Food and Agriculture Organization
of the United Nations

Pathogen exposure in farming and agriculture

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Multiple pathways of pathogen exposure in agriculture settings

Close human-animal interactions during management (e.g., brooding, feeding, handling).

High-density livestock farming and overcrowding.

Processing (e.g. slaughtering) and movement of livestock without pre-inspection.

Poor biosecurity at farms, processing facilities, and during transport.

Cross-border movement of livestock by pastoralists.

Deforestation and habitat conversion for agriculture, increasing human and animal exposure to wildlife pathogen.

Encroachment into wildlife habitats for livestock grazing, risking spillover.

Overuse of antibiotics, fostering antimicrobial-resistant pathogens.

Indiscriminate disposal of agricultural by-products promoting resistance.

Consumption of raw or poorly processed animal products.

Climate change (e.g., temperature, humidity, flooding) aiding pathogen survival and spread.

People actions and practices lead to exposure

Case Study 1 - MERS-CoV

MERS-CoV - Middle East respiratory syndrome coronavirus

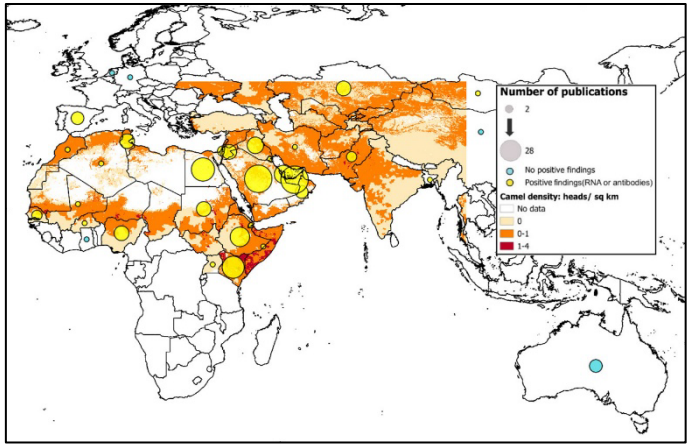
Emerging respiratory disease with pandemic potential. Ranked by WHO among **top three high-threat zoonotic coronaviruses**

Transmission: - Infection through direct/indirect contact with infected dromedary camels - High risk from consuming raw or undercooked camel products (milk, meat)

Impact:- 2 605 global cases with 937 deaths -Approximately 36% case-fatality ratio

No vaccine or specific treatment available

Contributing Factors: -Climate change driving communities, especially in Africa, to favor camels over cattle (Kagunyu et al. 2015; Rahimi et al. 2022)



