebrate animals to humans and vice-versa** is classified as zoonosis (Codex)

- Zoonoses are diseases that can spread between animals and people, **moving from wild and domesticated animals to humans and from humans to animals** (UNEP-ILRI report, 2020)



Note: Zoonoses are plural of zoonosis

Classification (one of the ways)

Emerging zoonotic diseases

- **Appear newly** in human populations or have existed previously but are **now rapidly increasing** in incidence or geographical range
- Hugely problematic with **some becoming epidemic and others pandemic**
- E.g., Ebola, Zika, HIV/AIDS and COVID-19

Epidemic zoonotic diseases

- Also known as **outbreak zoonoses**
- Typically occur **intermittently**. Have high temporal and spatial variability
- Often triggered by events like **climate variability, flooding and other extreme weathe**r**, and famines**
- Overall health burden much less than neglected zoonoses, but can cause '**shocks**' to food production and other systems
- E.g., leishmaniasis and Rift Valley fever

Neglected zoonotic diseases

- Also known as **endemic** zoonotic diseases
- Mostly domestic in origin, and continuously present to a greater or lesser degree in certain populations
- Common diseases which affect mostly **poor populations**
- Commonly neglected by **national governments and others**
- **Poor detection and surveillance** diminish their recognition
- Most are spread by **domestic animals**
- E.g., bovine TB, brucellosis, rabies, cysticercosis (pig tapeworm), echinococcosis (hydatid disease), Japanese encephalitis, leptospirosis, Q fever, Lassa fever virus and trypanosomiasis (sleeping sickness) + some food borne zoonoses

Source: Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission, 2020, UNEP-ILRI

Transmission

Direct infection

- Animals to human via contact, aerosols, body fluids (e.g., rabies)

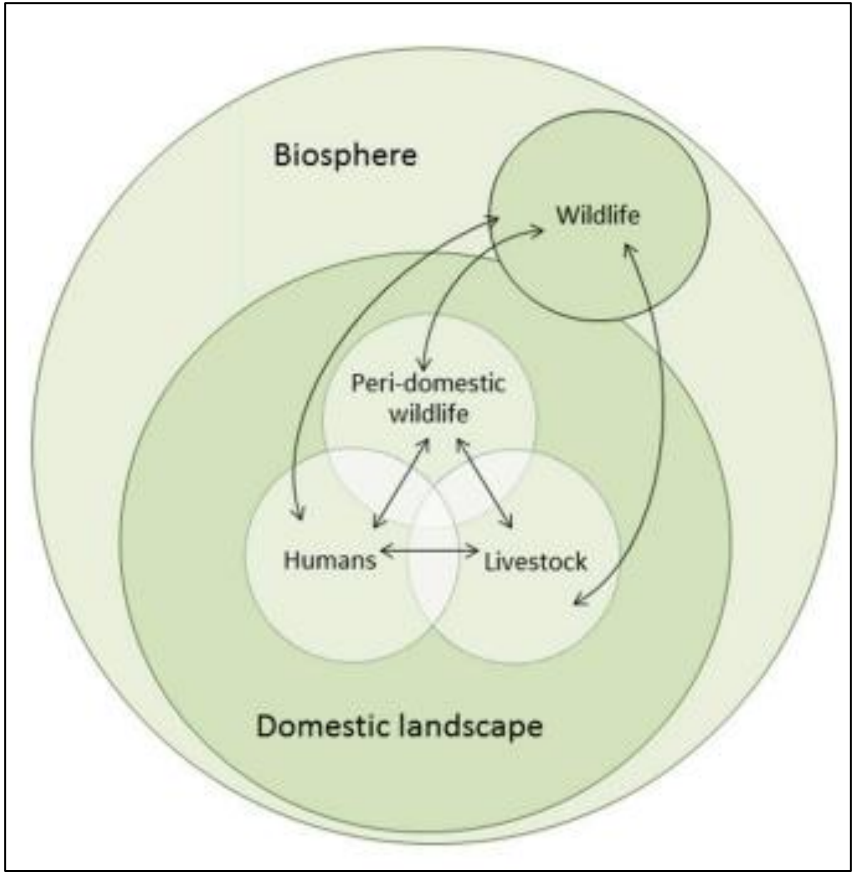
Indirect infection

E.g.,

- Through vectors (e.g., yellow fever, rift valley fever)
- Food-borne (e.g., salmonellosis)

