2025 Report

English Version

The state of the world's animal health



An inaugural global overview of animal health in a changing world

World Organisation for Animal Health

Required citation: World Organisation for Animal Health (2025). – The State of the World's Animal Health 2025. Paris, 124pp. https://doi.org/10.20506/woah.3586. Licence: CC BY-SA 3.0 IGO.

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2025 Report

English Version

The state of the world's animal health

An inaugural global overview of animal health in a changing world

World Organisation for Animal Health

Foreword

Animal health is inextricably linked to human health, the stability of ecosystems and the strength of economies. In a world facing increasingly complex global challenges – emerging infectious diseases, climate change, antimicrobial resistance and food insecurity – ensuring the health of animals is crucial. This first iteration of The State of the World's Animal Health report is a landmark publication released by the World Organisation for Animal Health (WOAH) for its 92nd General Session of the World Assembly, which reflects our commitment to evidence-based decision-making and data-driven action. Drawing on WOAH's comprehensive information systems and the collective expertise of its Members and expert network, this report offers a clear, objective and timely analysis of the global animal health landscape, helping us understand the current situation and the path toward a healthier future.

Animal diseases know no borders. Whether affecting livestock, wildlife or aquatic species, their impact can be devastating – threatening livelihoods, public health, food supply chains, international trade and biodiversity. Our ability to prevent, detect and respond to these threats depends on robust surveillance, strong Veterinary Services, and the effective implementation of science-based policies. This report serves as a valuable resource for the veterinary workforce, researchers, policy-makers, and all those invested in the health of animals and the resilience of our societies. It provides critical insights into disease trends, the situation of veterinary capacities worldwide and the effectiveness of interventions. Most importantly, it reinforces the message that proactive investment in animal health is an investment in global health security.

In addition to an objective analysis of the current situation, the core focus of this inaugural report is vaccination – one key element of disease prevention and control. Vaccination, alongside other measures, has saved countless lives, prevented economic losses, and reduced the need for antimicrobial treatments, playing a fundamental role in the fight against antimicrobial resistance. From eradicating deadly diseases like rinderpest to controlling threats such as rabies, foot and mouth disease and avian influenza, vaccines remain a powerful tool at our disposal. Yet, access to vaccines remains uneven, and challenges persist in vaccine research, production, distribution and uptake. Strengthening global cooperation and ensuring equitable access to safe, effective vaccines, alongside other control measures must be a priority for all of us. Valuable insights provided by this report will serve the discussion of this year's General Session Forum: "Veterinary vaccines and vaccination: from science to action – reflections for change".

Looking ahead, we must continue to strengthen our data collection and analysis, foster innovation in disease prevention, and reinforce global veterinary capacities. This report is not just a static reflection of where we are – it is a dynamic call to action. A call for deeper collaboration, greater investment, and a shared commitment to building a future where animal health is protected, global health is secured and sustainable development is realised, and food security is strengthened for generations to come.
Because animal health is our health.
It's everyone's health.



Dr Emmanuelle Soubeyran
Director General
World Organisation for Animal Health

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An inaugural global overview of animal health in a changing world

Welcome to the inaugural edition of The State of the World's Animal Health report, covering 2025. This report marks the launch of WOAH's flagship annual publication, which will be released each year on the occasion of the Organisation's General Session. It offers a comprehensive overview of the global animal health landscape.

Structured in two main parts, the report begins by highlighting the positive impact of vaccination as one measure on a selection of high-priority animal diseases and challenges – including African swine fever, avian influenza, brucellosis, foot and mouth disease, lumpy skin disease, mammalian tuberculosis, rabies, peste des petits ruminants, infectious salmon anaemia and antimicrobial resistance.

In Part I, aligned with the topic of this year's Animal Health Forum at WOAH's 92nd General Session, the report showcases these vaccination efforts tailored to very specific contexts through in-depth analysis, expert commentary, and regional perspectives, It also features case studies from across the globe, celebrating the success stories of WOAH Members and recognising their resilience in addressing ongoing challenges through vaccination efforts alongside other control measures.

Part II presents a comprehensive, data-driven overview of the current state of animal health worldwide. Drawing from WOAH's core data systems, including the World Animal Health Information System (WAHIS) and ANIMUSE (ANImal antiMicrobial USE), it delivers a deep, multifaceted analysis of prevailing trends, persistent challenges and emerging opportunities in global animal health.

As the only international organisation mandated to collect and share official data on animal diseases, WOAH ensures that this information is transparently disseminated to other partner organisations and to the international community, reinforcing trust, enabling early action, and supporting coordinated responses to transboundary animal diseases. WOAH acknowledges the efforts of the dedicated team involved in the production of this publication and hopes that readers enjoy this informative report.



eterinarian checking on a calf in Mongolia.



Vaccination and animal health

Part I.

Vaccination: a pivotal opportunity for the future of animal health

Since the first development of a laboratory-produced vaccine by scientist Louis Pasteur in 1872, vaccination has become an integral and significant part of the healthcare of humans and animals.

In the world of animal health, vaccination has played a key role in the eradication of rinderpest (also known as cattle plague), and is playing an increasingly crucial role in preventing and eradicating major animal diseases such as peste des petits ruminants (PPR), foot and mouth disease (FMD) and rabies, while contributing to overall animal health and welfare, when used alongside other measures.

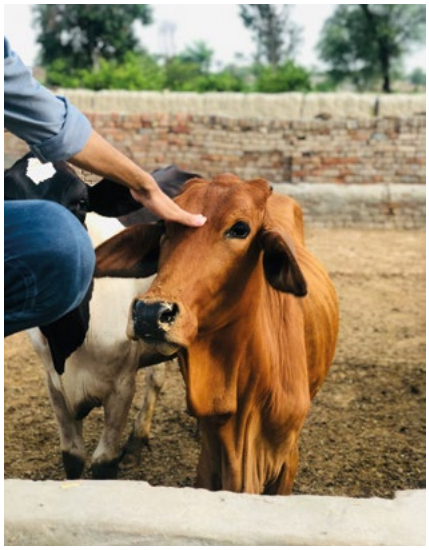
For centuries, rinderpest outbreaks caused the death of millions of cattle, buffalo, yak and wild animals across Africa, Asia and Europe. Decades of concerted efforts from governments and local organisations supported by WOAH and the Food and Agriculture Organization of the United Nations (FAO) achieved the eradication of rinderpest through mass vaccination campaigns of cattle. In 2011, global victory over this devastating disease was declared, ten years after the last case had been reported. Rinderpest eradication is a true testament to the role of vaccination and multilateral collaboration in protecting society against the effects of infectious diseases. The magnitude of the achievement is underlined by the fact that the only other disease (animal or human) to have been eradicated by vaccination is smallpox.

Protecting animals, livelihoods and global health

The benefits of vaccination extend beyond the individual animal being vaccinated. By reducing the incidence of infectious diseases in animals, vaccination helps decrease our reliance on antibiotics to treat diseases, thereby mitigating the development of antimicrobial resistance (AMR).



A mother sheep caring for her offspring.



↑ Compassion and science go hand in hand. Vaccines can protect livestock and livelihoods alike.

Alongside the implementation of optimal biosecurity measures, vaccination is also part of an important complementary approach to combating emerging disease threats.

Preventing disease outbreaks through vaccination reduces economic losses, protects human health from zoonotic diseases – those which pass from animals to people – and secures livelihoods, especially in communities dependent on livestock and their products.

In an economic context, effective vaccination programmes support the safe trade of animals and animal products, prevent the spread of disease across borders and strengthen the global livestock economy. These economic benefits are even greater for countries that implement successful vaccination strategies, as they can achieve official disease-free status from WOAH, which opens opportunities for increased international trade and economic growth.

Overcoming challenges through collaboration

Despite the lessons learnt from the eradication of rinderpest, eradication attempts currently targeting infectious diseases face a set of challenges, including unstable political situations, lack of available or consistent funding, and vaccination hesitancy and availability.

A key challenge is how to effectively use vaccination to control animal diseases, especially considering cost and logistical issues. Vaccines often come at a high cost due to the investment required for their research and development, production and distribution. Securing the required financial investment, particularly in low-resource settings, can be difficult.

Ensuring timely and widespread vaccine distribution remains difficult, particularly in remote or conflict-affected areas of the world. Effective disease control also requires cross-border collaboration, which can often be hampered by political, economic or logistical barriers.

Preventing animal diseases is a core mission of WOAH. Together with its partners and donors, WOAH has set up vaccine banks for several diseases to deliver high-quality animal vaccines to countries in need – because delivering quality vaccines to immunise animals against diseases when other control measures fall short is the best preventive method to stop their spread.

Since their inception in 2006, WOAH vaccine banks have enabled the delivery of high-quality vaccines complying with WOAH international standards in a timely manner and at a pre-established fixed, affordable price. Because vaccines are dispatched safely and rapidly, the beneficiary countries can focus on other essential aspects of their national disease strategies, such as raising awareness, training vaccinators, addressing logistical challenges and improving biosecurity measures.



"Vaccination programmes not only protect animal populations, but also safeguard public and environmental health."

↑ A clear gaze into a healthier tomorrow. Immunisation stands as our first line of defence against emerging diseases.

Veterinary vaccines and vaccination: from science to action – reflections for change

The focus of the Animal Health Forum at the 92nd WOAH General Session in May 2025, is *'Veterinary vaccines and vaccination: from science to action – reflections for change'*. Guided by leading scientists, the Animal Health Forum explores how existing and upcoming cutting-edge technologies, combined with updated science-based vaccination policies, can address current and future animal health challenges and enhance the sustainability of animal health worldwide via a multisectoral One Health approach.

Alongside other measures, vaccination programmes not only protect animal populations, but also safeguard public and environmental health. Decreasing the burden of animal diseases will mitigate the risk of zoonoses, reduce the need for antimicrobial use, preserve biodiversity and minimise the environmental impacts from livestock – while positively contributing to achieving the United Nations Sustainable Development Goals.



Ensuring animal well-being is essential for protecting public health.

Antimicrobial resistance: bugs no longer responding to drugs

Antimicrobial resistance (AMR) is one of the greatest threats to global health, food security and economic stability. Each year, millions of people and animals suffer from infections that no longer respond to treatment, leading to prolonged illnesses, higher medical costs, economic losses and preventable deaths. By 2050, AMR is projected to jeopardise the food security of 2 billion people and result in a US$ 100 trillion economic loss if urgent action is not taken.

AMR occurs when pathogens such as bacteria, or disease-causing agents, develop the ability to withstand the effects of medication, particularly antibiotics. AMR arises from the misuse, unnecessary or irresponsible use of antimicrobials in both human and veterinary medicine, as well as in plant health or by improper waste disposal and waste management.

Prudent use of antimicrobials minimises the risk of antimicrobial resistance and any adverse effects on the human and animal patients receiving the medication, other humans and animals around them, plants and the environment. It highlights the importance of the One Health approach, emphasising the interconnectedness of human, animal, plant and environmental health, to promote responsible antimicrobial use across all these sectors. Prudent use promotes only administering antimicrobials when necessary, choosing the correct medication and dose, and prescribing them for the appropriate duration of treatment.

An example of antimicrobial misuse is when antibiotics are given to animals with viral diseases. Antibiotics only work on bacteria and not viruses, so they are not effective against viral diseases. Thus the correct medication will not have been administered, the animals will not have been helped to get better and potential problems may have been created by encouraging resistant strains of bacteria to emerge following their unnecessary exposure to antibiotics.

Many antibiotics are used, in frequency and amount, to treat animal diseases that are preventable by vaccination and/or good husbandry practices. By preventing infections before they occur, vaccines not only protect human and animal health but also serve as one of the most effective tools in slowing the rise of drug-resistant bacteria.



↑ Clean culture of aerobic bacteria on agar plate.

Dr Alicia Gallardo, President of the Aquatic Animals Commission of WOAH and expert at the WOAH Collaborating Centre on Antimicrobial Stewardship in Aquaculture (CASA), underscored the importance of vaccination, including in the aquaculture sector:

"In aquaculture, vaccines can prevent bacterial, viral and even parasitic diseases. For instance, in salmon farming, we have experience with parasitic vaccination, such as for sea lice (Caligus rogercresseyi). Maintaining a better health status in fish populations, depending on environmental and epidemiological conditions, allows us to reduce antimicrobial use."

Vaccination – resist the resistance

In the fight against AMR, the role of vaccination in reducing antibiotic use has gained significant attention. Dr Gallardo strongly supported this approach:

"Vaccination is a key control measure for preventing bacterial diseases. It should be integrated into the biosecurity plan of a farming establishment, as well as into national strategic animal health plans. By preventing bacterial diseases, we can significantly decrease the use of antimicrobial products. This approach is a form of antimicrobial stewardship, which prioritises prevention as the first objective."

Prof Peter Borriello, former Chief Executive Officer at the Veterinary Medicines Directorate, the United Kingdom, shed light on the development of vaccination strategies. He recognised that administering vaccines – even those for viral diseases – could reduce antibiotic use. Initially met with scepticism, the idea was based on a simple premise: by preventing viral infections (by vaccination combined with other methods), the risk of misdiagnosis and subsequent unnecessary use of antibiotics would decrease. Additionally, animals with viral diseases are often more susceptible to bacterial infections and more likely to require antibiotics, which in turn could increase the risk of AMR.

Under WOAH's auspices, Prof Borriello played a key role as part of a group of experts in identifying where vaccines could have the most significant impact on reducing antibiotic use, particularly in sectors with the highest antibiotic consumption, such as poultry, swine and aquaculture. The group focused on improving existing vaccines and identifying gaps in areas where vaccines could make the strongest impact in terms of increasing their use and effectiveness.

"WOAH has done valuable work assessing the financial burden of AMR in livestock. This data is crucial in making the business case for vaccination."

Prof Peter Borriello
Former Chief Executive Officer at the Veterinary Medicines Directorate, the United Kingdom

Promoting vaccination as a tool to combat AMR and increase disease prevention encounters several challenges. Livestock farmers can express hesitation about new vaccine technologies, particularly DNA vaccines, due to concerns about their livestock being labelled as genetically modified organisms, which could affect marketability. In many countries, the cost of vaccines remains a major barrier to vaccination, and many farmers are still unfamiliar with the concept of preventive treatment. In these regions, education is key.

Antiparasitic resistance, particularly to anthelmintics, poses an even greater challenge. This issue is not as widely



Researchers are continuously developing innovative vaccines to combat antimicrobial resistance.

discussed but is crucial in veterinary medicine, particularly in regions where parasites play a significant role in animal health and productivity.

Prof Borriello emphasised the importance of economic data in supporting the case for vaccination:

"WOAH has done valuable work assessing the financial burden of AMR in livestock. This data is crucial in making the business case for vaccination."

Specifically in the context of aquaculture, Dr Gallardo added:

"The economic scale of aquaculture industries varies, with the salmon industry generating approximately US$ 19 billion globally. Conducting cost–benefit analyses is crucial to demonstrating the advantages of vaccination over treatment."

The effective containment of AMR requires a multifaceted approach, and vaccination holds significant potential in reducing antibiotic use. As Dr Gallardo stated:

"Vaccination remains one of the most important tools for preventing AMR. Other approaches, such as probiotics and genetic improvement, are also valuable, but vaccination provides immediate and effective disease prevention."