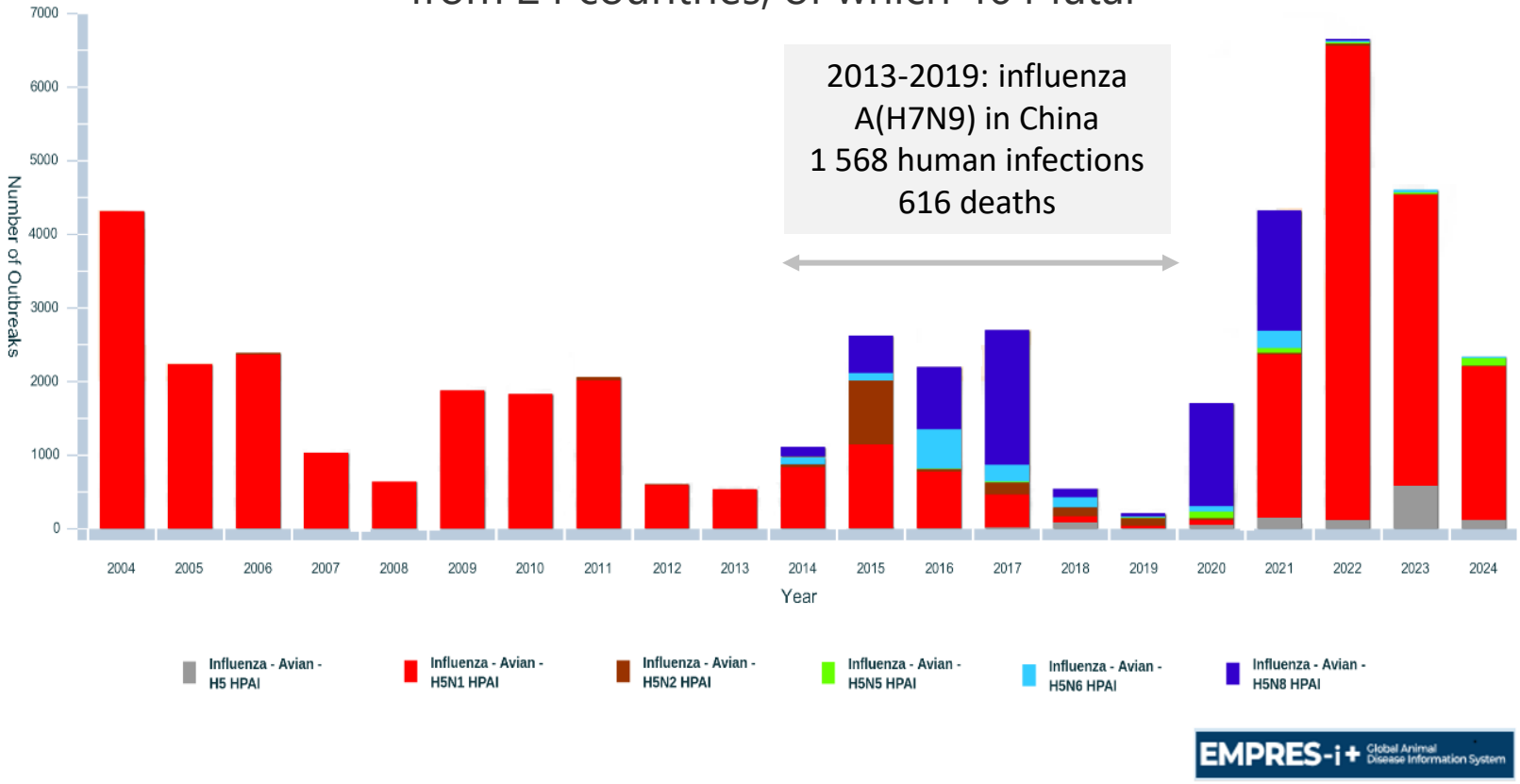
MERS-CoV livestock field surveys

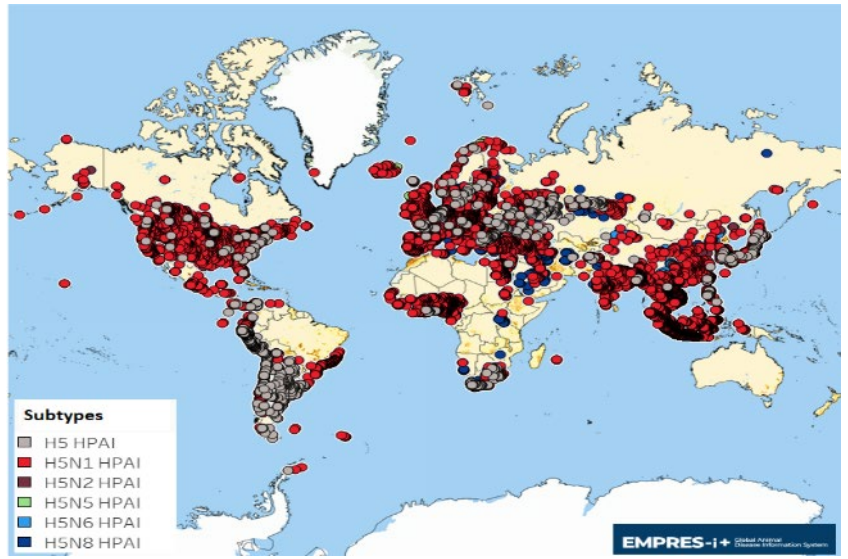
Case Study 2 – HPAI

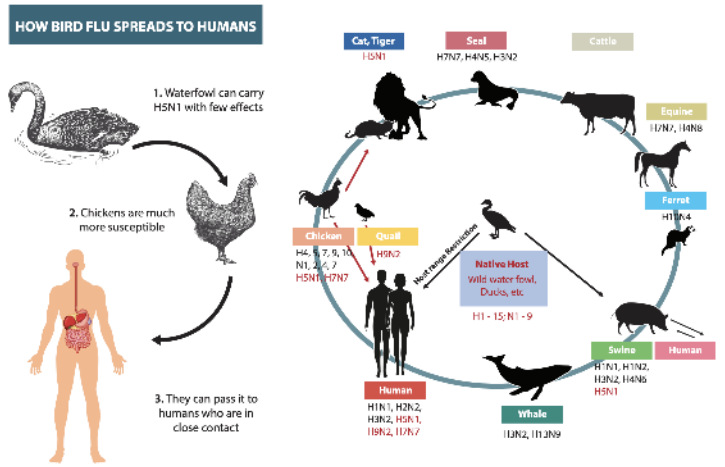
Evolution of HPAI as potential next pandemic threat

January 2003 - November 2024

939 influenza A (H5N1) human cases reported from 24 countries, of which 464 fatal

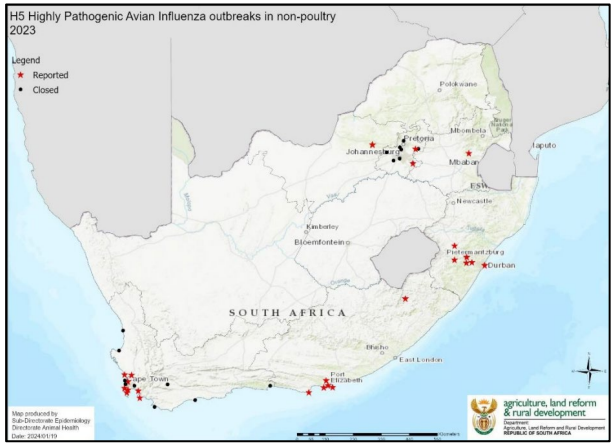




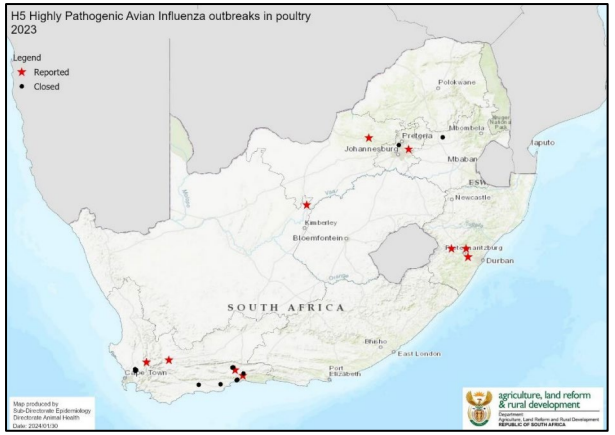


Case Study 2 - HPAI in South Africa (Cont.)

- 2023 Outbreak: Detected in April 2023, affecting 7 of 9 provinces. Reported 22 H5 and 15 H7 outbreaks to the World Organisation of Animal Health (WOAH).
- Impact: 13.8 million commercial poultry affected, including 25% of breeding chickens.
- Transmission:
  - Likely spread from seabirds (terns and penguins) to commercial farms.
  - Large farm infections facilitated spread across South Africa and linked to Mozambique via live bird trade.