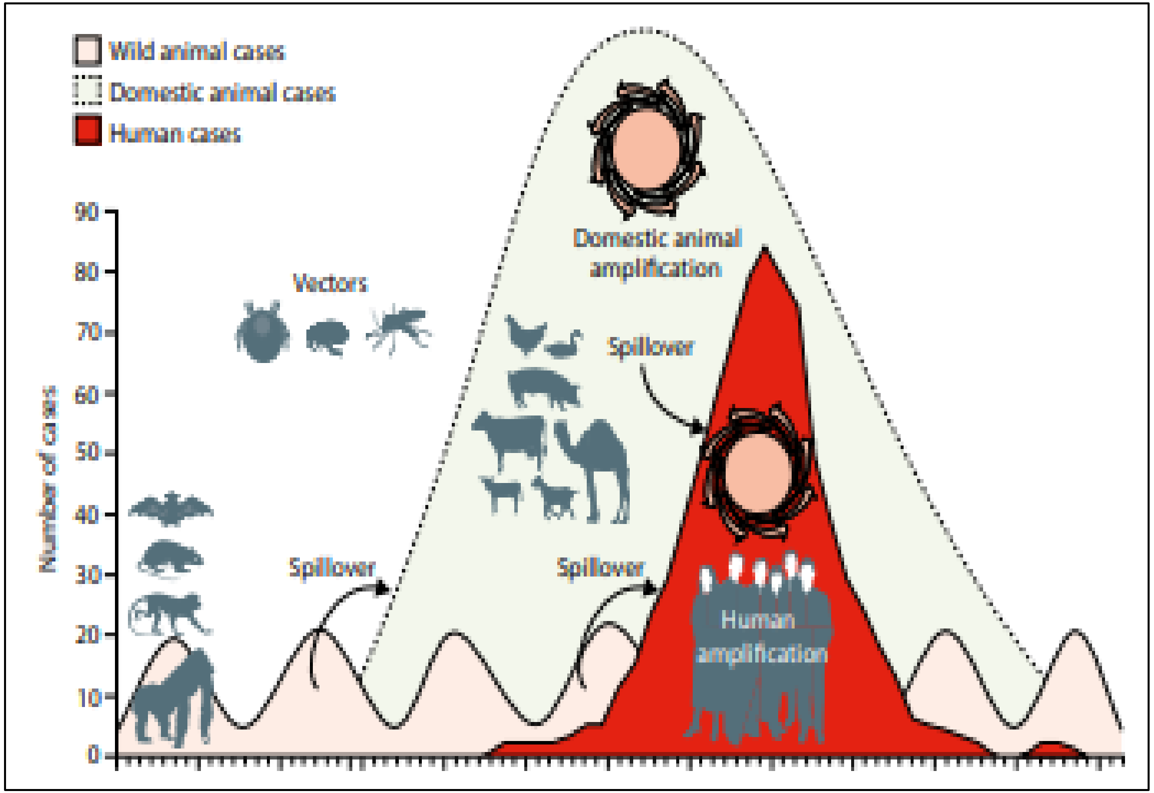
- Around 80 per cent of pathogens infecting animals are "**multi-host**," meaning they move among different animal hosts, including humans. **Domestic animals and peri-domestic wildlife can act as bridges** for the emergence of human diseases
- Vast majority of animals involved in zoonosis (historic or current) are domestic (**livestock**, domesticated wildlife and pets) as contact rates are high.
- Domesticated animal species share an average of **19 zoonotic viruses** (range of 5-31) with people, wild animal species share an average of **0.23** (range of 0-16)
- Some viruses generated in **bio-insecure industrial and intensive agricultural systems** result in zoonotic forms of the virus. An example is the **highly pathogenic avian influenza** (HPAI), an important economic disease of domestic poultry that **evolves from low-pathogenic viruses** that circulate commensally in the environment in wild bird populations

Pathogen flow at the wildlife–livestock–human interface



Source: [Jones et al., 2013, PNAS, 110: 8399-8404]

Spillover of zoonotic diseases and amplification in people; high domestic animal cases



Source: Karesh et al. (2012) [Lancet, 380: 1936–45]

Impact – includes loss of lives, economic and social

- About **200** zoonotic diseases
- **>60 per cent** of the infectious diseases in humans are zoonotic
- **> 75 per cent** of emerging infectious diseases are zoonotic
- About **2.6 billion** people suffer and almost **3 million** people die from zoonotic diseases annually
- High disease burden due to **food-borne illnesses** (e.g., salmonellosis)

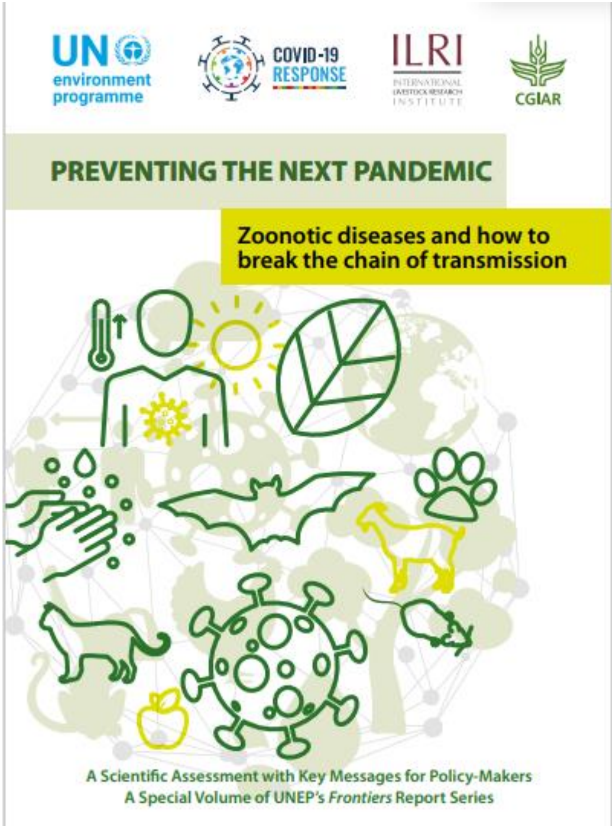
Overlap b/w emerging infectious diseases, zoonotic diseases, food-borne diseases and antimicrobial resistance