The future of vaccination in antimicrobial resistance reduction

The future of vaccination in reducing antibiotic use appears promising. Looking ahead, innovative vaccine solutions can further reduce the need for antibiotics. Dr Gallardo highlighted the role of research and new technologies in advancing vaccination strategies that not only prevent disease but also improve overall antimicrobial stewardship.

One promising area is microencapsulation technology, which enhances the delivery of antimicrobials in fish feed. Dr Gallardo explained:

"One of our key projects at CASA [Collaborating Centre on Antimicrobial Stewardship in Aquaculture] involves micro-encapsulation technology, which enhances the delivery of



↑ By implementing good husbandry practices and vaccination, farmers have significantly decreased antimicrobial use.

antimicrobials in fish feed. This approach has the potential to reduce antimicrobial use by 50% or more depending on the type of antimicrobial."

Microencapsulation improves the bioavailability and targeted release of antimicrobials, ensuring that drugs reach the necessary minimal inhibitory concentration – the lowest concentration of an antimicrobial required to inhibit bacterial growth – without excessive dosing. By optimising dosage, this technology reduces the risk of resistance developing, while also minimising environmental contamination from excess antibiotic use.

Beyond feed technologies, autogenous vaccines, custom vaccines developed from locally isolated pathogen strains, are becoming an essential tool for disease control. These vaccines are particularly useful for emerging bacterial threats that may not yet have commercially available vaccines.

However, the development of autogenous vaccines requires strong laboratory capacity, strain isolation expertise and regulatory support. Dr Gallardo stressed the need for improved regulatory frameworks to ensure these vaccines can be rapidly deployed in response to emerging pathogens.

Another area of future development is multi-pathogen vaccines, which could provide broad protection against several diseases with a single injection. Additionally, advancements in oral and DNA vaccines offer new opportunities to improve accessibility, particularly in large-scale aquaculture systems where individual injection of fish is impractical.

Strategic vaccination programmes tailored to specific epidemiological risks will be key to further integrating vaccines into AMR reduction efforts. Dr Gallardo underscored the importance of proactive policies:

"Vaccination remains one of the most important tools for preventing AMR. Other approaches, such as probiotics and genetic improvement, are also valuable, but vaccination provides immediate and effective disease prevention."

With continued investment in research, improved regulatory pathways, and greater adoption of innovative vaccine technologies, vaccination is poised to become an even more powerful tool in the fight against AMR.

WOAH in Action

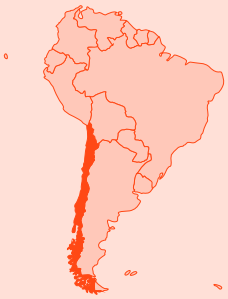
WOAH is uniquely positioned to be a leader in the global fight against AMR. Whether by closely working with national Veterinary and Aquatic Animal Health Services of Members, collecting and analysing data on antimicrobial use in animals, or advocating for improved practices, WOAH is acting to steer the world towards a healthier and more sustainable future by combating AMR. Here are some highlights of WOAH's work in this area:

- On 26 September 2024, at the 79th Session of the United Nations General Assembly in New York, global leaders approved a political declaration during the second High-Level Meeting on Antimicrobial Resistance. WOAH was a main actor in brokering this agreement, which declares a commitment to a set of clear targets and actions, including ensuring by 2030 that animal vaccination strategies are defined with an implementation plan, taking into account WOAH's list of priority diseases for which vaccines could reduce antimicrobial use, alongside other measures.
- The EcoAMR report series, consisting of three reports on the health and economic impacts of AMR in human and food-producing animals, spearheaded by WOAH, was released to highlight the urgency for action and the cost of inaction. The publication used the latest data from 204 countries and 621 subnational locations to forecast the impact of AMR on mortality, healthcare costs, food security and the global economy. The analysis, published in three reports, was produced by experts at WOAH, Animal Industry Data (AID), the Center for Global Development (CGD), Institute for Health Metrics and Evaluation (IHME) and RAND Europe, with contributions from The World Bank.
- WOAH's *Strategy on Antimicrobial Resistance (AMR) and the Prudent Use of Antimicrobials* aligns with the Global Action Plan of the World Health Organization (WHO) and emphasises a One Health approach that integrates human and animal health, as well as agricultural and environmental needs. The strategy outlines the goals and tactics that WOAH has set, to support Member fight AMR and implement WOAH international standards.
- In 2023, WOAH called on its Members to limit their use of antimicrobials to veterinary disease treatment purposes only. It also urged active dialogue with relevant stakeholders to phase out the use of antimicrobials as growth promoters, starting with those deemed critically important for human health.
- In the same year, the new digital platform on antimicrobial agents intended for use in animals, ANIMUSE (ANImal antiMicrobial USE) was launched after being extensively tested by countries in 2022. WOAH has been collecting data on the amounts and reasons for antimicrobial use in animals since 2015. Today, ANIMUSE provides unique access to this crucial and growing datasets that underpin informed decision-making.
- In 2022, CASA, under the auspices of the Faculty of Veterinary Medicine at the University of Chile, was designated as a WOAH Collaborating Centre. It is the first Collaborating Centre in the Americas to support the prudent and responsible use of antimicrobials and to provide scientific support to fight AMR in aquaculture.
- In 2021, WOAH released a technical document on the responsible and prudent use of anthelmintic chemicals to help control anthelmintic resistance in grazing livestock species, a first in the series of guidance to prevent development and spread of resistance to antiparasitic drugs.
- In 2019, WOAH created a Working Group on AMR to help implement its *Strategy on Antimicrobial Resistance and the Prudent Use of Antimicrobials*, as well as to support WOAH's response to this global health challenge. In 2025, the group released five technical reference documents offering species-specific guidance on antimicrobial classes and agents authorised for use in animals to control, prevent and treat infectious bacterial diseases.

Case Study 1

The Yelcho Project in Chile

Location
Chile



Chile's salmon industry is a major export sector with the country being the world's second-largest producer of farmed salmon (after Norway). The Chilean salmon industry has been facing significant economic and environmental challenges relating to the impact of salmon rickettsial syndrome (SRS) outbreaks and consequences of widespread antibiotic use.

SRS is an infectious bacterial disease that causes high death rates in fish and significant economic losses for the salmon industry. The Chilean salmon industry uses a lot of antibiotics to treat SRS infections, which contributes to the development of AMR and poses a threat to the industry's sustainability.

In March 2024, the Yelcho Project was launched to foster collaboration on reducing the Chilean salmon-farming industry's use of antibiotics, while concurrently increasing vaccination to prevent bacterial diseases.

The project is a collaborative initiative involving government bodies and private companies. Government participants include the Chilean Agricultural and Livestock Service and the National Fisheries and Aquaculture Service. Industry participants include 11 salmon-producing companies, the Salmon Council, SalmonChile's Salmon Technological Institute, and aquaculture consultancy firm Aquabench.

The Yelcho Project emphasises the use of vaccines as a primary strategy to combat AMR in aquaculture. It aims to focus on vaccine development and use to enhance the health of farmed salmon, while minimising reliance on antibiotics which contributes to AMR.

The initiative seeks to accelerate research and development in vaccination by fostering collaboration between various stakeholders to create more effective and rapid solutions for managing fish health without the excessive use of antibiotics. The ultimate goal is to improve animal welfare and public health by addressing the global concern of AMR. The Chilean Salmon Antibiotic Reduction Program (CSARP) is a separate initiative of the Monterey Bay Aquarium's Seafood Watch programme of the United States of America (USA) and the Chilean salmon farming industry. There is a CSARP goal to reduce the use of antibiotics in Chilean farmed salmon by 50% and achieve a 'Seafood Watch Good Alternative' rating or equivalent by 2025.

The Yelcho Project is driving the use of efficacious vaccines to significantly reduce antibiotic use, which could help the industry move closer to meeting or even exceeding this CSARP goal, as well as improve industry sustainability. While specific data on the Yelcho Project's impact is still emerging, early signs point to a promising future. If successful, the project could set a precedent for aquaculture industries worldwide, demonstrating how collaboration, innovation, and a focus on vaccines can reduce antibiotic use and combat AMR.

By reducing the need for antibiotics, the Yelcho Project not only supports the Chilean salmon industry but also addresses AMR as a global public health issue. It has potential to become the blueprint for how the aquaculture industry, and other animal production industries, can combat this growing threat by joining forces.

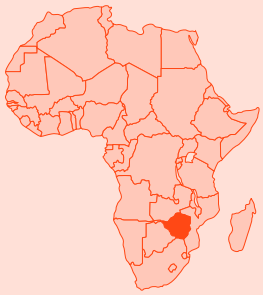


↑ Fresh seafood for sale in the historic main fish market in the centre of Santiago, capital of Chile.

Case Study 2

Investing in alternatives to antibiotics in Zimbabwe

Location
Zimbabwe





↑ Cattle are the cornerstone of Zimbabwe's livestock sector, and vaccinating them against theileriosis is a critical step in reducing AMR risks.

Like many countries, Zimbabwe is concerned about the misuse of antimicrobials in human and animal health occurring globally.

Zimbabwe's Department of Veterinary Services reported that 65% of cattle mortality is linked to theileriosis, a parasitic disease caused by the blood parasite *Theileria* and transmitted by ticks, in addition to other tick-borne diseases. With support from WOAH, Zimbabwe has pioneered the development of an alternative to antibiotics: the theileriosis vaccine.

This successful project was one of ten launched globally by the Antimicrobial Resistance Multi-Partner Trust Fund (AMR MPTF) to apply best practices and scale up joint action in the fight against AMR.

In June 2019, the AMR MPTF was launched by the Tripartite: FAO, WHO and WOAH. In mid-2021, the United Nations Environment Programme officially became a co-signatory of the AMR MPTF, when the partnership formally changed to the Quadripartite.

The AMR MPTF has recently been extended to 2030 to align with the Sustainable Development Goals agendas and timelines adopted by United Nations members in 2015. It provides crucial technical assistance and funding to participating countries for relevant programmes aimed at combating AMR. The United Nations Secretary-General recognises the AMR MPTF as the mechanism to secure consistent and coordinated financing to combat AMR through a One Health approach.

In Zimbabwe's project to develop and produce theileriosis vaccines, the initial step involved collecting ticks from national parks using the dragging method. By June 2022, personnel had tirelessly collected 70,000 ticks to support the production of 100,000 doses of the theileriosis vaccine, with the initial 20,000 doses prioritised for disease hotspots.

To ensure the success of vaccination, additional efforts were dedicated to training staff of technical offices from Zimbabwe's Department of Veterinary Technical Services) Parasitology Section in performing *Theileria* immunofluorescence antibody testing, to assess animal response to vaccination, as well as carrying out critical quality controls along the vaccine production chain to ensure effective vaccines are manufactured. WOAH supported all aspects of vaccine development through to deployment.

The theileriosis vaccine is a breakthrough that enables Zimbabwe to tackle three of the four major tick-borne diseases affecting its cattle industry without the use of antimicrobials. This AMR MPTF project has been a story of success and hope in tackling AMR.



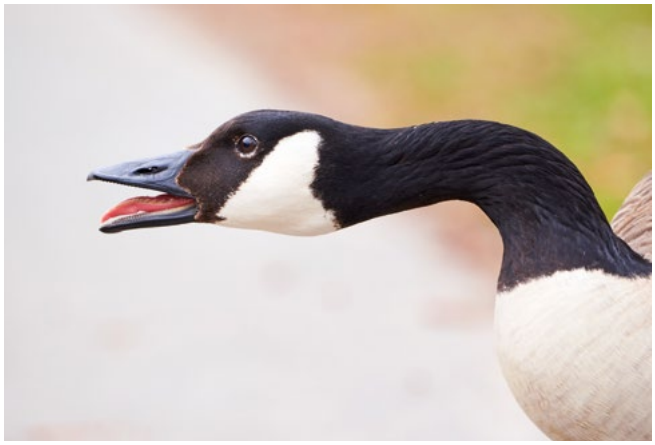
Protecting poultry from avian influenza secure livelihoods for vendors (like this Cairo poultry seller).

The world is facing an unprecedented battle against high pathogenicity avian influenza (HPAI): a disease that has devastated poultry production, disrupted ecosystems and threatened global food security. In the last 20 years, over 633 million birds have been lost due to infection or culling efforts aimed at controlling the spread of the virus. The economic fallout has been severe, with major disruptions in international trade, affecting local poultry industries, and consumers of poultry products.

HPAI is no longer just a seasonal or regional concern. Since 2022, the virus has spread into new geographical areas, infecting new species of wild birds, domestic poultry, and even a growing number of mammalian species, including livestock and companion animals. In some cases, the virus has spilled over into humans, raising concerns about its potential to evolve into a larger public health crisis.

The scale and complexity of this ongoing epizootic require urgent action beyond traditional control measures. For years, strict biosecurity and active surveillance have been the primary tools in preventing and containing avian influenza outbreaks. These remain essential, but the relentless spread of the virus, despite aggressive containment efforts, demonstrates that more must be done. Vaccination has emerged as a potential tool to complement existing measures, reducing both the spread and severity of infections.

How vaccination is reshaping the avian influenza crisis



↑ Canada geese are among the many wild bird species devastated by avian influenza.



↑ Farmer working on a farm and feeding poultry.

It's everyone's health: wildlife, livelihood and trade

Beyond the devastating loss of poultry, HPAI is causing unprecedented mass die-offs in wild-bird populations, disrupting ecosystems and threatening biodiversity. Seabirds, raptors and waterfowl have suffered catastrophic losses, with entire breeding colonies wiped out. The virus has also infected marine mammals, scavengers and even livestock, raising concerns about its potential adaptation to new hosts. Though the risk of human infection remains low, the more mammalian species that are affected, the greater the possibility of the virus adapting to mammal-to-mammal, and potentially human, transmission. The decline or loss of species disrupts ecological dynamics, including trophic interactions, biodiversity services, migration patterns and food chains. As integral components of ecosystem stability, the loss of biodiversity causes cascading effects that compromise environmental resilience and global wildlife conservation.

HPAI outbreaks not only devastate animal populations but also trigger strict trade restrictions, severely disrupting global poultry markets. Many countries impose import bans on affected regions, causing economic instability for poultry-exporting nations. Producers lose access to key international markets, weakening economies that rely on poultry trade. Meanwhile, importing countries struggle with supply shortages, forcing them to seek alternative sources – often at higher costs.

For consumers, the effects are immediate. The prices of poultry products rise, straining food security, particularly in low-income populations where poultry is a primary source of protein. As HPAI continues to spread, these disruptions compound over time, worsening access to affordable food in vulnerable regions.

Beyond economics, the crisis presents serious environmental challenges. The disposal of millions of culled birds generates massive amounts of biohazard waste, requiring strict management to prevent further disease spread and environmental contamination. Improper disposal can affect soil, water and air quality, adding long-term ecological damage to the crisis's economic and logistical burden.

These trade disruptions are deeply intertwined with the livelihoods of farmers and producers, who bear the brunt of HPAI's economic toll. Many farmers, producers and animal owners had to eliminate entire flocks, including seemingly healthy birds, to contain the disease and decontaminate premises. These measures have severe financial consequences, wiping out livelihoods and leaving poultry producers without income or food sources. Rural communities that rely on poultry for food security and trade are particularly vulnerable.