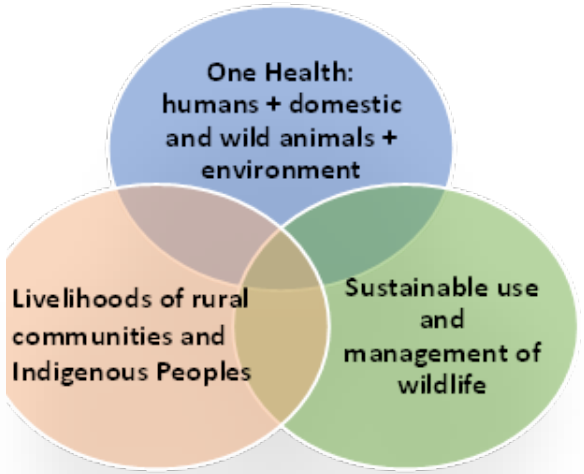


Spatial Distribution of HPAI H5 Outbreaks in **non-poultry**



Spatial Distribution of HPAI H5 Outbreaks in **poultry**

Case Study 3 : The Wildlife-Livelihoods-Health Nexus

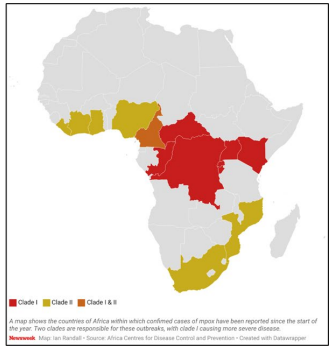


Vast wildlife diversity supports food security, nutrition, health, income generation, and education

The interplay between infectious diseases and wildlife, domestic animals, people is exacerbated by rapid transformation (population growth and urbanization, economic development and natural resource depletion)

Wildlife is increasingly competing with humans for limited natural resources resulting in an increase in human-wildlife conflicts (HWCs)

HWC currently ranks among the major threats to the survival of many endangered species as well as the security and well-being of local Communities



Prevention and detection measures should consider all aspects of the animal-human-environment interface, using the One Health approach

Case Study 4 - Antimicrobial Resistance (AMR)

Economic Consequences:

- Potential global economic losses from antimicrobial resistance (AMR) transmission (livestock to humans) could reach **$5.2 trillion by 2050** (Volsett et al., 2024).

AMR in Livestock:

- High prevalence of multidrug resistance (e.g., Extended Spectrum β-Lactamase, Methicillin-Resistant Staphylococcus aureus).

Drivers of Higher AMR Transmission in LMICs:

- **Economic Factors:** 60% of low-income populations work in agriculture, compared to 29% in middle-income and 3% in high-income countries (World Bank, 2024).
- **Sociocultural Factors:** Cultural views on livestock (e.g., cattle "purity") and taboos on food wastage can impede biosecurity (e.g., consumption of dead animals, raw milk).
- **Infrastructure Challenges:** Weak sanitation systems expose **2 billion people** to contaminated water sources with AMR elements.

Case Study 5 - Anthrax

Vulnerable Populations: 64 million low-income livestock keepers. and 1.1 billion livestock in anthrax-prone areas (Carlson et al., 2019).

Prevalence in Livestock highest in Africa

(Sushma et al., 2021).

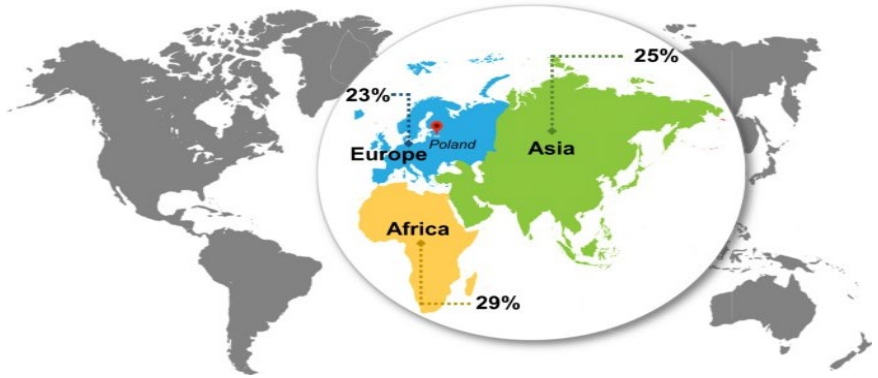
Annual Cases: 20 000 to 100 000 globally (likely underestimated due to stigma and underdiagnosis).

Transmission:

- 95% of human cases from skin contact with infected animals.
- Also transmitted via contaminated meat.
- Bioterrorism potential.

Environmental factors and anthrax:.

- Increased rainfall/heavy downpours disrupt soil conditions and facilitate the spread of anthrax (Garret, 2017).



Case Study 5 : Anthrax outbreak in Zambia (Cont.)