Deaths due to viral pandemics

Pandemic	Causative virus	Worldwide deaths
Spanish Flu (1918-19)	Influenza A (H1N1) virus	20-50 million
Asian Flu (1957-58)	Influenza A (H2N2) virus	1.1 million
Hong Kong Flu (1968)	Influenza A (H3N2) virus	1 million
After 2000		
SARS (2003)	SARS CoV virus	916 (Nov 2002- Aug 2003)
Swine Flu (2009)	Influenza A (H1N1) virus	0.15-0.57 million (during first year)
MERS (2012)	MERS-CoV virus	858 (since Sept 2012)
Ebola (2014-16)	Ebola virus	11,310
Covid-19 (2019-present)	SARS-CoV2 virus	4.69 million (as on Sept 21, 2020)

Three out of seven major anthropogenic drivers of zoonotic disease emergence are directly related to food systems

1. Increasing demand for animal protein
2. Unsustainable agricultural intensification
3. Increased use and exploitation of wildlife
4. Unsustainable utilization of natural resources accelerated by urbanization, land use change and extractive industries
5. Travel and transportation
6. Changes in food supply chains
7. Climate change



Source: Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission, 2020, UNEP-ILRI

Four out of 10 policy options suggested to reduce the risk of future zoonotic pandemics are also directly related to food systems

1. Raise awareness of health and environment risks and prevention
2. Improve health governance, including by engaging environmental stakeholders
3. Expand scientific inquiry into the environmental dimensions of zoonotic diseases
4. Ensure full cost financial accounting of the societal impacts of disease
5. Enhance monitoring and regulation of food systems using risk-based approaches
6. Phase out unsustainable agricultural practices
7. Develop and implement stronger biosecurity measures
8. Strengthen animal health (including wildlife health services)
9. Build capacity among health stakeholders to incorporate environmental dimensions of health
10. Mainstream and implement one health approaches

Source: Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission, 2020, UNEP-ILRI

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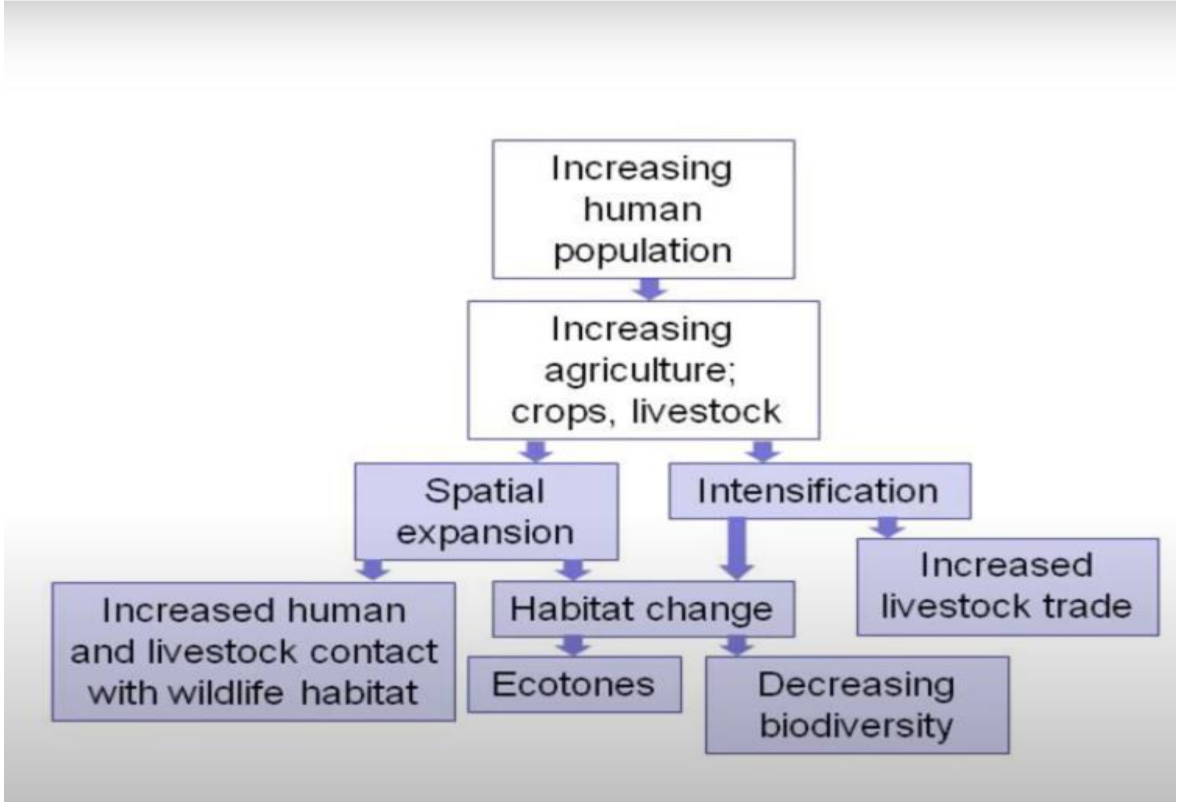
Characteristics of intensive /industrial animal/fish production systems