In addition to economic devastation, HPAI takes a profound emotional toll on those directly affected. Farmers and workers must endure the psychological distress of witnessing mass culling events, as animals they have cared for are destroyed. The trauma, combined with financial uncertainty, exacerbates stress and mental health challenges across affected communities.



Migratory patterns of many wild birds, like the mallard ducks, contribute to the spread of avian influenza.

HPAI is more than an animal health crisis: it is a global emergency destabilising agriculture, food security, trade and ecosystems. Addressing its impacts requires an urgent, multifaceted solution to protect economies, livelihoods and biodiversity, while strengthening resilience against future outbreaks.

Can vaccination be considered as a tool to curb avian influenza?

Vaccination against HPAI is increasingly being considered as a complementary tool in disease management due to the global rise in outbreaks and the growing genetic diversity of circulating virus strains. Traditional sanitary control measures, such as mass culling, have proven costly, both economically and socially, raising concerns about their long-term sustainability. While biosecurity, surveillance, and movement controls remain essential, vaccination can complement these efforts by reducing virus circulation within and between flocks, minimising economic losses, and lowering the risk of spillover to wildlife and humans. Furthermore, when properly implemented, vaccination aligns with international trade standards, ensuring that poultry products remain marketable. Encouraging the development of effective vaccines also drives innovation in disease prevention, reinforcing an anticipatory rather than reactive approach to managing HPAI.

According to Julian Madeley, Director General of the World Egg Organisation, when used in conjunction with biosecurity and surveillance, vaccination could be a very useful tool to control the spread of HPAI in laying hens.

Newcastle disease serves as an example,' he explained, 'Once we had effective vaccination strategies, it became a manageable problem. Outbreaks still occur, but they no longer devastate the industry as they once did. We believe the same can happen with HPAI if vaccination is widely adopted alongside robust surveillance measures.

In fact, many countries have already rolled out successful vaccination campaigns, including China, the world's largest egg producer, France, Guatemala, Kazakhstan and Peru. And, as more and more countries adopt vaccination against HPAI, it is crucial that both vaccination and surveillance are carried out to a high standard.

"Moving forward, it's all about communication and collaboration." Madeley added, "We need to continue advocating for vaccination as an additional tool, complemented by biosecurity and surveillance. And we must ensure that best practice tools are made available to farms so that they can carry out these measures effectively."



↑ A flock of migratory birds flies over water at dawn.

Should wild birds be vaccinated?

Disease in wildlife, including wild birds, is a critical concern. The role of wildlife health is fundamental in sustaining ecological balance and ecosystem functionality.

However, attempting to vaccinate wild birds against avian influenza at scale presents significant challenges. Difficulties include the ability to capture the wild birds with consideration for bird and human safety and welfare, the selection of suitable vaccine strains and dosages, the logistics and resourcing in administering the vaccine to each individual bird and how to reliably track and monitor vaccinated individuals. Instead of vaccination, controlling avian influenza in wild birds focuses on biosecurity measures, monitoring, and avoiding as much as possible interactions between wild and domestic birds. Carcass removal, when safe to do so, and habitat protection are other strategies to mitigate virus spread.

Nevertheless, in December 2023, WOAH released the document 'Considerations for emergency vaccination of wild birds against high pathogenicity avian influenza in specific situations', detailing that emergency vaccination of wild birds against HPAI should be considered in the following situations:

1. If an outbreak of HPAI threatens endangered or critically endangered species, vaccination may be necessary to prevent population declines or potential extinctions. A case study of emergency vaccination of California condors approved by the United States Department of Agriculture (USDA) in 2023 showed the potential of vaccination for endangered species but also highlighted challenges in field deployment.
2. If the virus poses a high risk of spreading to other wild-bird populations or domestic poultry, especially in areas with dense bird populations or along migratory routes, then emergency vaccination may potentially have a place.
3. If conventional control measures like culling, surveillance and biosecurity are insufficient or impractical in reducing the outbreak, vaccination may serve as a supplementary tool.
4. In cases where localised outbreaks could have devastating effects on wild-bird populations, and where other measures are not feasible, targeted vaccination could be considered.
5. If certain species are particularly vulnerable to HPAI, especially those that play critical ecological roles, vaccination might be considered to prevent cascading effects on the ecosystem.

In such cases, should vaccination be considered, it must be carefully thought out as part of a broader coordinated response plan that includes risk assessment, surveillance, and consultation with relevant experts and stakeholders. Alignment with WOAH international standards and a commitment to monitoring must also be emphasised when considering the deployment of emergency vaccination.

WOAH in Action

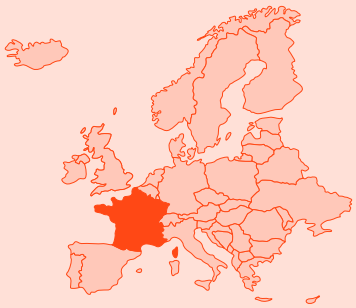
WOAH plays a key role in tackling avian influenza by promoting science-based policies and enhancing global surveillance.

- In February 2025, WOAH and FAO launched the Global Strategy for the Prevention and Control of High Pathogenicity Avian Influenza (2024–2033) to replace the previous strategy from 2008. This ten-year plan takes a systems approach, addressing HPAI within the wider context of global challenges. The strategy aims to create sustainable and resilient poultry production systems, while ensuring the protection of domestic animals, wildlife, the environment and human health. The strategy also promotes the selection and updating of poultry vaccine antigens to enhance disease control and outbreak prevention.
- In December 2023, WOAH released the policy brief 'Avian influenza vaccination: why it should not be a barrier to safe trade,' highlighting the importance of balancing disease control with international trade.
- To support safe and fair trade, WOAH and the International Alliance for Biological Standardization (IABS) are working on surveillance standards for vaccinated poultry populations. These discussions aim to establish robust monitoring systems that will ensure vaccination does not create unnecessary trade barriers, while maintaining strong disease-prevention measures. Following the WOAH Animal Health Forum held during the May 2023 WOAH General Session, and the IABS October 2022 workshop on HPAI, WOAH and IABS held a follow-up meeting in October 2024 titled 'Vaccination and surveillance for HPAI in poultry: current situation and perspectives'.
- The OFFLU Network, a global initiative supported by WOAH and FAO, brings together experts to reduce the impact of animal influenzas. OFFLU contributes to risk assessments and actively shares critical data with the scientific community and policy-makers. As part of its mission, OFFLU participates in the WHO vaccine composition meeting for avian and swine influenza, collaborating with WOAH Reference Laboratories, research programmes and national veterinary laboratories. OFFLU is also involved in the avian influenza vaccine matching initiative, which aims to provide information on the antigenic diversity of circulating HPAI viruses that may impact the effectiveness of existing vaccines. By providing essential genetic, antigenic and epidemiological data, the network helps develop animal and human candidate vaccine viruses for pre-pandemic preparedness. This ensures that, in the event of zoonotic transmission, vaccines can be developed rapidly to offer the best possible protection.

Case Study 3

Safeguarding France's poultry industry with vaccination

Location
France



In October 2023, France became the first European Union (EU) country to implement a nationwide vaccination campaign against HPAI in ducks due to their key role in disease transmission.

Dr Marie-Christine Le Gal is the WOAH Delegate for France, as well as the Deputy Director and Head of Veterinary Services for the French Directorate General for Food – Ministry of Agriculture and Food Sovereignty. According to Dr Le Gal, the decision to vaccinate against HPAI in France was not one made lightly.

France underwent years of successive HPAI outbreaks leading to significant economic and animal health losses. Biosecurity measures did not stop the spread of the virus, and the continuing disease and mass culling were negatively impacting farmers. The country was seeking a different way of doing things along with a potential long-term solution.

"Innovation is essential. We're not just talking about vaccines, but also about everything surrounding health management: epidemiological surveillance, modelling tools, new technologies to detect outbreaks more quickly. We must continue to invest in these areas because that's how we'll be able to anticipate crises rather than just suffer them. France is at the forefront on these issues, and we will continue to push in this direction," said Dr Le Gal.

She explained that the close collaboration with multiple relevant parties over a long period ensured buy-in and success. Stakeholders included the local scientific community (the French Agency for Food, Environmental and Occupational Health & Safety, veterinarians and researchers); local farmers; and international trading partners. These interested parties were consulted on numerous occasions to address any concerns – and more importantly, to present with concrete evidence on the benefits of vaccination.

Farmers were naturally concerned and hesitant about the effectiveness of the vaccine, potential side effects on the ducks receiving the vaccine, and whether vaccination would complicate trade or commercial exchanges. However, they were subsequently convinced by on-the-ground experience showing an immediate protective effect in the first year. The protective effect of vaccination was not only limited to duck farms but also benefited the entire poultry industry. The Toulouse Veterinary School ran a model which estimated up to 700 outbreaks in France that year due to exposure to wild birds, however, the country only suffered 10 outbreaks as a result the vaccination campaign.

When asked about the initial reluctance of France and other countries to vaccinate, Dr Le Gal outlined the concerns regarding the potential reaction of international markets towards the country's poultry and poultry products should it implement vaccination.

In terms of how France addressed these trade and vaccine safety concerns, Dr Le Gal described full transparency as being the key. France thoroughly explained its approach to, and shared study results and data with, its trading partners.

It implemented a rigorous traceability system to identify every vaccinated poultry, monitored the epidemiological situation, and strengthened surveillance with regular checks to ensure the virus is not circulating despite the vaccination. Some sceptical countries are starting to change their stance, with the USA having lifted poultry trade restrictions on France in January 2025.

The differentiating infected from vaccinated animals principle

France has committed to applying the principle of differentiating infected from vaccinated animals (DIVA), to ensure that vaccinated poultry can still be tested to differentiate whether their immune response is from vaccination or true infection. This is to assure itself of effective disease surveillance and control, and to reassure its trading partners that vaccinated animals do not pose an undetected risk of spreading the disease.

The DIVA principle is a method that allows animal health authorities to distinguish between animals that have been vaccinated against a disease and those that are infected with a disease. This is achieved by using vaccines that stimulate an immune response different from that triggered by the actual infection. Diagnostic tests are then used to identify these differences, ensuring that vaccinated animals can be distinguished from infected ones.

The DIVA principle helps maintain surveillance integrity, supports trade by proving animals are not actually infected, and prevents vaccinated animals from being mistakenly treated as infected. It is particularly important for controlling diseases like avian influenza while avoiding trade disruption.

Dr Le Gal reflected on the pilot studies where ducks were vaccinated, indicating these were crucial in providing lessons to adjust France's strategy and build the now solid framework that is dedicated to continuous improvement. She noted that France is convinced that vaccination will play an increasingly important role in the country's fight against HPAI and will support the overall One Health approach that is promoted by the country. This will be alongside innovation in animal health management – including improving epidemiological surveillance, modelling tools and new technologies for early disease detection.

France is also looking forward to influencing international policies on HPAI vaccination, in terms of overcoming fears of trade complications – with a rigorous framework, good surveillance and transparency; to promote consideration of vaccination as being the only real sustainable solution in the face of certain health threats.

"France has been a pioneer on this issue [vaccination], and our role now is to support this global evolution, sharing our experience and continuing to evolve practices," Dr Le Gal concluded.

"France has been a pioneer on this issue [vaccination], and our role now is to support this global evolution, sharing our experience and continuing to evolve practices."

Dr Marie-Christine Le Gal
WOAH Delegate for France



↑ Mulard ducks, central to France's foie gras industry, were heavily impacted by HPAI outbreaks. Vaccination efforts have significantly reduced infection rates.

The promise and challenges of African swine fever vaccination

The continuing spread of African swine fever (ASF) is a global concern for the pig industry, as no geographical region is left unaffected. For many farming families and communities, the disease has brought emotional and financial devastation – wiping out entire herds, threatening livelihoods, and disrupting food security. For years, the lack of a vaccine or effective treatment has made it very difficult to control the disease. The research community has been working to develop an effective vaccine, and recent announcements of modified live vaccines being approved or tested in some countries have raised hopes for the availability of new effective tools to contain the current ASF epidemic. Many countries are interested in using these candidate vaccines to help control ongoing outbreaks on their territories.
The ASF virus (ASFV) is a highly contagious haemorrhagic disease of pigs, with a near 100% fatality rate in some outbreaks. Since its jump to Georgia in 2007, ASF has spread relentlessly across Europe, Asia-Pacific, and more recently into two countries in the Americas. China alone lost an estimated 40% of its pig population in 2018–2019 due to ASF outbreaks, resulting in massive economic disruptions and threatening global pork supply. The disease affects both domestic pigs and wild boar, the latter of which often act as a reservoir and complicate control efforts due to their mobility and difficulty in surveillance.

Vaccine development: a scientific breakthrough in sight

In recent years, progress in vaccine development has generated cautious optimism. Among the most promising strategies are live-attenuated vaccines, which involve using weakened forms of the virus to trigger immunity without causing the disease. These vaccines have shown notable



Farmer feeding pigs on an open farm.

efficacy in laboratory trials and some controlled field settings. One of the most recent examples is the vaccine research led by the United States Department of Agriculture and Vietnamese authorities.

In 2022, Vietnam became the first country in the world to authorise the piloting of commercial use of a vaccine against the current ASFV genotype II outbreaks. Subsequent pilot programmes across multiple provinces in Vietnam have aimed to further evaluate the vaccine's effectiveness in varied farm conditions. Initial results have been described by the Vietnamese authorities as 'very promising,' with vaccinated pigs showing both protection and minimal side effects. As of early 2024, Vietnam had begun to expand vaccine distribution under controlled commercial rollout, closely monitored by Veterinary Authorities and supported by international organisations.

The global community is closely watching Vietnam's experience, with some planning trials of their own. In parallel, China has reported progress on several ASF vaccine candidates, including both live-attenuated and gene-edited formulations, though large-scale commercial deployment is still pending.

Ensuring vaccine safety and effectiveness

Despite these advances, the use of ASF vaccines – especially live-attenuated ones – poses significant challenges and risks if not properly regulated. WOAH has issued a position statement urging countries to only consider vaccines that meet international standards of safety, efficacy and quality. As emphasised in WOAH's October 2023 position statement, the improper use of substandard or non-compliant ASF vaccines can have serious consequences.



↑ Pigs in Vietnam are heavily affected by the African swine fever, with the country reporting one of the highest outbreak counts in 2024.

Poor-quality vaccines may not only fail to protect animals but could also introduce new problems. Modified live viruses, if inadequately attenuated, may cause clinical disease. Worse still, vaccine viruses could recombine with field strains, generating novel variants that are harder to detect and control. There is also a risk of chronic or persistent infections developing, complicating disease surveillance and potentially leading to long-term circulation of vaccine-derived virus.

To mitigate these risks, WOAH recommends that ASF vaccination should be used only as part of a comprehensive prevention and control strategy. This includes strict biosecurity measures, effective surveillance, movement restrictions and structured vaccination programmes with clear objectives. Post-vaccination monitoring is essential to evaluate vaccine performance and detect any adverse events. In all cases, national regulatory authorities must ensure that candidate vaccines undergo rigorous assessment in line with international guidance, including WOAH's Manual of Diagnostic Tests and Vaccines for Terrestrial Animals and its Terrestrial Animal Health Code.