June 2023 Outbreak Overview: 26 cases linked to consumption of wild hippopotamus meat. Zambia's most severe anthrax outbreak to date

Rapid propagation across 9 provinces driven by:

- Trade in wildlife carcasses
- Use of infected cattle products

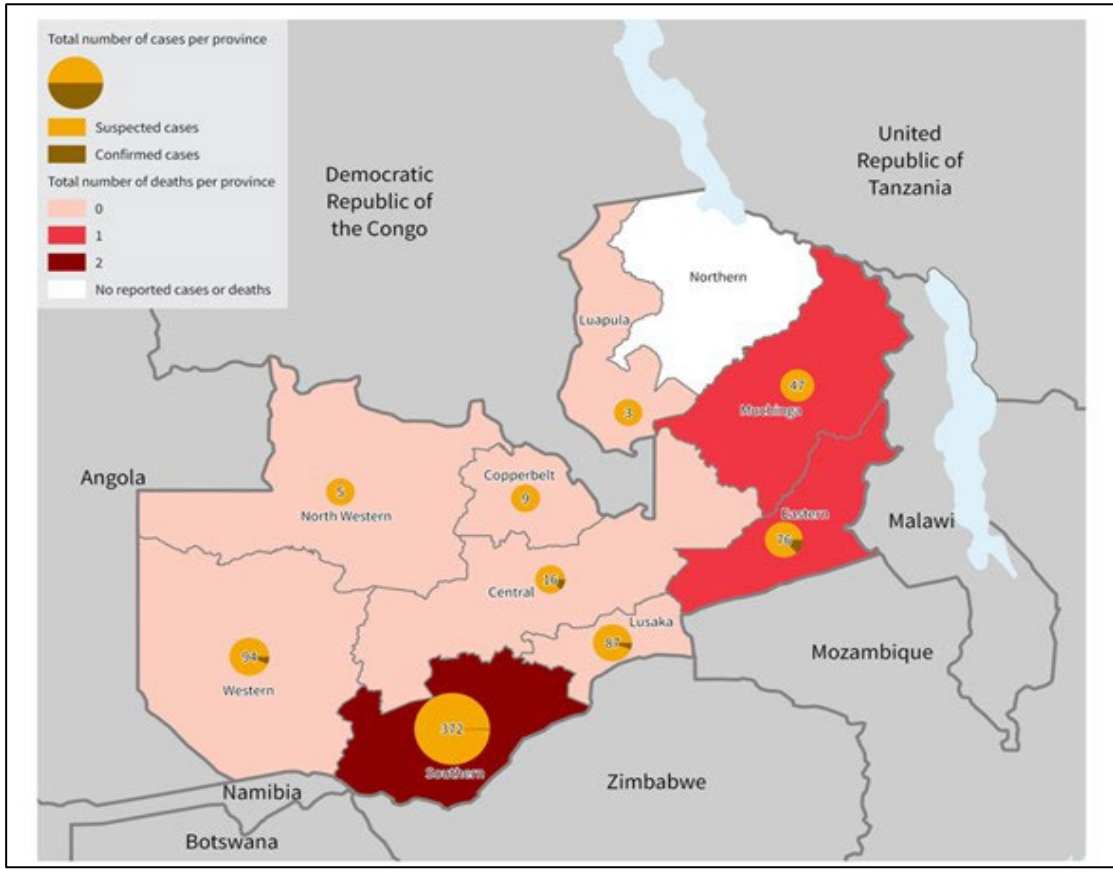
Legal trade in game meat during peace times becomes illegal during outbreaks

Reported figures:

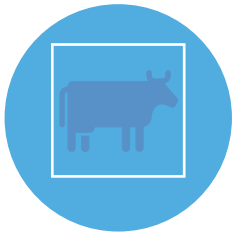
- 684 suspected cases
- 4 deaths

Regional Risk:

- Prolonged drought forced communities into desperate food needs
- Rivers flowing into Zimbabwe, Mozambique, and Malawi amplify threat of anthrax spread to neighboring countries



Challenges to improve, prevent, and mitigate pathogen spillover



Rising incomes increasing demand for livestock-based foods

Accelerating land use changes increasing contact between people, domesticated animals and wildlife.