- Large-scale units with **high stocking density** of animals/birds/fish
- **Genetically selected similar breeds** for productivity (not disease resilience)
- Kept under **confined conditions** and in **close proximity; limited focus on animal husbandry**
- **Dependence on commercial feed**, inputs (also known as animal feeding operations, factory farms)
- Often **geographically concentrated**; vertically integrated by large players; involves contract farming
- Industrial systems but considered agriculture; can bypass required regulatory attention

- High use of **chemicals** including antibiotics (easy/economical substitute) which can lead to resistant bugs
- **Amplification** of pathogens/virulence due to 'monoculture effect' as there are more contact opportunities among those lacking genetic diversity
- **Waste** from such farms which is rich in bacteria, antibiotics, resistant conferring genes can lead to greater emergence and spread of diseases (and AMR)
- **Agriculture expansion** for animal feed crops (e.g. soy) and **intensification entering into forests and natural habitats** diffuses boundaries b/w human-animal-wild-life

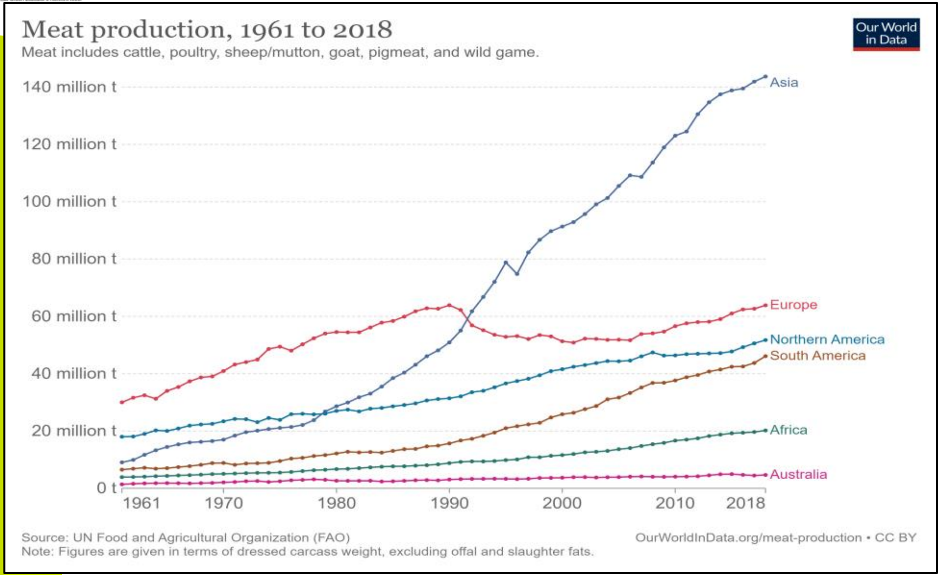
Intensification and spatial expansion



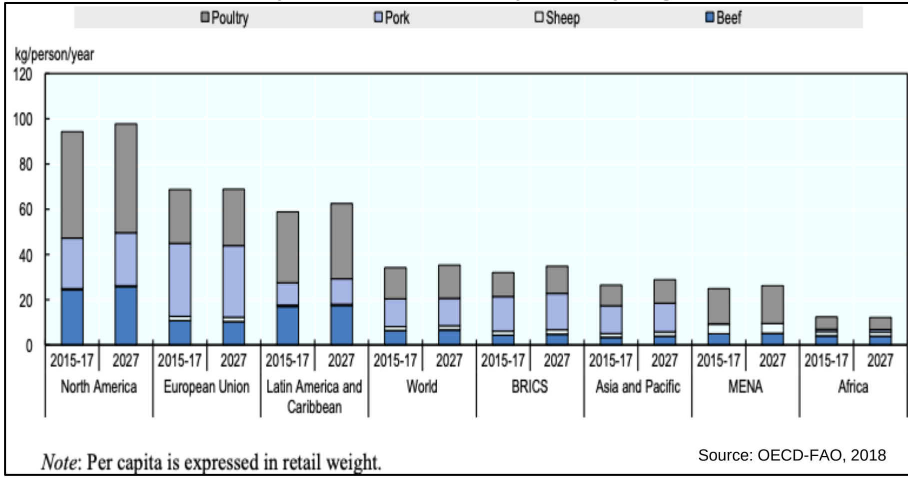
Source: Delia Grace, 2012

High stocking density in intensive animal farms

Growing meat production and consumption; Asia producing more but per-capita consumption less