Recognising the importance of high-quality vaccines, WOAH has proposed a draft standard for ASF vaccine development and evaluation, as published in the September 2023 report of its Biological Standards Commission. This standard, which will be proposed for adoption at WOAH's 92nd General Session in May 2025, outlines key considerations for the production, quality control and authorisation of ASF vaccines, and calls for public comment from Member and vaccine developers.

Special considerations for wild boar populations

ASF control efforts must also address wild boar populations, which play a significant role in maintaining and spreading the virus, particularly in parts of Europe and Asia. The virus can persist for long periods in carcasses, contaminated environments and wild boar faeces, making eradication especially difficult in areas with high densities of free-ranging wild pigs. Moreover, the occurrence of ASF in wild suids can have broader ecological implications, as it may negatively impact conservation and biodiversity. In some regions, indigenous pig species also experience significant mortalities and morbidities due to ASF, threatening local wildlife populations and ecosystem balance.

Some research institutions are investigating oral vaccination strategies targeted specifically at wild boar. Drawing from the successful use of oral vaccines for classical swine fever, scientists are exploring the feasibility of using bait to deliver live-attenuated ASF vaccine strains to wild populations. The French Agency for Food, Environmental and Occupational Health & Safety has developed a promising attenuated strain that does not involve genetic manipulation, potentially easing regulatory approval for wildlife use.

Nevertheless, oral vaccination campaigns in wildlife raise distinct logistical and ecological questions, including bait distribution strategies, vaccine uptake rates and the risk of unintentional exposure to non-target species. These issues require careful study before any field deployment can be considered.



↑ Two pigs on a farm in the Dominican Republic.



↑ Collecting data in pig farms is crucial for tracking and controlling the global spread of African swine fever.

A tool, not a silver bullet

It is crucial to recognise that vaccination, even if proven highly effective, is not a standalone solution. ASF control requires a multifaceted approach adapted to the specific epidemiological context of each country. Drawing from the experience of other disease control programmes, the use of vaccination should be employed together with other control measures, such as strict biosecurity, the application of sanitary measures, stamping-out policy and other tools such as zoning and compartmentalisation.

When used, vaccination must be implemented through a well-designed programme. This includes clear goals – such as emergency containment, reduction of disease prevalence or protection of valuable breeding stock – as well as robust infrastructure for vaccine storage, distribution and administration. It also requires adequate training for veterinary personnel and communication with farmers to ensure compliance and cooperation.

Equally important is the need for a defined exit strategy. Once the risk level declines, countries should have a clear plan for phasing out vaccination and returning to disease-free status, in line with WOAH standards. This is especially important for maintaining trade relationships, as vaccination may impact a country's disease status and its ability to export pigs and pork products.

The advent of candidate vaccines against African swine fever marks a turning point in the global fight against this devastating disease. For the first time, tools are emerging that could allow countries to potentially not only rely on depopulation for disease control, but also to reduce the long-term burden of ASF through immunisation.

However, realising the full potential of ASF vaccination will depend on rigorous safety evaluations, effective regulatory oversight and strategic implementation. Rolling out the use of poor-quality vaccines or poorly designed or hastily executed vaccination programmes risks doing more harm than good – undermining trust, spreading disease and compromising future control efforts.

International coordination, scientific transparency, and adherence to global standards are more essential than ever. The global pig industry, Competent Authorities and research community must continue working together to ensure that ASF vaccines deliver on their promise, protecting animal health, supporting livelihood, and contributing to food security worldwide.

WOAH in Action

ASF requires strong risk management and national control programmes to be effectively tackled. Launched in 2020, the *Global Control of African Swine Fever: A GF-TADs Initiative (2020–2025)* is jointly implemented by WOAH and FAO under the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs). The goal of the initiative is to improve countries' capacity to prevent, respond to and eradicate ASF using WOAH international standards and the latest scientific knowledge. It brings together governments, the pig industry and technical experts to help Members build long-term strategies to control ASF at global, regional and national levels. It also supports safe production and trade, aiming to keep food systems stable.

Regional and global coordination

WOAH leads Standing Groups of Experts on ASF (SGEs-ASF) in Asia, Europe, the Americas and Africa. These groups facilitate technical exchange and collaboration at the regional level. In 2024:

- The 9th SGE-ASF for Asia and the Pacific met in the Philippines to focus on risk communication and community engagement.
- The 22nd and 23rd SGEs-ASF for Europe were held in Germany and North Macedonia, covering wild boar control and cross-border cooperation.
- The 4th SGE-ASF for Africa, held online, addressed outbreak management.
- The ASF Global Coordination Committee was launched in 2023 to link the regional SGEs and coordinate cross-regional priorities. The committee met again in 2024 during WOAH's 91st General Session to align future technical efforts.

Diagnostics, vaccines and laboratory expertise

WOAH manages the ASF Reference Laboratory Network, which provides Members with technical advice on diagnostics, surveillance and vaccines. In 2024, the network released a manual on laboratory diagnostic protocols for ASF. It supported monitoring of ASF vaccine development and advised on updates to the *Terrestrial Manual*, with vaccine standards expected to be adopted in 2025.

Guidance

WOAH has developed and continues to refine a set of technical tools and standards for ASF:

- *The Compartmentalisation Guidelines for ASF* were published in 2021.
- Work is underway on guidelines for the domestic–wild interface and vaccine use.

Surveillance and reporting

ASF outbreaks are tracked globally through WAHIS, and ASF *Situation Reports* are published regularly, providing updates on outbreak trends and response measures. These reports also include recommendations for Members.

Tailored country support and capacity-building

Through the Performance of Veterinary Services Pathway (PVS Pathway), WOAH has developed ASF-specific content to help countries assess their capacity to prevent and control the disease. In 2024:

- A PVS Evaluation Follow-up mission with ASF content was conducted in Timor Leste.
- An SGE-ASF expert mission was held in Albania to provide tailored advice for local conditions.

WOAH also took part in key events such as the 4th ASF Coordination Meeting for South-east Asia, held in November 2024 to support implementation of the Association of Southeast Asian Nations (ASEAN) ASF Prevention and Control Strategy, including the development of a monitoring and evaluation framework.



A healthy dog is a safe companion. Vaccinating both humans and animals is essential to break the transmission cycle and protect communities.

Rabies: still significant, still deadly

Children playing in the streets of rural communities is a common sight in the Philippines—and so too are free-roaming dogs of unknown rabies status. In these everyday moments, a simple game can quickly turn dangerous if a child is bitten. Rabies, a deadly but preventable disease, continues to pose a serious threat to families around the world. Claiming the lives of over 59,000 people each year globally, rabies remains a significant public health issue in many countries. With a fatality rate approaching 100% once symptoms first appear, rabies is a devastating disease with severe consequences for both human and animal welfare.

Stopping rabies at the source: why dog vaccination works

Bites from rabid dogs remain the most common form of transmission in human cases. The rabies virus spreads when an infected animal bites or scratches another animal or human, depositing saliva containing the virus.

Since 99% of human rabies cases are due to bites from infected dogs, the disease can be prevented and eliminated by educating people to avoid being bitten by dogs, seek treatment when bitten, and vaccinate dogs to disrupt the rabies transmission cycle.

The rabies vaccine, introduced in the late 19th century by Louis Pasteur, remains one of the most powerful tools in preventing this deadly disease in both humans and animals. Mass dog vaccination campaigns have been proven to eliminate dog-mediated rabies in several countries, yet progress has stalled in many others. Between 2005 and 2022, an average of 78% of WOAH Members affected by rabies reported vaccinating dogs, but the percentage of countries reporting implementing rabies control measures has dropped from 85% to 62% in recent years. This decline is a dangerous setback in the global fight against the disease.

To successfully eliminate human deaths from dog-mediated rabies, countries must adopt a comprehensive, coordinated approach that includes:

- *mass dog vaccination:* Vaccinating at least 70% of susceptible dogs in at-risk areas is the most effective way to eliminate human rabies cases;
- *surveillance and reporting:* Helping to prevent further spread of the disease by early detection;
- *dog population management:* Ensuring responsible ownership and humane control of free-roaming dog populations reduces transmission risks;

- *public awareness and education:* Teaching communities about rabies prevention and responsible companion animal care is key to reducing exposure;
- *collaboration with human-health authorities:* A One Health approach ensures access to post-exposure treatments and strengthens disease-prevention efforts.

WOAH has long advocated for increased investment in rabies control, urging governments and international donors to fund mass dog vaccination programmes. By focusing efforts on vaccinating dogs – the key link in the transmission chain – rabies can be prevented at its source, ultimately saving countless human and animal lives.

Optimising vaccination success

Dr Mohamed Idriss Doumbouya is Guinea's WOAH Delegate as well as the Director of Guinea's National Directorate of Veterinary Services. He is also the initiator of Guinea's first nationwide dog vaccination programme, which was rolled out in 2023, and which successfully vaccinated approximately 92,000 dogs and cats in the short period between August and December that year.

Dr Doumbouya attributes the success of this inaugural mass vaccination programme to having a collaborative and multisectoral approach within the One Health framework, including education and awareness, and continuous vaccination to maintain herd immunity using effective vaccines. "In Guinea, our programme has been successful because our human-health colleagues understand that rabies in a significant public health issue. Public awareness should be the first step so that people understand the importance of vaccination campaigns," explained Dr Doumbouya.

He emphasised that education played a key role, alongside ensuring that human-health professionals, veterinarians and local communities worked together. For example, some cities donated refrigerators to localities that did not have access to them, ensuring the correct storage of vaccines so that they remained effective when administered to dogs.

Guinea obtained 100,000 high-quality vaccines through the WOAH Vaccine Bank, which Dr Doumbouya described as a positive experience of facilitated collaboration. Of course, getting the vaccines is a big factor, but not the only factor, to successfully deploying the vaccines. "If we aim to eliminate rabies by 2030 in Guinea, we must maintain continuous vaccination campaigns! I believe it's possible to stop dog-mediated rabies. With rabies as a public health priority, the goal can be achieved!" said Dr Doumbouya.

With his optimism as the bonus ingredient, Guinea will continue to progress towards a rabies-free future by prioritising rabies as a public-health issue, working collaboratively across different sectors, and continuing education and vaccination efforts.

Just over 10,000 km away, in Bhutan, rabies vaccination is performed on an annual basis in the nine dzongkhags (districts) most burdened by the disease. "In [the] 1970s and 1980s, rabies was prevalent in many parts of the country.



↑ A woman is giving food to hungry street dogs, a reminder that community care, along with vaccination, is crucial to improve the health of dogs.

"If we aim to eliminate rabies by 2030 in Guinea, we must maintain continuous vaccination campaigns! I believe it's possible to stop dog-mediated rabies. With rabies as a public health priority, the goal can be achieved!"

Dr Mohamed Idriss Doumbouya
WOAH Delegate for Guinea

At that time, control efforts mainly involved culling stray dogs." Rinzin Pem, Bhutan's Chief Veterinary Officer explained. "However, this approach was strongly opposed by the public, reflecting Bhutan's cultural and spiritual reverence for life and widespread disapproval of animal killing."

Public opposition and the realisation that vaccination was an evidence-based alternative to culling led to a shift in strategy. "Bhutan is a small country with close-knit communities, so public sentiment had a strong influence," said Dr Pem. That and a rabies education plan fully backed by government made implementing vaccination relatively easy.

Like in Guinea, mass dog vaccination in Bhutan is a collaborative effort bringing together Veterinary Services and local governments. Advocacy and awareness programmes are carried out annually in rabies high-risk communities, with a particular focus on schools as children are most vulnerable to the disease. These programmes are conducted by Veterinary Services in collaboration with the Ministry of Health. Mass dog vaccination in free-roaming dogs is conducted annually in high-risk districts by the Veterinary Services.

In 2021, Bhutan launched its most ambitious initiative the Nationwide Dog Population Management and Rabies Control Programme envisioned and guided by the King of Bhutan, it aimed for 100% sterilisation and vaccination of free-roaming dogs nationwide. 'We started in September 2021, and by October 2023, we had successfully sterilised all free-roaming dogs and also achieved 90% rabies vaccination coverage for them,' stated Dr Pem. "If you visit Bhutan now, you'll notice that all free-roaming dogs in the streets have notched ears – this means they are sterilised and vaccinated."

"This was made possible through a whole-of-nation approach. We secured financial resources, engaged communities, and worked with 12,000 volunteers – locally known as "Desuups" – over the two-year programme." She continued, "Prior to this, our vaccination efforts were more ad hoc and dependent on available resources. This nationwide campaign changed that; ensuring a more systematic and effective approach. It also reinforced responsible pet ownership and increased public compliance with rabies vaccination."

Dr Pem is confident that Bhutan will also reach its goal of 'Zero by 30' – eliminating human deaths from dog-mediated rabies by 2030 – thanks to compulsory microchipping, registering and vaccination of domestic dogs and the efforts to maintain at least 70% vaccination coverage and sustain 100% sterilisation coverage of free-roaming dogs.

"I'd like to emphasise, however, that transboundary animal diseases don't recognise national borders" she added, "While Bhutan has made significant progress, no country can eliminate rabies alone. Regional and global cooperation is essential."

Beyond the needle: the role of oral rabies vaccination

While injectable vaccines remain the primary tool for rabies control in dogs, ensuring widespread coverage, especially among free-roaming and hard-to-reach dog populations, remains a significant challenge. In many middle- and low-income countries, logistical and economic barriers hinder the ability to maintain adequate vaccination coverage, putting both animals and humans at continued risk of rabies transmission.

Oral rabies vaccination (ORV) is a promising complementary tool to injectable vaccines, particularly for vaccinating free-roaming and hard-to-reach dog populations in areas where catching and handling dogs is challenging. ORV has already been instrumental in eliminating rabies in wildlife species across Europe and North America. In recent years, pilot projects in low- and middle-income countries in Africa and Asia have shown that ORV of dogs can also be safe, immunogenic, and effective in free-roaming dogs when the right bait, vaccine formulation and distribution system are used.

Despite its promise, national-scale deployment of ORV in dogs remains limited. Key challenges include ensuring vaccine safety for humans and non-target species, navigating regulatory approvals, managing cold-chain logistics, and integrating ORV into national rabies control plans. Cost–benefit analyses and operational research are ongoing to help address these challenges.

ORV is not a replacement for injectable vaccines but expands the reach of vaccination efforts. When strategically integrated into broader control programmes, ORV may enhance vaccination coverage, particularly in settings with high numbers of free-roaming and hard-to-reach dog populations.



↑ A veterinarian vaccinating a dog against rabies in Cambodia.

WOAH in Action

Joint efforts are critical in vaccination and education efforts. WOAH's support to its Members in addressing dog-mediated rabies is deeply rooted in collaboration, as demonstrated by the following initiatives.

WOAH Reference Laboratory Network for Rabies

In May 2021, WOAH established the Reference Laboratory Network for Rabies (RABLAB). Composed of 14 WOAH Reference Laboratories for rabies, RABLAB coordinates scientific and technical activities related to rabies diagnosis, surveillance and research.