Unregulated wildlife trade and understanding of wildlife disease ecology

Limited diagnostic capacity in many developing countries

Rapid virus mutation requiring constant updates to detection methods

Complex early warning systems requiring multiple data sources

Socio-cultural , political and economic –community factors

Under-Reporting:

Lack of incentives and government support

Limited farm resources, Few incentives for biosecurity

Policy & Supply Issues

Government restrictions and emergency vaccination reduce demand

Weak private sector vaccine supply chains

Knowledge Gaps

Misinformation on animal health spreads via media

Behavioral Hurdles

Hard to change behaviors or address externalities from unwilling farmers

Regulatory Enforcement

Regulations poorly enforced, communities exploit weak oversight

FAO's strategies to mitigate pathogen exposure in farm settings: An Overview

Collaborative Approach:

- Engage all stakeholders (community, farmers, transporters, processors, etc.)
- Foster interdisciplinary planning and co-created surveillance

Prevention & Control:

- Promote socio-behavior changes in human-animal interactions
- Support biosecurity measures, vaccination, and veterinary training
- Limit antimicrobial use and enhance resistant-pathogen surveillance

Systems & Regulation:

- Improve farm and processing surveillance systems
- Regulate wildlife trade and reduce wildlife-human interface incursions
- Implement integrated pest/pathogen management, waste, and water controls

Research:

- Encourage studies on disease-resistant animal varieties

How FAO supports mitigation: Working with Governments and Communities

FAO support

1. **Technical support**
2. **Projects**
3. **Programmes**

National Government

1. Design policies, strategies, regulations to shape human actions and practices in agriculture to limit pathogen exposure
2. Invest in public goods such as infrastructure (labs) and technical capacity (training and placement) to support implementation of the policies
3. Oversight and Regulation
4. Monitoring and Evaluation

Local Government

1. Implement the policies, strategies and regulations
2. Build the capacities of the local communities

Communities/Value chain actors

1. Undertake agricultural production in compliance with policies, strategies and regulations ; the main investors in the agricultural value chains

FAO mitigation efforts and AMR: Surveillance, Assessment, Community Engagement

- Supporting governments to undertake surveillance and report Multidrug Resistance Organisms as a basis of predicting pandemic prone microbes.

- Providing governments with assessment Tools for One Health & AMR Progress:
  - FAO Assessment Tool for Laboratories and AMR Surveillance Systems- increase capacity to detect/monitor AMR emergence
  - Progressive Management Pathway for AMR tool to assess content and progress in National AMR Action Plans
  - AMR-LEX to disseminates laws, regulations and policies relevant to AMR within the context of agri-food systems.

- "Bottom-up" community-led approach to address AMR emergence and transmission on the farm through reducing AMU:
  - Farmer Field Schools: Community-based training promotes best practices like biosecurity and localized solutions.

FAO mitigation efforts & MERS-CoV's: Surveillance & Capacity Building

Project Support:

- USAID-funded EPT-2 supports enhanced surveillance and applied research

Surveillance Focus:

- Studies in Egypt, Ethiopia, Jordan, Kenya target key camel value chain nodes:
  - Breeding herds, live markets, quarantine stations, slaughterhouses

Key Findings:

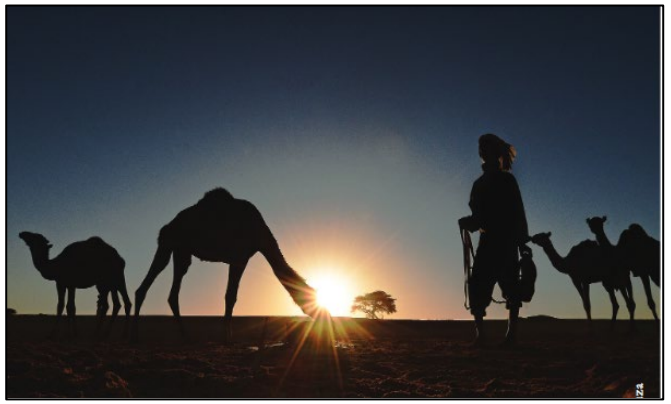
- 60% of camels in the Horn of Africa show MERS-CoV evidence

Capacity Building:

- Trained 368+ government personnel in diagnostics and sample collection
- Supported development of national MERS-CoV surveillance plans
- Ongoing surveillance for camel deaths

Trade Links:

- Value chain studies reveal significant trade with the Middle East where human MERS-CoV cases occur.