Per-capita meat consumption by region



- Little change in high-income countries on animal source food consumption during last four decades
- **Rapid increase in South east Asia.** Since 1960, daily supply of proteins from animal products has doubled to 21 per cent; from fish, it has increased by half to 15 per cent. **Sub-Saharan Africa has seen similar increase**
- **South Asia has also seen growth** in **animal protein consumption**, but not that strong
- Increase in animal protein consumption in many LMICs accompanied by significant growths in population have driven a strong growth in **meat production (+260%), milk (+90%), and eggs (+340%)** over last 50 years

Source: Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission, 2020, UNEP-ILRI

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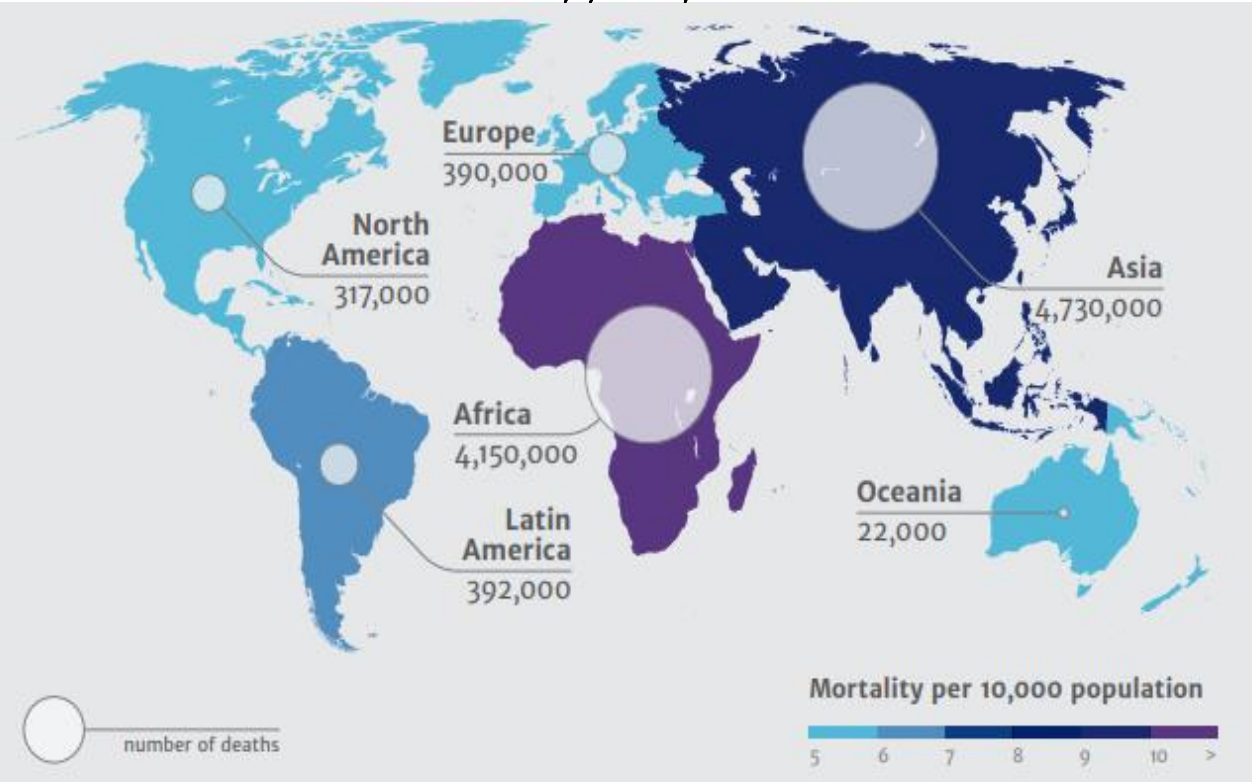
Antimicrobial Resistance, a silent pandemic

- Antimicrobial resistance (AMR) happens when microorganisms (such as bacteria, fungi, viruses, and parasites) change when they are exposed to antimicrobial drugs (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics) (WHO) ….**and make them ineffective**.
- Antibiotics are becoming ineffective. Huge threat. Leading to **health impacts** (longer hospital stays, expensive treatments); it can also impact **productivity, food security, livelihood and attainment of sustainable development goals (SDGs)** apart from economic loses
- **Main drivers**: misuse and overuse in humans, animals, crops and improper waste management
- A big proportion of antimicrobials produced is used in **food-producing animals**, including **critically important** (WHO categorization of antimicrobials for risk management of AMR due to non-human use of antimicrobials)
- Momentum led by **WHO-OIE-FAO Tripartite as part of One-health approach.** UNEP also roped in. Global governance mechanisms include a **Global Leaders Group**; **100+ countries have** developed their National Action Plans to contain AMR (most based on One-health approach)