This network supports WOAH Members with rabies diagnostics, surveillance, capacity-building and programme implementation. Scientific and technical training for personnel is provided by WOAH Members to other members. Showcasing heartening 'Members for Members' collaboration. RABLAB emphasises the importance of using approved, high-quality rabies vaccines that meet international standards for efficacy, safety and sterility. This emphasis helps ensure that vaccination campaigns achieve sufficient herd immunity, contributing to sustained reduction, and eventual elimination, of dog-mediated rabies.

WOAH Rabies Vaccine Bank

The WOAH Rabies Vaccine Bank is a mechanism that enables reliable, rapid and large-scale procurement of high-quality dog rabies vaccines for systematic mass vaccination and emergency responses. Rather than holding physical stockpiles, WOAH operates the bank through contractual arrangements with commercial vaccine manufacturers, selected via international tenders.

The WOAH Rabies Vaccine Bank is not intended to replace national procurement. Instead, it is a voluntary mechanism for WOAH Members, which acts as a catalyst by simplifying access to vaccines that comply with WOAH standards, promoting economies of scale, encouraging disease control planning and stimulating implementation of effective national vaccination strategies.

As of May 2025, the WOAH Rabies Vaccine Bank has delivered 29.3 million dog rabies vaccine doses to countries in Africa and Asia since its creation in 2012.

Endorsement of official control programme for dog-mediated rabies

The endorsement of a national official control programme for dog-mediated rabies by WOAH is a strategic milestone for countries aiming to eliminate human rabies deaths. This endorsement signifies that a country's Veterinary Services and other Competent Authorities have demonstrated their capacity to implement effective rabies control and elimination strategies. This achievement provides international recognition of the country's commitment, facilitates broader access to international expertise and capacity-building, and strengthens the case for increased governmental and investor engagement for rabies elimination efforts.

United Against Rabies Forum

The United Against Rabies (UAR) Forum was established in 2020 to implement the objectives of *Zero by 30: The Global Strategic Plan to End Human Deaths from Dog-mediated Rabies by 2030*. Hosted by WOAH, on behalf of the Tripartite organisations (WOAH, FAO and WHO) the UAR Forum is an inclusive network bringing together international organisations, country and regional authorities, development partners, private-sector partners, academic experts and non-governmental organisations. Encompassing more than 90 organisations, with representation from 38 countries, the UAR Forum is committed to working together and leveraging existing tools and expertise in a coordinated manner to support countries to achieve 'Zero by 30'.

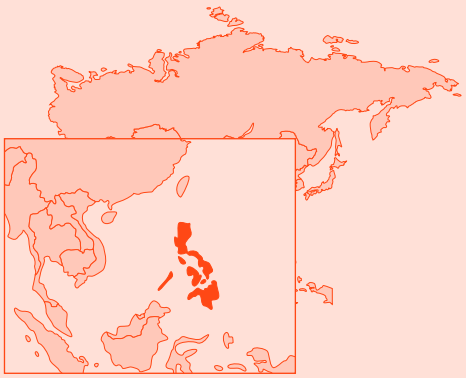


A dog with its owner in Cambodia.

Case Study 4

Philippines: Collaboration is critical

Location
Philippines



In the Philippines, rabies remains a significant public health issue causing approximately 200 deaths annually, with 98% of cases resulting from rabid-dog bites.

To combat this, the National Rabies Prevention and Control Program was established. The programme is a multi-agency effort led by the Department of Agriculture's Bureau of Animal Industry in collaboration with the Department of Health and other national agencies.

Key points to success:

- The Philippines leveraged support from WOAH's rabies vaccine bank. In February 2013, the country received 500,000 doses of rabies vaccine through EU funding, leading to a noticeable decline in rabies cases.
- From 2014 to 2016, further assistance came through the Australian-funded Stop Transboundary Animal Diseases and Zoonoses Rabies Project, which provided 940,000 additional doses.
- Recognising the impact of mass vaccination, the Department of Health increased funding by 69.5 million Philippine pesos.
- In 2015, as a result of the above support, the Philippines secured over 7 million dog rabies vaccine doses, with 4.22 million doses delivered by December.
- Between 2015 and 2020, 15.7 million vaccine doses have been delivered.

Although the country still faces challenges in its efforts to combat rabies, such as sustained funding and human resources for rabies control, this case study truly highlights the effectiveness of international collaboration and financial assistance in controlling rabies.

Continuous advocacy campaigns to secure funding and policy support for rabies prevention from the Philippine government will still be required to keep the momentum.

By utilising the WOAH Vaccine Bank and integrating a One Health approach, the Philippines successfully expanded its rabies vaccination efforts, which led to a significant reduction in cases.

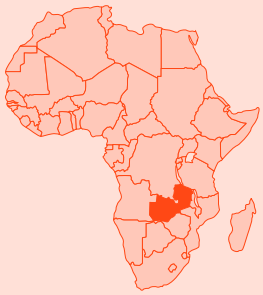


↑ Children with dogs in the Phillipines.

Case Study 5

Zambia's rabies control strategy: a model for One Health success

Location
Zambia



Zambia has been combating rabies in the country through a focus on controlling dog-mediated rabies. Rabies poses significant health and economic risks, with domestic dogs as the primary transmitters of the disease. The country also faces wildlife-mediated rabies, particularly from jackals and hyenas near wildlife reserves.

Zambia developed a comprehensive rabies control strategy that was endorsed by WOAH in 2023. The strategy aims for Zambia to eventually self-declare freedom from rabies.

Key components included:

- Mass dog vaccination: The country conducted mass vaccination campaigns across various districts, targeting a 70% dog vaccination rate. Tools like the Rabies Vaccination Tracker and smartphone applications were introduced to monitor vaccination coverage.
- Pilot projects: In Lusaka, a pilot project vaccinated 50,000 dogs in just one year, exceeding initial targets. This success was made possible through collaboration with various partners, including those from the private sector.
- Public awareness and education: Educational campaigns in schools and communities raised awareness about rabies prevention and control.

Zambia's strategy prioritises a One Health approach, integrating human, animal and environmental health. One significant achievement is the implementation of integrated bite case management, which promotes collaboration between health centres, the police, and veterinary officials to ensure a swift response to dog-bite incidents. Furthermore, continuous training and the adoption of innovative technology have been essential in tracking vaccination progress, overcoming initial challenges to strengthen disease control efforts.

WOAH's endorsement helped Zambia secure additional resources and international support, including a contribution of 700,000 doses of rabies vaccines from the Centers for Disease Control and Prevention and United States Agency for International Development, enhancing Zambia's global position in rabies control.

Zambia's rabies control strategy has been endorsed as a model of success in the One Health framework. The country's comprehensive approach, combined with innovation, partnerships and education, sets a benchmark for other nations fighting rabies, and contributes to the global goal of eliminating human deaths from dog-mediated rabies.



↑ Child playing with a dog.



Goats and sheep are the animals most affected by peste des petits ruminants.

Peste des petits ruminants: a risk to livelihoods and food security

Imagine waking up to find your family's primary source of income, food and stability at serious risk. This is what happens when a farmer's entire herd of sheep or goats suddenly becomes sick, unable to eat or dies. This is the devastating reality of peste des petits ruminants. PPR is a highly contagious viral disease that continues to ravage livestock populations across Africa, Asia, the Middle East and, more recently, parts of Europe, threatening 80% of the world's sheep and goat population.

Once thought to be confined to regions in the Global South, PPR has recently re-emerged in Europe, underscoring its transboundary threat. New outbreaks in Greece, Romania, Bulgaria and Hungary mark a concerning shift in the disease's geographical footprint, challenging assumptions about its containment and raising the stakes for global eradication efforts.

PPR spreads rapidly among domestic and wild sheep and goats, causing fever, painful mouth sores, severe pneumonia and diarrhoea. With mortality rates often exceeding 70% in naïve populations, it is one of the most devastating animal diseases. Entire herds can be wiped out in weeks after a single outbreak – leaving millions of rural families without food, income or means to rebuild.

More than 300 million farming households depend on small ruminants for survival, and women – who play a crucial role in livestock rearing – are hit hardest when PPR strikes. The loss of animals directly impacts their ability to provide for their children's nutrition, education and future.

But there is hope. A highly effective, lifelong vaccine exists, and, with widespread vaccination efforts and better coordination between countries to manage livestock movement and promote safe trade, PPR can be eradicated – just as rinderpest was before it. By eliminating this disease, we can protect livelihoods, strengthen food security and empower communities worldwide.

Controlling peste des petits ruminants to achieve social empowerment

Given its high death rate accompanied by high morbidity, meaning lots of animals experience clinical signs of the disease especially in naïve populations, PPR also has a significant economic impact on livelihoods within a community. The disease puts at risk the livelihoods and food security of some 300 million rural families worldwide who rely on small ruminant farming. Its reappearance in Europe is a stark reminder that no region is immune, and that global coordination is more crucial than ever. Eradicating PPR, through effective vaccination programmes and other appropriate measures, would not only benefit animal health and welfare, but also improve community livelihoods.

As women and youth are overrepresented in small ruminant rearing in PPR-impacted countries, the disease can affect the revenue they commonly invest into improving nutrition and child education. Controlling PPR can therefore empower women and youth, while providing better prospects for their children.

The PPR virus consists of a single serotype with four lineages/strains. The currently available live-attenuated vaccines offer cross-protection against all lineages, hence one PPR vaccine can be used effectively globally. This implies that an animal recovered from a PPRV strain or that has been vaccinated develops immunity and is protected against infection by any other PPRV strain.

The vaccine is inexpensive to produce and induces long-term protective immunity in vaccinated animals. It is highly effective but is sensitive to heat and requires a cold chain to be maintained up to the point of use to avoid virus inactivation. This temperature sensitivity poses a challenge in warmer climates where access to refrigeration may be limited. However, thermostable vaccines have now been developed and a report on the criteria to guide its use is pending submission to WOAH. It is anticipated that the increased availability of quality thermostable PPR vaccines will make efficacious field vaccination more feasible. Despite years of progress in PPR control, Europe is now facing fresh challenges. The disease has been detected in Greece and Romania in July 2024, in Bulgaria in December 2024, and in Hungary in January 2025. This resurgence of PPR in parts of Europe, regions previously free of the disease, has prompted serious concern and increased vigilance among Veterinary Authorities.

Morocco: Triumphing over peste des petits ruminants through vaccination

From 2005 to 2022, an annual average of 70% of WOAH Members affected by PPR reported official vaccination against the disease. During this period, a stable trend was observed with a peak of 82% of affected countries vaccinating in 2015.

One of these countries is Morocco. After PPR was first detected in the country in 2008, the government implemented several measures, including large-scale vaccination campaigns, to contain and control the disease. Morocco has not



↑ Wandering sheep on the hill in a city of Fes in Morocco.

recorded any more PPR outbreaks since its last reported case in November 2022. Thanks to the country's ongoing mass vaccination efforts, continuous surveillance, and strict controls on animal imports, Morocco has effectively mitigated the risk of reintroduction of PPR. However, the primary threat remains the illegal or uncontrolled movement of infected animals across borders.

This same risk now confronts the European continent. The recent outbreaks in south-eastern Europe underscore the persistent threat posed by transboundary animal diseases. They also reveal how swiftly PPR can spread undetected, as infected animals often carry the virus silently before showing any clinical signs.

Morocco developed two different strategies to control and eradicate the disease. Initially, from 2008 to 2010, more than 90% of PPR-susceptible animals were vaccinated annually against the disease. To test the effectiveness of this approach, two serological surveys were carried out in 2012 and 2014 respectively, which confirmed that the virus was no longer circulating in the small ruminant population.

Since 2020, and following the evolution of the PPR situation at subregional level, the Moroccan Veterinary Authority adjusted its vaccination strategy for both PPR and sheep pox to once every two years using a single dose of bivalent vaccine. The Moroccan Government covered the vaccination costs, and the fees of the private veterinarians commissioned to carry out the vaccination campaigns, which represented a large investment to vaccinate on average 22.4 million small ruminants every two years, to achieve the remarkable result of controlling the disease.

Despite these efforts, and bearing in mind that PPR is a cross-border disease, it would appear that one of Morocco's greatest challenges today is the harmonisation of the subregional approach to combating PPR, which must involve conducting widespread vaccination programmes for small ruminants at regular intervals using effective and high-quality vaccines. This means mobilising sufficient financial resources to ensure maximum vaccination coverage of sheep and goats in the countries of the subregion, in order to control and eradicate the disease and reduce its negative impact on farmers.

"In countries like Morocco, the Maghreb, and other African countries, there is a high mobility of animals. This makes it difficult to adopt a strategy based solely on sanitary measures, as controlling the movement of animals is very challenging, if not impossible. This is why we believe that adopting an approach combining vaccination with other sanitary measures as a means of controlling and eradicating a disease such as PPR is the most appropriate choice for our context, despite its cost, and the results obtained from this vaccination approach are perceptible. The use of effective, high-quality vaccines is also essential to the success of the vaccination strategy" said Dr Abderrahman El Abrak, the WOAH Delegate for Morocco.

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Dr Abderrahman El Abrak
WOAH Delegate for Morocco



↑ Lambs are being treated with a traditional remedy of tarr to protect them against attacks by predators in the Karroo.



Goats on trees in Marrakesh, Morocco.

"We have a well-developed private veterinary sector in almost every region of Morocco, which provides significant support in conducting livestock vaccination campaigns against several animal diseases, particularly PPR, helping us achieve a very high vaccination coverage rate. Their support has been crucial in reaching our objectives, particularly in raising awareness and motivating farmers to participate in the vaccination campaigns."

Dr Abderrahman El Abrak
WOAH Delegate for Morocco

Veterinary Services, farmer participation and local vaccine production

Since 2008, Veterinary Services in Morocco have collaborated with Moroccan pharmaceutical companies to produce a vaccine against PPR. As of 2025, two companies are producing effective PPR vaccines in Morocco. This allows the country to have direct access to reliable and field-tested vaccines at a competitive price, with reliable vaccine supplies during large-scale vaccination campaigns.

For several decades, Morocco has also invested in the development of the private veterinary sector by encouraging veterinarians to settle in rural areas. Their presence ensures the availability of regular support to farmers, while providing a highly effective network of professionals on which animal health authorities can promptly rely on when deploying vaccination campaigns.

The Moroccan Government pays for the work of these rural private veterinarians, so that farmers are not required to cover vaccination costs. This strengthens the partnerships between everyone involved, with positive outcomes for animal welfare, while effectively controlling virus circulation. As Moroccan farmers are already familiar with vaccination campaigns for other livestock diseases – including FMD, they have been willing to get their livestock vaccinated against PPR. A key factor driving participation is having the cost fully covered by the Moroccan Government, making PPR vaccination more accessible and adoptable. Local authorities are also involved by working alongside Veterinary Authorities to ensure the maximum participation of farmers. As Morocco works to achieve PPR-free status, the animal welfare benefits coupled with reduced economic losses from the disease also contribute to better incomes for farmers.

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Good quality Veterinary Services are indispensable for the successful and sustainable implementation of PPR prevention and control activities. Strengthening veterinary capacity will also create more cost-effective opportunities to control other priority animal diseases, through the combination of activities such as vaccinations against other major diseases, epidemiological investigations, diagnostic activities and treatments.