SCAN to watch how FAO prevented MERS-CoV in Kenya

FAO mitigation efforts & Anthrax: Surveillance & Community Engagement

One Health Approach:

- Multidisciplinary team (ECTAD, Veterinary & Wildlife Services, Zambia Ministry of Health) conducted comprehensive monitoring and surveillance

Community Engagement:

- Local leaders and village headmen led efforts to boost community participation

Outbreak Investigation:

- Mixed-methods (qualitative data, sampling) confirmed anthrax as the outbreak's cause

Interventions:

- Led to government vaccination campaign and targeted risk communication

Know more here

FAO mitigation efforts & HPAI: Surveillance & Community Engagement

Increased awareness on ZD risk & mitigation

Risk reduction through BSS training & measures

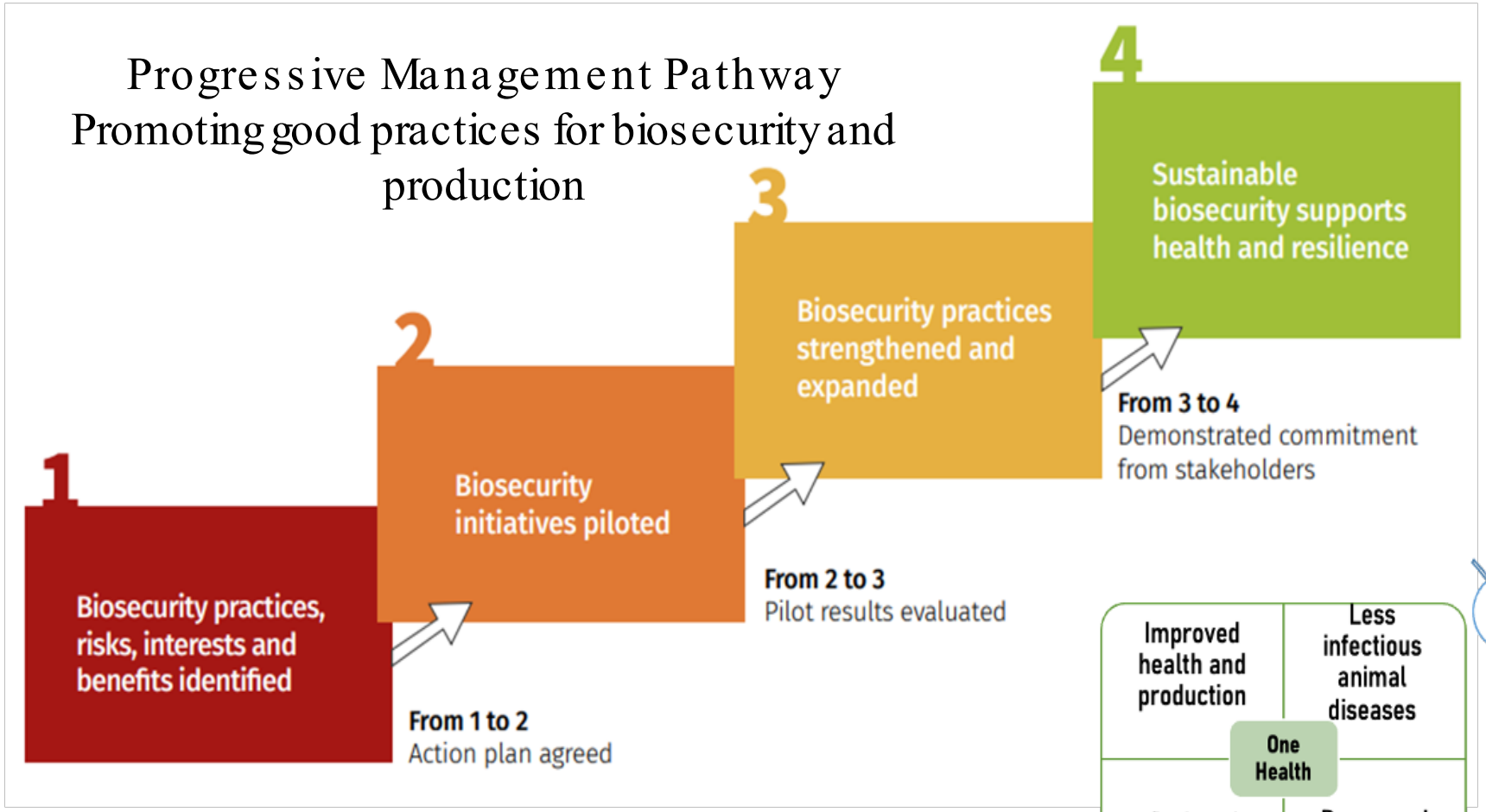
Cross-border approaches to improve regional collaboration (cross border simulation exercises: i.e SN &ML, SN -MAUR