Estimated 10 million lives in a year at risk by 2050, if no action taken; About 90 per cent in Asia and Africa

Deaths attributable to AMR every year by 2050

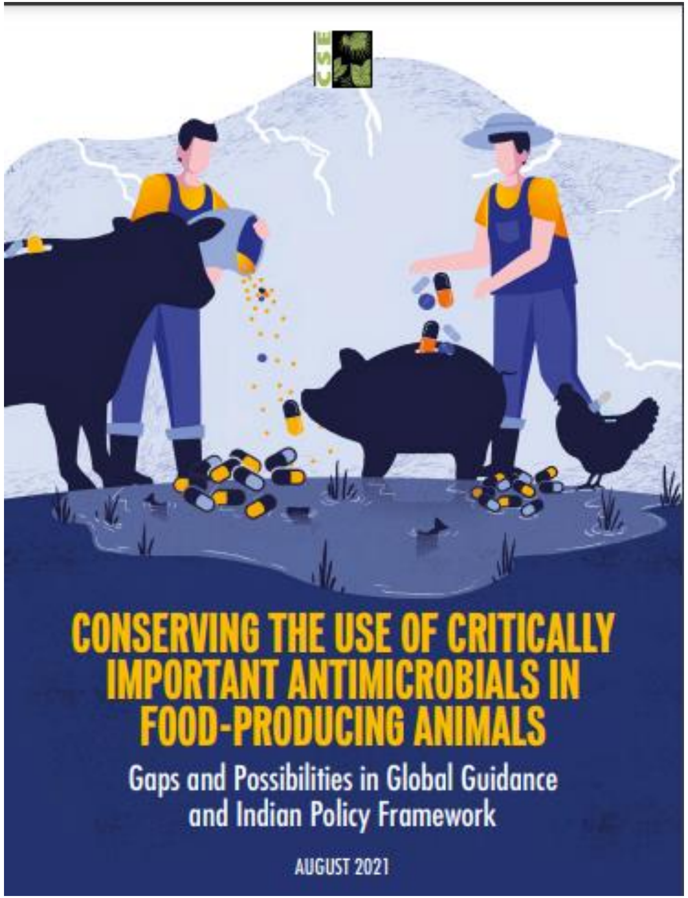


Source- AMR: Tackling a crisis for the health and wealth of nations

- **700,000 deaths** globally every year estimated due to resistant infections (Review on AMR, 2016)
- **2,30,000 deaths** globally in 2017 due to MDR/RR-TB; most cases and deaths in India, China (WHO, 2018)

CSE's latest report identifies misuse and overuse of critically important antimicrobials in the Indian food-animal production sector

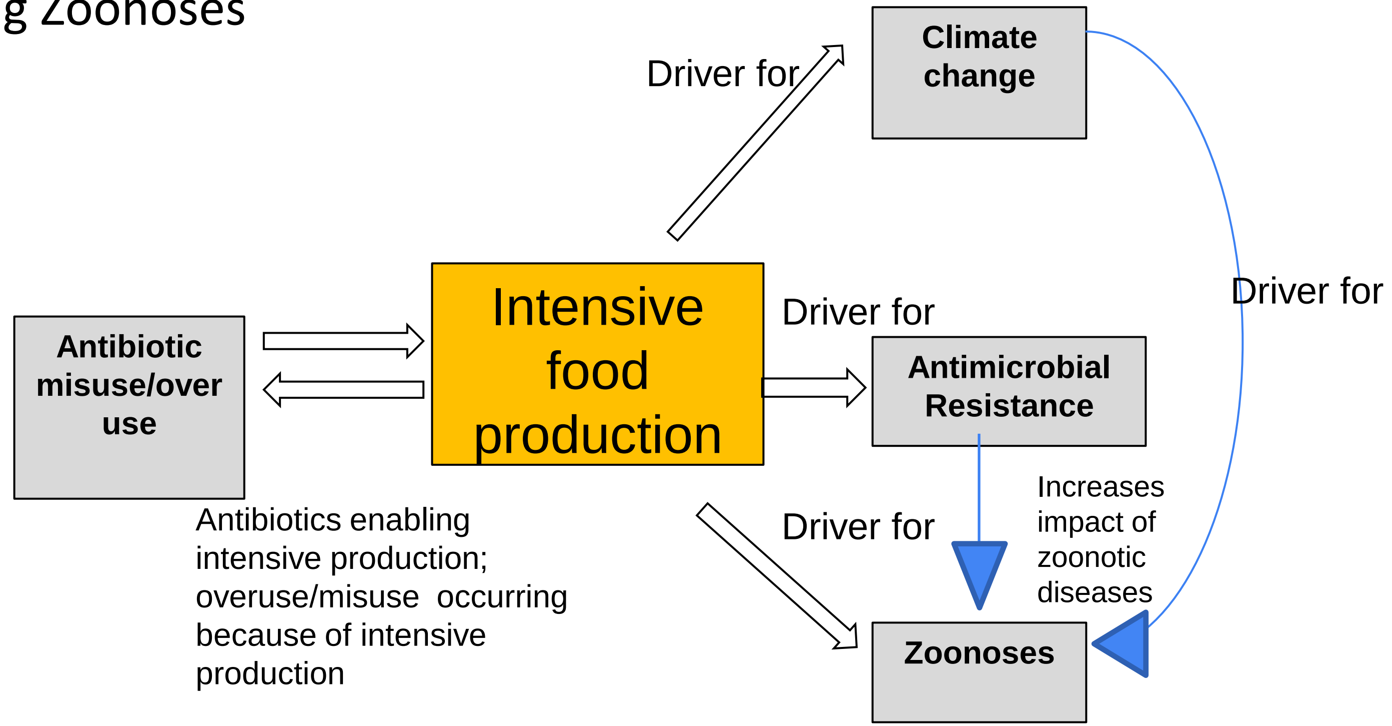
- **Global**
  - Analyses the **global guidance of the Tripartite organizations** with regard to critically important antimicrobials
  - **Calls for coherence and uniformity in global guidance** on use of critically important antimicrobials in food-animals
- **India**
  - Presents the **on-the-ground situation** in India, which also partly reflects the impact of global guidance
  - Provides **a series of policy measures** including a roadmap to contain the misuse of critically important antimicrobials in food-animal production