A regional approach vital to eliminating peste des petits ruminants

The porous nature of many land borders between countries makes it challenging to restrict the movement of animals to reduce the disease risk to the animal health status of a country. Morocco is leading initiatives to harmonise regional eradication strategies and enhance cross-border cooperation.

Dr El Abrak, summarised the situation as follows:
Given the difficulty of effectively and sustainably controlling the risks associated with illegal animal movements across borders, the only way to control this risk is through a coordinated regional and sub-regional approach to fighting the disease. A single country cannot achieve its goal of eradicating a transboundary disease like PPR on its own as the risk of illegal introduction cannot be completely eliminated. Therefore, it is essential for other countries to implement similar control strategies so that we can stop the circulation of the virus across different regions.

He went on to say:
A harmonised regional strategy is required to completely and permanently eliminate this disease. Morocco has made a tremendous effort to control the disease, and it has successfully achieved this goal. However, given the different epidemiological situations in neighbouring countries and the risks of illegal animal movements across borders, we need a coordinated regional approach to PPR control.

As the transborder nature of PPR requires actions to be harmonised in all countries in the same region, regional coordination is essential for successful implementation of the Global Control and Eradication Strategy of PPR (GCES), published by WOAH and FAO. Countries affected by PPR have been grouped into nine regions where the progress towards eradication of PPR will be assessed in regional roadmap meetings, and through the utilisation of regional action plans outlining the control and eradication measures to be implemented at national and regional levels.

The resurgence of PPR in Europe underscores the urgency of these plans and the need to act before the virus establishes a broader foothold on the continent.

Vaccination is the cornerstone of the fight against PPR, and its widespread implementation is essential to the eventual eradication of this devastating disease. Drawing inspiration from the successful eradication of rinderpest, we are reminded that global collaboration, strategic vaccination campaigns, and sustained efforts can indeed eliminate a deadly animal disease. The experience gained from rinderpest eradication provides a blueprint for tackling PPR, emphasising the importance of timely and targeted vaccination to protect sheep and goats. By building on these lessons, we can accelerate progress, tracking milestones toward a world free of PPR. With collective effort and continued dedication, we have the opportunity to achieve another monumental success in animal health.

WOAH in Action

Launch of the Pan-African Programme for the Eradication of Peste des Petits Ruminants and Control of Other Priority Small Ruminant Diseases

In February 2025, the Pan-African Programme for the Eradication of Peste des Petits Ruminants was officially launched in Addis Ababa, Ethiopia, with the goal of eliminating PPR by 2030. This initiative brings together African Union members, governments, development partners, FAO, WOAH and the private sector to combat the disease, which poses a significant threat to livestock and economies. The first phase (considered preparatory) of the EU-financed programme is funded to EUR 8 million to kickstart the Pan-African programme costed at EUR 528 million. The programme aims to foster partnerships and invest in sustainable veterinary solutions to ensure Africa's livestock future is PPR-free.

Global Control and Eradication Strategy of Peste des Petits Ruminants

PPR is a notifiable WOAH-listed disease and must be reported to the Organisation, according to the *Terrestrial Animal Health Code.* Countries have the option of applying for official recognition by WOAH of their freedom from PPR – either for their whole country, or a specific zone. WOAH also provides a voluntary mechanism available for Members to seek official endorsement of their PPR control programmes.

WOAH and FAO jointly developed the *Global Strategy for the Control and Eradication of PPR* under GF-TADs. The main goal of the strategy is to eradicate PPR. With ongoing global efforts, PPR has the potential to become the second animal disease to be eradicated in history following rinderpest. One of the important lessons learnt from the successful eradication of rinderpest, which is being applied to PPR eradication efforts, is the need to use a highly efficient vaccine. Vaccination is therefore one of the key tools utilised in the *Global Strategy for the Control and Eradication of PPR.*

The GCES provided for a PPR Monitoring and Assessment Tool that has been specifically designed to monitor and evaluate the implementation of the strategy. WOAH's Tool for the Evaluation of Performance of Veterinary Services is also used to assess the performance of Veterinary Services to support the technical activities of PPR control and eradication.

WOAH Peste des Petits Ruminants Vaccine Bank

The WOAH PPR Vaccine Bank ensures the timely supply of high-quality vaccines meeting WOAH standards. Established in 2012, the bank provides both emergency and planned vaccine supplies at competitive prices. It reduces procurement complexities and lowers costs. The bank's role is crucial for harmonising PPR control efforts, particularly in Africa. The vaccine bank has particularly supported countries implementing the Sahel Regional Project Supporting Pastoralism (PRAPS), with support from the World Bank.

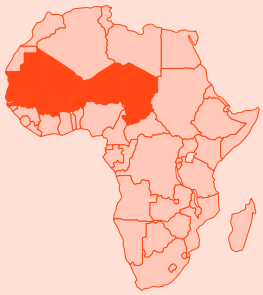
Sahel Regional Project Supporting Pastoralism

The Sahel Regional Project Supporting Pastoralism (PRAPS), co-funded by governments and the World Bank, targets PPR control in the Sahel region (Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal). Between 2016 and 2022, 188 million doses of PPR vaccine were distributed in the region, including 32.2 million doses in 2022. Despite progress, challenges like vaccine effectiveness, quality control and human resource constraints remain.

Case Study 6

Peste des petits ruminants control in the Sahel: a regional success story

Location
Sahel region





↑ Shepherd with herd of goats in the dusty African savannah.

Through PRAPS, six countries of the Sahel region, the semi-arid region of western and north-central Africa which forms a transitional zone between the arid Sahara Desert to the north and the belt of humid savannas to the south, including Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal, have been involved in an ambitious initiative to control PPR in the region.

PRAPS is co-funded by governments and the World Bank to support national and regional efforts to build more sustainable and effective Veterinary Services, including the development of basic veterinary technical manuals. The regional coordination of the animal health component of PRAPS is entrusted to WOAH under a partnership agreement with the Permanent Interstates Committee for Drought Control in Sahel.

Between 2013 and 2024, 117.76 million doses of PPR vaccine were distributed to the PRAPS countries, with an impressive 32.2 million doses delivered in 2022 alone. The use of the WOAH PPR Vaccine Bank has been instrumental in supporting the supply of quality PPR vaccines.

While significant progress has been made in PPR vaccination in the Sahel region, several challenges persist in controlling the spread of PPR and achieving long-term control goals. One of the primary issues is ensuring the effectiveness of the vaccinations. Although substantial efforts have been made to distribute vaccines, the region's vast and sometimes remote landscapes pose logistical challenges that can delay timely vaccine delivery, affecting coverage and diminishing the vaccine's impact. Additionally, maintaining high-quality vaccines under difficult environmental conditions is a constant concern, as improper storage or handling can reduce their efficacy. Furthermore, the shortage of trained veterinary personnel is a significant hurdle. Many countries in the Sahel face a lack of skilled staff to manage vaccination campaigns, perform surveillance and respond effectively to outbreaks. This human resource gap is exacerbated by limited access to training programmes and high turnover in Veterinary Services. Moreover, the region's political and economic instability, along with its vulnerability to climate change, complicates coordination efforts and creates an environment where resources are often thinly spread. Finally, despite considerable funding, securing sustained financial support for ongoing vaccination campaigns, surveillance activities and infrastructure development remains a challenge. These factors combined make it difficult to achieve complete eradication, requiring continued investment in infrastructure, training and international cooperation to ensure long-term success in the fight against PPR.

Countries involved in PRAPS have made notable strides in enhancing the livelihoods of pastoralists in the Sahel by addressing critical issues related to animal health, resource management, market access and crisis preparedness. Continued collaboration among governments, international partners, and local communities will be vital to overcome existing challenges and ensure the sustainability of these improvements.



Three young gauchos on horseback herding prised Aberdeen Angus cattle into rocky hillside enclosure.

Foot and mouth disease: A global threat to livestock and trade

Trade and movement of animals are essential to feeding a growing global population, helping ensure that communities around the world have access to meat, milk, and other vital animal products. But in our increasingly connected world, the same systems that support food security can also accelerate the spread of infectious diseases. What helps put food on the table for one family could, without strong safeguards, risk livelihoods elsewhere. And with global agricultural demand expected to soar by 70% to feed a projected 9.1 billion people by 2050, the threat of diseases like FMD looms larger than ever. In such a world, even a single outbreak could have far-reaching consequences.

FMD is one of the most economically destructive livestock diseases worldwide, threatening food security, rural livelihoods, and the global trade of animals and animal products. While some countries have successfully eradicated FMD, others continue to battle its spread, requiring constant vigilance and robust prevention strategies. Among the most effective tools in disease control, vaccination has played a pivotal role in reducing outbreaks and maintaining FMD-free status.

FMD is a highly contagious viral disease, affecting cattle, swine, sheep, goats and other cloven-hoofed ruminants. Although it is rarely fatal in adult animals, the disease can be catastrophic for young animals, causing inflammation of the heart muscle or death due to the inability of infected dams to produce milk. Symptoms in infected animals include fever, blister-like sores on the tongue, lips, mouth and between the hooves – leading to severe production losses and weakened animals. While most affected animals eventually recover, the economic impact of the disease can be devastating.



↑ Working with Angus cattle in the Argentine field.

Together with other measures, vaccination has proven to be a vital tool in protecting susceptible animals from FMD. Depending on the country's specific situation, vaccination strategies can range from mass coverage of the entire livestock population to targeted vaccinations in high-risk areas or emergency vaccination in case of outbreak. Deciding whether to vaccinate is a decision made by each country's national animal health authorities, considering factors such as epidemiological situation, economic considerations, logistical challenges in vaccine administration, and the potential impact on international livestock trade. However, the benefits of a well-coordinated vaccination effort cannot be overstated – it helps prevent large-scale outbreaks, reduces economic losses, protects rural livelihoods, and enables countries to maintain or regain access to international markets. This is especially important as the global trade in animals and animal products continues to grow, and the need for disease prevention becomes even more critical in safeguarding both public health and the economy.

Successful foot and mouth disease vaccination in Argentina

During past outbreaks of FMD in Argentina, vaccination of bovine and buffaloes was an important strategy used to manage FMD, including successful eradication of the disease following improvements to vaccination protocols and the type of vaccine administered.

"Argentina's success in controlling FMD was the result of a combination of factors – improved vaccines, strong private-sector involvement and strict government oversight. The country's experience provides a valuable model for other regions striving to eradicate the disease," says veterinarian Dr Sergio Duffy, consultant and Senior Technical Advisor from the Center for Animal Health and Food Safety at the University of Minnesota.

Utilising vaccines that provided longer-lasting protection for livestock was a key factor in the successful management of FMD in Argentina.

Dr Duffy explained:
Like many countries in South America, Argentina had been trying to control foot and mouth disease for decades. However, by the early 1990s, the country had a breakthrough with managing the disease. The first major change was replacing the use of saponin-based vaccines containing the plant-derived saponin with oil-adjuvanted vaccines – the adjuvants are the constituents added to vaccines in order to improve immune responses.

These vaccines provided longer-lasting immunity, ensuring that cattle older than two years were protected for at least one year, rather than requiring more frequent revaccination as before. The second key factor was that the National Service for Agri-Food Health and Quality increased the standards for vaccine approval. The number of protective doses required for each vaccine series to be approved was raised, which significantly improved the quality of vaccines used in the field.

"Argentina's success in controlling FMD was the result of a combination of factors–improved vaccines, strong private-sector involvement and strict government oversight. The country's experience provides a valuable model for other regions striving to eradicate the disease."

Dr Sergio Duffy
Veterinarian, consultant and Senior Technical Advisor from the Center for Animal Health and Food Safety at the University of Minnesota.



Argentine gaucho on horseback herding cows with his dog.

"The third key factor was the direct involvement of the private sector in the financing and management of FMD vaccination programmes at the local level, which resulted in improving their compliance and ensuring their continuity", concluded Dr Duffy.

Based on WOAH vaccination guidelines

WOAH's guidelines state that vaccination programmes carried out in a target population of animals should provide coverage of at least 80% of that population, with vaccination campaigns being completed in the shortest possible time and administered in the correct dose and by the appropriate route. Vaccination should also be scheduled to minimise interference from maternal immunity – the natural immunity that a mother passes onto her young.

The vaccines used should meet WOAH international standards, and the virus strain or strains in the vaccine must antigenically match those of the disease circulating in the field. With FMD, it is important that vaccines containing inactivated virus, meaning the killed version of the virus that causes the disease are utilised, because an inactivated virus does not have the ability to multiply in vaccinated animals. The use of live virus vaccines, which may cause the vaccinated animal to develop the very disease it is being vaccinated against, is not acceptable due to the danger of the reversion to virulence – or disease-causing ability and further transmission to other animals.

Community support is vital to managing foot and mouth disease

FMD production losses have a big impact in countries where many people are directly dependent on livestock. The success of control and eradication efforts hinges on the agriculture sector's support, making active community engagement and commitment essential for achieving lasting results.

Dr Francisco D'Alessio, WOAH Regional Representative for the Americas, explained that one of the most critical factors in the successful FMD vaccination strategies implemented



"Control and eradication efforts succeed only when they are embraced by the agricultural sector. Community engagement and ownership are what drive sustainable, impactful outcomes."

Dr Francisco D'Alessio
Regional Representative for the Americas

↑ A farmer gets down with a cow from a truck, Buenos Aires, Argentina.

across South America was the active involvement of the private sector and farming communities in the rollout of vaccination campaigns and the presence of strong regional coordination mechanisms:

Rather than a top-down government-imposed programme, livestock producers themselves took an active part in organising and implementing the vaccination efforts, under the supervision and coordination of the Veterinary Authorities. Each country set up its specific vaccination mechanisms involving local stakeholders under tight official campaign calendars.

In some cases, the private sector fully financed the vaccination process, covering the costs of vaccine procurement and administration. Also, in areas where small-scale or subsistence farmers faced economic hardship, dedicated funds ensured that vaccines were provided free of charge to those unable to afford them, to ensure adequate vaccination coverage.

In some regions of South America, gathering cattle is only feasible at specific moments of the year due to geographical challenges such as the extensive farming systems, forests, flooding or mountainous terrain. The agriculture sector's support and active community engagement in the vaccination allowed cattle to be effectively protected despite these logistical challenges. Strict protocols for transport and storage were also implemented to preserve vaccine efficacy. Vaccines had to be delivered to vaccination centres in refrigerated containers, and vaccination personnel received thorough training to ensure best practices in vaccine storage, administration and animal handling.

In a region with long land borders and important regional trade, the development of a coordinated regional plan following similar strategies was essential. As a result of these coordinated measures, vaccination coverage increased significantly across the region, leading, together with adequate surveillance and prevention strategies, to the effective control and progressive eradication of FMD in the region.

"Control and eradication efforts succeed only when they are embraced by the agricultural sector. Community engagement and ownership are what drive sustainable, impactful outcomes," emphasised Dr D'Alessio.