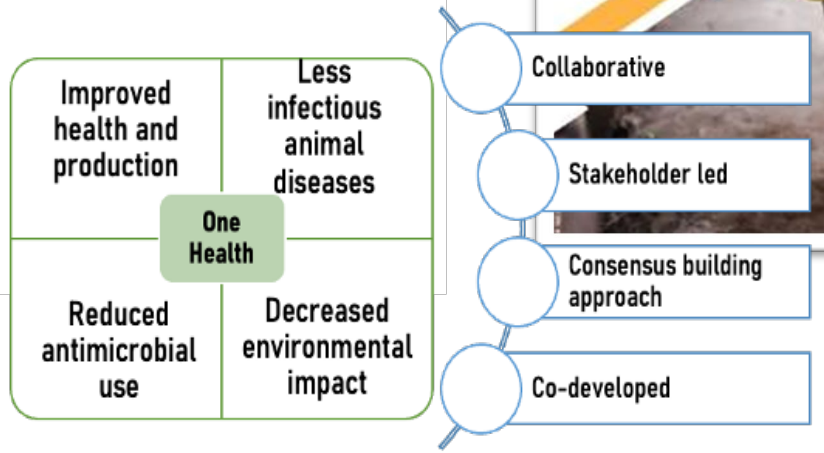
More **targeted, cost-effective surveillance** – i.e. SN & NG using risk based approach.

Enhanced diagnostic capacities to improve detection

Regional emergency meeting for HPAI prevention and control in ECOWAS region @FAO

FAO emphasizes holistic approaches to mitigation in agrifood systems





Progressive biosecurity management pathways in value chains (PMP-TAB)

https://www.fao.org/documents/card/en/c/cc5771en

Addressing challenges at the human-livelihoods-health nexus

Recognize the importance of the use of wildlife for many communities

Maintain and restore healthy and resilient ecosystems to reduce risks of zoonotic spillovers and future pandemics.

Regulate, manage, and monitor the harvesting, trade and use of wildlife.

Understand that sustainable wildlife management is essential in addressing pathogen spill over.

Improve data collection, monitoring and statistics on wildlife and its contribution to rural economies, food security, nutrition and health

Build the capacity of rural communities

Foster effective intersectoral coordination at the national and regional levels

Summary and Call-to-Action

- Demographic, climatic, and economic trends will continue to increase the risk of pathogen exposure/spillover in agricultural settings, especially in LMICs.
- Pathogen exposure/spillover in agriculture is patterned by a diverse set of behaviors across scales, from farms to local, national, and regional governments/organizations.
- FAO's work on MERS-CoV, HPAI, Anthrax, and AMR highlight the complexities of limiting exposure and transmission
- FAO's work to mitigate spillover stresses the continued need for:
  - Embracing bottom-up, community focused/led interventions
  - Implementation of multi-country collaborative training programs and strengthening of cross-border surveillance
  - Adoption of a holistic One Health approach to develop effective surveillance, strategies, and evaluation tools.
- Call to Action! Strengthen partnerships, invest in research, and commit to fostering resilient food systems globally!

Scan to learn more about ECTAD's work globally

Thank you.

Protecting people, animals, and the environment every day

Drawings: FAO/Chiara Caproni