Key finding: critically important antibiotics are misused and overused in Indian food-animal production sector

- **27 critically important antimicrobials from seven classes** were found to be used in **dairy, poultry and aquaculture** for both therapeutic and non-therapeutic purposes.
- **Eighteen were from three highest priority critically important antimicrobial classes**, i.e. macrolides and ketolides; third-, fourth- and fifth-generation cephalosporins; and quinolones and fluoroquinolones.
- While almost all these antimicrobials are recommended for treating infections in humans, a **high degree of resistance was found** in several common and severe infection causing bacteria from humans against them (e.g., cefotaxime, ceftazidime, ciprofloxacin, levofloxacin, erythromycin, gentamicin, amikacin and ampicillin)
- **Several gaps and possibilities identified** in the policy framework related to antimicrobial use in food-producing animals. **Most do not target critically important antimicrobials** except one against colistin in 2019 by the Ministry of Health and Family Welfare. **Recommendations made.**

In summary: Intensification is driver for Zoonoses and other problems; antibiotic misuse/overuse is enabling intensification and therefore enabling Zoonoses



Source: CSE analysis

What should be done – two broad pointers

1. Food systems need to be made sustainable:

- They need to be transformed. This is the time to change the way we grow our food; re-think our relationship with it. Also, important is to understand well the diets which are nutritious, healthy and planet-friendly
- Today is the day for United Nations Food Systems Summit that aims to transform food systems to help attain SDGs by 2030. We hope that issue of intensive food systems gets due attention and some strong commitments are made towards sustainable ways. However, some reports suggest they are less likely due to powerful industry influence.

2. One-health approach needs to be mainstreamed:

- Human-animal-environmental sector stakeholders need to work together
- Understanding of environmental dimensions is critical
- Human population, animal population is increasing. From 2.6 billion in 1950 to 7.7 billion in 2020 and expected to be about 9.7 billion in 2050. We need to understand and ensure that growing animal-human interface does not mean more diseases

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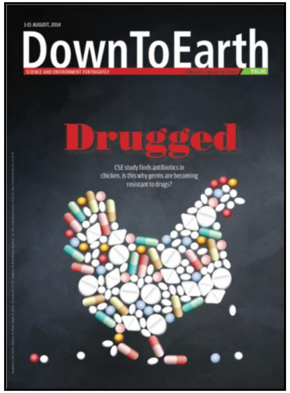
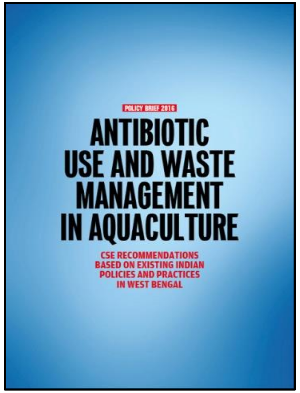
CSE’s work on AMR in food systems and environment: India