Foot and mouth disease: a constraint on international trade

Each year, losses from FMD are estimated to be between US$ 6.5 billion and US$ 21 billion in regions where the disease is endemic, and more than US$ 1.5 billion when outbreaks occur in FMD-free zones. FMD is a significant constraint on international trade in animals and animal products, and the disease especially restricts world trade in a south–north direction. Endemically or sporadically infected countries generally face total embargoes on the export of their live animals and fresh meat to FMD-free countries. In addition to the trade restrictions, the disease also severely reduces the productivity of the meat and milk industries in countries impacted by it. There are also further costs of FMD resulting from the policing of borders by FMD-free countries, and the costs of tests and quarantine for live animal imports.

For any country, particularly those where agro-pastoral production plays a central role in the economy, achieving FMD-free status brings significant economic and trade benefits, in addition to improvements in animal health and welfare. Countries that have been officially recognised as free from the disease are committed to maintaining their WOAH status.

Dr D'Alessio explained:
In the case of South America, the economic gains from achieving FMD-free status have been substantial, especially in terms of increasing animal production and gaining access to international markets. Previously, beef exports from the region faced trade limitations, but with eradication of FMD, new export opportunities opened up, including access to key global markets, and what is even more important, allowing their sustained maintenance over time.

While large-scale commercial producers probably saw the most direct benefits from expanded trade, small-scale farmers also experienced improvements. The reduction in FMD outbreaks led to fewer production losses throughout the livestock sector. Additionally, the pork and sheep industries in the region also benefited, as the absence of FMD improved their access to new and diversified markets.



↑ Children on a field playing with a cow.



↑ A cow and its calf in the field.

Tailored approaches supported by well-funded Veterinary Services

While vaccination was used effectively in Argentina to manage FMD, the control strategies for FMD vary between countries due to factors like disease prevalence, geography, economic resources and veterinary infrastructure. Varied livestock systems and differing levels of government support also shape approaches. Tailored strategies are therefore necessary for each country, considering local challenges, resources, trade priorities and veterinary infrastructure.

Veterinary Services are the backbone of FMD prevention and control, playing a vital role in disease surveillance, educating farmers, ensuring safe trade practices, and responding effectively to outbreaks. Their effectiveness depends on strong government support, with adequate funding and resources to enforce biosecurity measures, conduct surveillance and implement vaccination campaigns where needed. Investing in veterinary infrastructure and personnel strengthens national and regional capacities to manage FMD risks, protecting livestock health while sustaining food security, trade, and economic stability for millions worldwide.

FMD remains a persistent challenge for livestock-dependent economies, threatening food security, trade and rural livelihoods. The recent outbreaks in Europe, including in Germany, Hungary and Slovakia, highlight the need for vigilance, proactive surveillance, and strict adherence to biosecurity measures. Tailored strategies, supported by strong Veterinary Services and international cooperation, are essential to managing and eventually eradicating FMD in affected regions. By implementing robust control measures and learning from past outbreaks, countries can work towards securing a future where FMD no longer poses a major economic and agricultural threat.

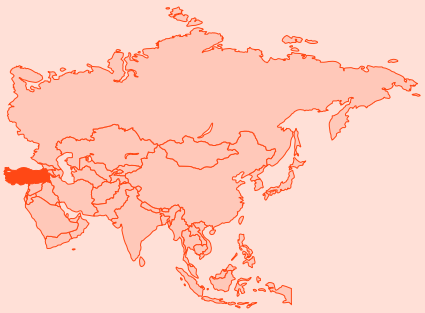
WOAH in Action

- FMD was the first animal disease for which WOAH established an official disease-free status, highlighting the Organisation's long-standing commitment to global animal health. Since then, several countries have established freedom from FMD, benefiting from enhanced trade opportunities and improved livestock production. However, FMD is endemic throughout many countries in Africa, the Middle East and Asia, and in certain parts of Europe.
- WOAH plays a critical role in monitoring and validating FMD status worldwide, with each country's FMD status publicly available on its website. The recognition of FMD-free status by WOAH is a significant achievement, offering countries access to international markets, enhancing their agricultural exports, and reinforcing their commitment to safe and sustainable livestock practices. With ongoing global collaboration, WOAH firmly believes that the eradication of FMD is achievable, and that the Organisation's continued work remains crucial in advancing this goal.
- In 2012, together with FAO, WOAH developed the *Global Foot and Mouth Disease Control Strategy* with the aim of reducing the global burden of FMD and the risk of reintroduction of the disease into free areas. Some countries may also be aiming to eradicate the disease, while others already recognised as free from FMD are focused on maintaining this status.
- The Global Strategy combines the Progressive Control Pathway for Foot and Mouth Disease and the WOAH PVS Pathway, which evaluates the national Veterinary Services of a country with the aim of bringing it into compliance with WOAH quality standards.
- The Progressive Control Pathway for Foot and Mouth Disease is applied at national level while progress is assessed at regional level using roadmap platforms, which enables harmonised programmes and exchange of information. Regional roadmaps are organised based on coordinated actions within the seven major FMD virus pools, and a long-term shared vision under GF-TADs. By evaluating progress regionally, countries can share best practices, align strategies and address shared risks effectively. This helps ensure that control measures are harmonised across neighbouring countries, which is essential for preventing the spread of FMD and achieving sustainable, long-term control across regions.

Case Study 7

The Republic of Türkiye's successful fight against foot and mouth disease

Location
Türkiye



In 2023, the Republic of Türkiye responded swiftly to a major threat to its livestock sector: the SAT-2 serotype of FMD. First detected in eastern Türkiye on 3 March, the SAT-2 serotype posed a significant risk after spreading in neighbouring countries earlier that year.

Recognising the danger, Türkiye's Ministry of Agriculture and Forestry acted quickly, working with WOAH and the EU. Dr Ahmet Gümen, Türkiye's WOAH Delegate, said the country's readiness came from its experience in an FMD-prone region. "We've developed strong expertise in early detection and rapid response," he noted.

Preparations had already begun by January 2023, when Türkiye's National Disease Control Centre started coordinating with other institutions using insights from the Risk-Based Control Programme, active since 2014. Planning focused on surveillance, crisis communication and logistics. One of the main priorities was to secure the SAT-2 strain from affected neighbours in order to include it in local vaccines. This was achieved through international cooperation under WOAH and FAO. "We detected the SAT-2 threat before it reached us," said Dr Gümen.

Türkiye is one of only seven countries globally that produces its own FMD vaccine. Although the SAT-2 strain had not yet been included in vaccines at the start of 2023, samples were obtained from Iraq on 25 January and confirmed on 2 February.

Thanks to rapid coordination, by 28 February the national Foot and Mouth Disease Institute had produced a vaccine containing the SAT-2 strain, just 37 days after confirmation. An additional 497,500 doses were secured from the EU vaccine bank. High-risk areas were prioritised, with EU-supplied vaccines used in Thrace, an FMD-free zone in the west, where 800,000 sheep and cattle were vaccinated to preserve this status.

A nationwide effort followed. With over 9,000 veterinarians deployed across the country, Türkiye managed to vaccinate 14.2 million cattle – 90% of the national herd – and 2.5 million sheep by the end of August. Despite the logistical difficulties of reaching remote and mountainous areas, mobile units and portable cold storage ensured vaccine delivery. Temporary staff were added where needed to support the workload.

Dr Gümen stressed: "Access to reliable vaccine was vital, but the dedication of our staff, especially after the 6 February earthquake, was key."

The powerful earthquake that struck south-eastern Türkiye disrupted operations in 11 provinces, yet Veterinary Services adapted quickly. Volunteers provided animal care and continued vaccinations, sometimes operating in field-hospital conditions.

In a historic move, Türkiye implemented its first-ever nationwide standstill policy, halting all animal movements. While some resistance was expected, the policy was widely accepted thanks to transparent communication with

farmers and stakeholders. “We explained the reasons and coordinated with all parties,” said Dr Gümen. The movement restrictions were enforced through national databases and checkpoints supported by security forces.

At the same time, veterinarians were tasked with educating the public about FMD, biosecurity and quarantine protocols. Non-governmental organisations and private-sector vets also contributed, particularly in areas with limited public staff.

Public–private partnerships were instrumental. Large farms supported early detection through their in-house veterinarians, while freelance vets extended coverage in under-resourced areas. “We’ve long used a model that combines public and private expertise,” noted Dr Gümen.

Türkiye maintained biannual vaccinations to sustain control of the virus. In autumn 2023, 13.7 million cattle and 500,000 sheep were vaccinated within just 2.5 months. An interim round between autumn and spring 2024 increased protection further, with 13 million cattle vaccinated three times since the beginning of the outbreak. As a result, the number of outbreaks dropped by 70% – from 350 to 104.

To support these efforts and better monitor animal movements, Türkiye established veterinary road control and inspection stations. The first opened in Erzurum in September 2023, and by early 2025, four more were operational in Elâzığ, Ankara, Kayseri and Çankırı. These stations are staffed by veterinarians around the clock who conduct health inspections, issue fines or enforce slaughter where necessary. “These stations are essential to preventing the spread of FMD and other diseases,” said Dr Gümen.

Looking ahead, Türkiye plans to expand its Foot and Mouth Disease Institute’s production capacity to meet both national demand and support nearby countries like Azerbaijan. “With continued commitment, we aim to eradicate FMD in Türkiye,” concluded Dr Gümen.



→ A calf and sheep on a farm in Uskudar Istanbul, Turkey.



Mongolian nomad farmer showing chinese tourist how to milk a cow.

Vaccinating against a silent threat: mammalian tuberculosis

It is a disease that quietly erodes rural livelihoods, disrupts international trade, threatens biodiversity, and crosses the boundaries between species, environments and borders. Mammalian tuberculosis (mTB), primarily caused by Mycobacterium bovis, is far more than a veterinary concern: it is a global health issue in the truest sense.

From badgers in Britain to buffalo in South Africa, and from dairy cows in India to elephants in zoos, the pathogen is relentless, chronic and complex. While mTB affects a wide range of species, bovine tuberculosis sits at the centre of the problem. It is the primary form of mTB in domestic livestock and acts as a critical reservoir for cross-species transmission, including to wildlife and humans. As such, controlling bovine TB is not only essential for protecting cattle, but also for breaking wider transmission chains within ecosystems and communities. Much of the global research, surveillance and policy effort around mTB therefore focuses on cattle as a strategic point of intervention. Its management has historically relied on rigorous testing and culling, movement restrictions and painstaking biosecurity efforts. But now, a new chapter may be on the horizon, one in which vaccination could turn the tide.

The numbers speak volumes. Globally, mTB results in billions of U.S. dollars in economic losses annually due to cattle condemnations, trade restrictions reduced productivity, and the cost of control measures. In low- and middle-income countries, where ‘test and slaughter’ strategies are often unfeasible, the disease is not only endemic but neglected.

In India, the world’s largest milk producer with over 300 million cattle and buffaloes, it is estimated that 7% of dairy cattle are infected. In sub-Saharan Africa, where livestock and human interactions are intimately intertwined, studies show that zoonotic TB represents a significant share of the human TB burden. Even in high-income countries with long-standing control programmes, such as the United Kingdom (UK) and Ireland, wildlife reservoirs complicate eradication efforts.

This is where the One Health approach becomes essential. WOAH highlights mammalian TB as a disease that demands multisectoral collaboration. Animal health, human health and environmental health are threads of the same fabric, and TB cuts through all of them.



↑ People and bull on a beach near the sea during sunset, India.

A vaccine for cattle: hope on the horizon

The idea of vaccinating cattle against TB is not new. The bacille Calmette-Guérin vaccine (BCG) – a live, attenuated strain of M. bovis – has been administered to humans for over a century. Its potential use in cattle, however, has been fraught with complications. Chief among them: BCG interferes with the current tuberculin skin test, making it difficult to distinguish infected animals from vaccinated ones, representing a major barrier to surveillance and trade.

But recent breakthroughs are changing that. Over several years the UK's Animal and Plant Health Agency, alongside international collaborators, has developed a new differentiate infected among vaccinated animals (DIVA) skin test. This test induces an immune response in M. bovis infected animals (and therefore results in a positive skin test result) but not in uninfected BCG vaccinates.

The DIVA advances were described as being 'game-changing,' and trials supported by the UK Government have continued across multiple sites.

The DIVA test uses antigens absent from BCG strains but present in wild-type M. bovis, allowing the test to remain effective even in vaccinated animals. This combination overcomes one of the major historical hurdles to cattle vaccination. Recent international studies investigating the full extent of BCG protection in natural conditions have also found a total efficacy of 89%, providing further evidence of the positive potential if it can be coupled with an effective DIVA test.

As Dr Felicity Wynne, Head of TB Science Advice at the UK's Animal and Plant Health Agency, explained: "We're currently undertaking field trials to gather enough data to get the vaccine and test authorised for use in the UK and be recognised internationally. We're also actively engaging with WOAH (...) as we will seek updates to the WOAH Code and Manual for the CattleBCG and DIVA skin test once our trials are successfully completed."

The commercial licensing of a BCG-based vaccine for cattle would be revolutionary, with implications across several domains. In terms of public health, reduced infection in cattle would lead to fewer zoonotic transmissions to humans, particularly in countries where raw milk is still widely consumed. From an animal welfare perspective, the availability of a vaccine could significantly decrease the need for culling, which is often a distressing and controversial component of TB control.

In the area of wildlife management, since vaccination has already been approved for badgers in the UK, acoordinated vaccination approach across different species could help disrupt TB transmission cycles within ecosystems. Finally, regarding trade and the economy, once DIVA-compatible vaccines and diagnostic tests are standardised, international trade regulations could be revised, enabling countries where TB is endemic to gain access to new markets. It also aligns with One Health principles by addressing the disease at its animal source before it spills over to humans or wildlife. However, implementation will not be without challenges.

Vaccine delivery systems, cold-chain logistics, regulatory harmonisation, and cost-sharing between public and private sectors will require international coordination.

Dr Wynne emphasises the global importance of this work: "By vaccinating cattle against bovine TB, we have the potential to not only protect individual animals from infection but also create a barrier to transmission within herds and across populations."

What have we learnt from wildlife vaccination?

The UK's badger vaccination programme has offered promising real-world evidence of its potential. The trials funded by the UK Government have shown that BCG use in badgers is effective and vaccination programmes can be delivered at a large scale. This evidence base underpinned the licensing of the BadgerBCG vaccine in 2010. More recently, in a four-year part-government-funded study led by the Zoological Society of London, Cornwall Wildlife Trust and Imperial College London, 265 badgers were vaccinated using injectable BCG across 12 farms in Cornwall. By the end of the programme, infection rates among the badgers dropped from 16% to zero, demonstrating the impact that targeted, farmer-led vaccination efforts could have on controlling bovine tuberculosis in wildlife. These findings are informing England's plans to create a badger vaccination field force to deliver badger vaccination in targeted locations within TB high-risk areas.