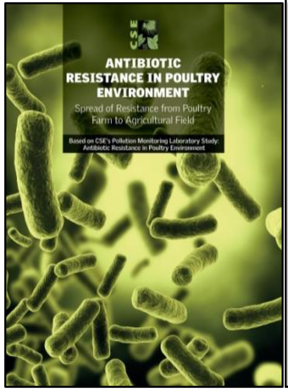
Antibiotics in honey, 2010



Antibiotic use in poultry, 2014



Antibiotic use in aquaculture, 2016



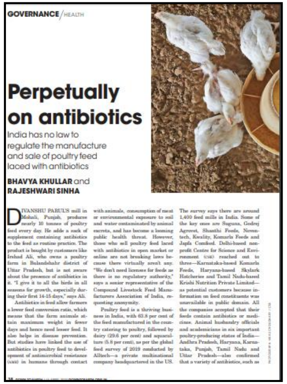
AMR in poultry environment, 2017

Antibiotic use in fast food supply chain, 2017

Disposal of pharma manufacturing waste, 2017

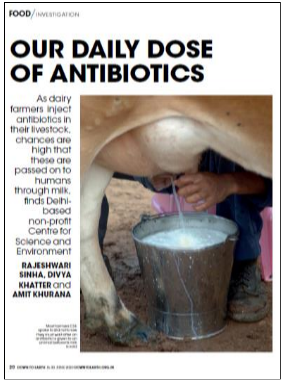
Antibiotic use in crops, 2019

Disposal of unwanted drugs, 2019

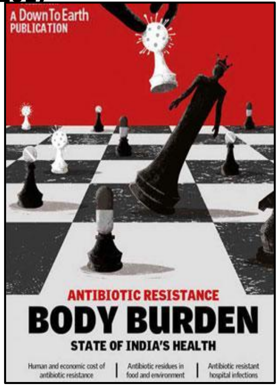


Antibiotic use in feed, 2020

Antibiotic use in fast food supply chain, 2020



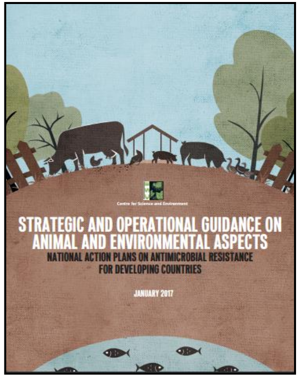
Antibiotic use in dairy, 2020



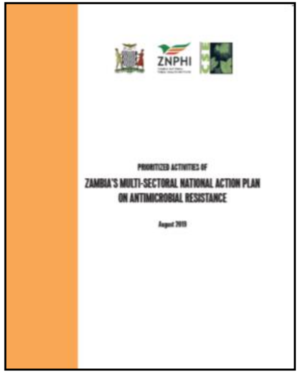
Body Burden, 2020

Use of ethnoveterinary medicines in dairy sector, 2021

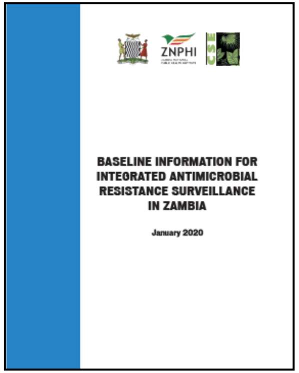
CSE's work on AMR in food systems and environment: Global



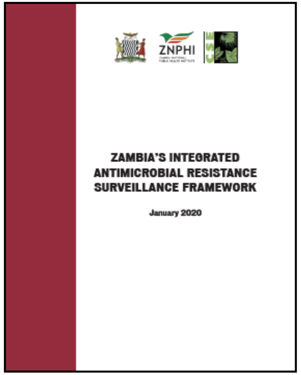
Strategic guidance for NAP for developing countries, 2016



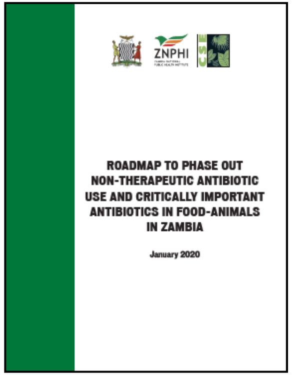
Prioritized NAP-AMR (Zambia, 2019)



Baseline information for Integrated AMR surveillance (Zambia, 2020)

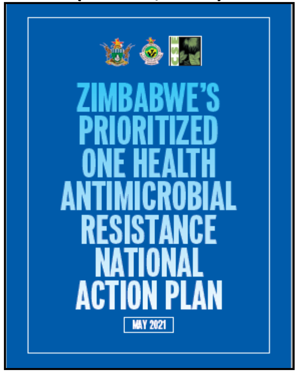


Framework for Integrated AMR surveillance (Zambia, 2020)

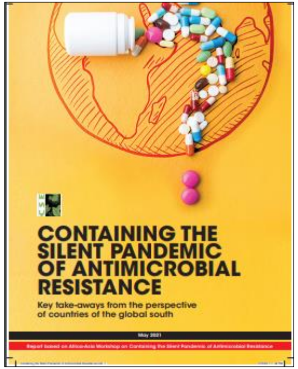


Roadmap to phase out antibiotic misuse in food-animals (Zambia, 2020)

Framework for drug take-back and EPR (Zambia, 2021)



Prioritized NAP-AMR (Zimbabwe, 2021)



Containing the silent pandemic of AMR (2021)

Conserving the use of critically important antimicrobials (2021)