Oral delivery of the BCG vaccine to wildlife has demonstrated promising results in several countries. In Ireland, a three-year field trial in County Kilkenny showed that badgers vaccinated orally with lipid-encapsulated BCG had significantly lower infection rates compared to unvaccinated groups, indicating that oral vaccination can confer protection against tuberculosis in free-living badger populations. Unfortunately, despite these results it has not been possible to demonstrate the consistent benefits of oral vaccination in badgers needed to produce a licensed vaccine. The primary method of badger vaccination involves trapping and injecting badgers with the vaccine. However, in New Zealand, oral BCG vaccination of brushtail possums achieved up to 96% efficacy in reducing tuberculosis incidence, suggesting that oral vaccination is a viable strategy for controlling TB in wildlife if a suitable and cost-effective delivery system can be developed. In the USA, researchers have developed and tested oral BCG delivery systems for free-ranging white-tailed deer, demonstrating high levels of vaccine uptake and laying the groundwork for broader field applications. These findings collectively highlight the potential of oral BCG vaccination as a scalable and effective approach to wildlife immunisation against tuberculosis.

These interventions reduce not just disease burden in the vaccinated animals, but indirectly protect unvaccinated individuals in the population, showcasing a powerful herd immunity effect.

The road ahead

Mammalian TB has long been a slow-moving but formidable foe. Its complexity, spanning multiple species, continents and contexts, means there will never be a one-size-fits-all solution. But the advent of effective, differentiating vaccines marks a pivotal shift.

As more countries move toward licensing cattle BCG vaccines and combining them with DIVA-compatible diagnostics, there is renewed hope that elimination, not just control, may one day be within reach.

Yet progress will depend on sustained investment, global cooperation, and above all, the political will to implement science-backed strategies that protect not only herds and wildlife, but the people who depend on them.



↑ Badger vaccination plays a vital role in breaking the mammalian tuberculosis transmission cycle.



↑ Woman with a cow, India.

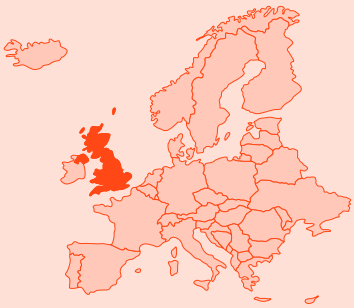
"By vaccinating cattle against bovine TB, we have the potential to not only protect individual animals from infection but also create a barrier to transmission within herds and across populations."

Dr Felicity Wynne
Head of TB Science Advice at the UK's Animal and Plant Health Agency

Case Study 8

Cattle tuberculosis vaccination efforts in the United Kingdom

Location
United Kingdom





↑ Two dexter cows in a meadow.

The UK is currently at the forefront of efforts to license a cattle TB vaccine based on the Bacillus Calmette-Guérin (BCG) strain, along with a companion diagnostic test to differentiate infected from vaccinated animals (DIVA). This innovation could allow for effective disease control alongside other proven strategies.

Bovine tuberculosis remains one of the most complex animal health challenges in the UK. In England alone, tens of thousands of cattle are slaughtered each year due to the disease, resulting in significant economic losses for farmers and public authorities alike. Current control strategies rely heavily on biosecurity, regular testing, movement restrictions, and removal of infected animals, measures that are not only expensive but also socially and politically divisive, particularly when they involve wildlife such as badgers.

The potential introduction of a BCG-based cattle vaccine, coupled with a DIVA test, could shift the paradigm. The ability to vaccinate cattle without compromising the accuracy of diagnostic surveillance has long been a scientific and regulatory hurdle. The DIVA test, which detects specific markers absent in vaccinated animals, aims to solve this problem. In 2021, field trials for the vaccine-DIVA combination began in England and Wales, involving volunteer farms under real-world conditions. These trials are a critical step towards obtaining commercial authorisation, both nationally and potentially through international bodies like WOAH.

However, the implementation of cattle vaccination is not straightforward. Even if proven safe and effective, a licensed vaccine must also meet trade standards. Some countries currently prohibit live animal or germplasm imports from regions where TB vaccination is used, due to concerns over current test interference. For the UK, and any other country considering this route, securing international recognition for DIVA-compatible vaccines will be essential for protecting trade relationships.

The UK Government has emphasised that the development of a cattle vaccine is part of a broader, long-term bTB eradication strategy. However, progress has been incremental, and the timeline for widespread rollout remains uncertain. Questions also remain about who will bear the costs of vaccination, how it will be delivered at scale, and how it will fit into broader disease control programmes.

Investment by the UK in this approach is significant, and other countries with high TB burdens are watching closely. The UK is actively engaging with WOAH on these trials and once completed is committed to sharing findings with trading partners to ensure they have confidence in the CattleBCG vaccine and DIVA skin test. The outcomes of the UK's efforts may influence future policy directions elsewhere, especially in regions where test-and-cull policies are less practical or politically feasible. If successful, this case could support a wider shift toward integrated, science-based TB control strategies that better align with the principles of One Health.



Young boy with a buffalo.

Protecting livestock from lumpy skin disease

Across many rural communities in Southeast Asia, veterinarians and farmers work side by side under challenging conditions to protect their animals from emerging threats. One such threat is lumpy skin disease (LSD), a highly contagious viral illness that can devastate cattle herds. The urgency to vaccinate is deeply felt – each dose delivered represents not just protection for an individual animal, but also a step toward preserving livelihoods, food security, and national economies. In areas where livestock are central to family income and nutrition, the impact of LSD is more than just biological; it is personal and economic.

LSD is a viral disease that primarily affects cattle, buffalo, yaks and mithun, causing painful skin nodules or raised lumps, hence the name of the disease. Other signs of the disease may include high fever, reduced milk yield, inflamed nose and eyes with excessive drooling, enlarged lymph nodes or glands that can be easily felt, reluctance to move due to fluid accumulating in the lower limbs, and loss of appetite, weight or body condition. Sometimes reproduction can be affected. This means that bulls become temporarily or permanently infertile and cows may abort or not cycle into heat for a while. In severe cases, the disease can even be fatal, particularly in young or weak animals.

Beyond animals' well-being concerns, farmers suffer significant economic losses from LSD and associated loss of trade, from decreased milk production, weight loss, disrupted growth reproduction patterns, as well as damaged hides in infected cattle.

The spread of the LSD virus over long distances is primarily associated with movements of infected animals. However, there is also local spread of the disease by biting insect vectors (disease transmitters), such as flies, mosquitoes and ticks. LSD can therefore be spread over long distances by wind transporting insects carrying the LSD virus, or via the movement and trade of infected livestock.



↑ Prevention is the best investment.

To fight off the devastating effects of LSD, vaccination remains an effective tool in preventing its spread and mitigating its impact. Rigorous vaccination programmes, when combined with strong biosecurity measures, can significantly reduce infection rates and protect entire herds. Countries that have implemented widespread LSD vaccination campaigns have seen substantial success in controlling outbreaks and minimising economic losses. For farmers, veterinarians and policy-makers alike, vaccination is not just a preventive measure, it is an essential investment in the health and sustainability of the livestock industry.

Unmatched benefits of vaccination

In countries experiencing LSD outbreaks, vaccination has multiple benefits and remains a crucial tool for the control and potential eradication of the disease. Vaccination not only protects animals from getting infected with LSD, but also reduces further vector transmission of the LSD virus as the insects are not taking up virus from infected animals to spread it. This results in fewer infected and sick animals with reduced milk production and other impacted production performance, which in turn prevents economic harm. Compared to culling infected animals, vaccination is more cost-effective and easier to implement, with fewer negative impacts on animal welfare.

However, despite its benefits, LSD vaccination presents several challenges. The most widely used vaccines are live-attenuated ones, such as the Neethling strain vaccine, which provides strong immunity but can sometimes cause mild symptoms in vaccinated cattle. Farmers may be alarmed by small lumps or lesions that resemble the disease, even though they are harmless and temporary. Additionally, immunity from LSD vaccines is not always lifelong, requiring booster doses to maintain protection. Achieving high vaccination coverage, at least 80%, is essential to slow the virus's spread, but logistical and financial constraints, shortage of supply, vaccine hesitancy among farmers, and gaps in Veterinary Services can hinder large-scale vaccination efforts.

To maximise vaccine effectiveness, campaigns must be well-coordinated, ensuring that vaccination occurs before peak insect seasons when the risk of transmission is highest. This strategy has been successful in reducing LSD outbreaks in several regions, especially in countries where LSD was previously widespread. Vaccines should meet WOAH standards and be safe for all cattle breeds, including pregnant animals. As happens with any vaccination campaign against a livestock disease, strong Veterinary Services and collaboration between authorities, farmers and industry stakeholders are critical to promoting vaccine uptake, and ensuring a sustainable long-term control strategy.

A comprehensive approach to lumpy skin disease control

While vaccination is an important tool, it is not sufficient on its own to eliminate LSD. Effective disease control requires a combination of strategies, including vector control, movement restrictions and strong biosecurity measures. Since LSD is spread by biting insects such as mosquitoes, flies and ticks, eliminating stagnant water sources where mosquitoes breed, judicious use of insecticides and improving farm hygiene to minimise insect exposure could support LSD control.

In the event of an LSD outbreak, quarantining infected animals and restricting livestock movement from affected areas are necessary to prevent further spread. For newly introduced cases, rapid emergency vaccination and strict movement controls can help contain the disease before it becomes endemic.

A multisectoral approach is required, involving stakeholder collaboration, targeted investments and well-defined national action plans. Raising awareness among farmers about LSD transmission risks and the importance of biosecurity measures is vital. Additionally, strengthening Veterinary Services through capacity-building programmes and improving access to laboratory facilities for early disease detection will enhance response efforts. For LSD-free countries, prevention strategies should focus on early detection, risk assessment and preparedness for potential outbreaks.

By integrating vaccination with other disease control measures, countries can improve their ability to manage LSD, protect livestock and safeguard farmers' livelihoods.



↑ A group of cows on a lake in the Netherlands.

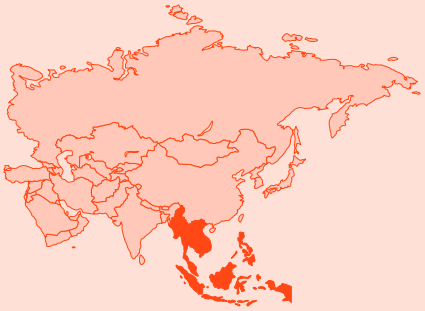
WOAH in Action

- To combat the spread of LSD, WOAH, in collaboration with partners, has taken significant steps, notably through GF-TADs. After LSD entered Europe for the first time in 2015, it became a priority for GF-TADs Europe, leading to the establishment of the Standing Group of Experts on Lumpy Skin Disease in 2016. Under the GF-TADs umbrella, this initiative fosters regional cooperation, scientific discussions and harmonised mitigation measures among affected countries.
- In response to various outbreaks in the Asia-Pacific region, WOAH organised a series of public webinars to enhance the knowledge and understanding of this emerging disease, along with various coordination meetings between relevant regional organisations and authorities in South-East Asia, and commissioned a study on the impacts of LSD in Asia. The spread of LSD across the region highlights the need for a coordinated regional approach to strengthen cross-border control efforts that involve real-time information-sharing and harmonised approaches, and high-level regional collaboration among national authorities and stakeholders.
- Recognising the urgent need for regional coordination to manage this transboundary animal disease, ASEAN member countries, WOAH and partners have collaborated to develop the ASEAN LSD Prevention and Control Strategy 2024–2030. This strategy aligned with global and regional frameworks such as the GF-TADs Strategy and ASEAN's livestock action plans, aims to guide coordinated efforts to prevent and control LSD in the region. With eight out of ten ASEAN countries affected, the strategy provides a structured approach, including a theory of change and a monitoring and evaluation framework, to mitigate LSD's impact and enhance regional preparedness and response.

Case Study 9

Safeguarding the livestock industry in South-East Asia

Location
South-East Asia



Since the first confirmed outbreak of LSD in Bangladesh in 2019, the disease has quickly spread throughout Asia, affecting India and north-west China in 2019. LSD then spread to South-east Asia, being particularly prevalent in Vietnam and Myanmar in 2020; then to Thailand, Cambodia, Laos and Malaysia in 2021; Indonesia in February 2022; and Singapore in March 2022. To date, no country has been able to eradicate LSD without vaccination.

In March 2021, LSD was first detected in north-eastern Thailand and significantly impacted the nation's cattle industry, prompting the Thai Government to implement a comprehensive programme of vaccination and control measures.

Within four months of the initial outbreak, the disease quickly spread to dairy and beef cattle in 64 out of 77 provinces in Thailand. The first phase of the Thai Government's national LSD vaccination programme targeted 360,000 vaccine doses for ring vaccination of cattle around outbreak areas, then approximately 5 million cattle nationwide were vaccinated during the second phase.

In addition to reduced milk production, LSD causes substantial economic losses through decreased carcass quality, disruption to animal trade and increased operational costs for cattle producers.

The 2024 Final Report Study to Assess the Impact of Lumpy Skin Disease (LSD) in Asia published by WOAH detailed how a dairy cooperative in Thailand experienced a milk loss of 127 tons, valued at US$ 68,943 due to LSD outbreaks in merely three months. The report also indicated that the average loss per affected dairy farm in Thailand was approximately US$ 2,461, largely due to the costs of treating infected animals and losses in milk production.

In 2024, researchers from Chiang Mai University in Thailand published a study that confirmed the mass vaccination programme, along with other control measures such as regulating cattle movement and managing insect vectors, effectively reduced the incidence of new LSD cases in Thailand.

Thailand's experience highlights the importance of a swift and coordinated vaccination campaign to control LSD.

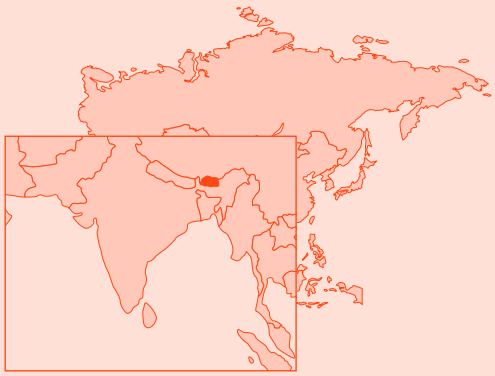


↑ Buffalo shepherd on the rice field in Asia.

Case Study 10

Bhutan: wide vaccination coverage against lumpy skin disease

Location
Bhutan



In 2020, Bhutan's livestock sector experienced significant economic losses after LSD was reported for the first time in the country. The Government of Bhutan initiated a comprehensive vaccination campaign to control the LSD outbreak and prevent further spread of the disease.

In August 2023, Bhutan received over 338,000 doses of LSD vaccines procured from Türkiye, valued at 20.5 million Bhutanese ngultrum. These vaccines were stored in a cold storage facility at Bhutan's National Centre for Animal Health in its capital Thimphu, before being distributed to all districts across the country. The ambitious goal of the LSD vaccination campaign was to immunise approximately 300,000 cattle, mithun, buffalo, yaks, and yak crossbreeds nationwide within a month.

The Department of Livestock in Bhutan reported a remarkable effort in the LSD vaccination programme that achieved significant coverage across the country. While specific data on the programme's success rates are limited, the extensive vaccination efforts are expected to have substantially reduced additional incidences of LSD in Bhutan, thereby safeguarding the country's livestock industry and supporting the livelihoods of Bhutanese farmers.

The successful implementation of the vaccination campaign highlights Bhutan's commitment to controlling transboundary animal diseases like LSD, and ensuring the health and productivity of the nation's livestock population.



↑ Black yak in Tibet.



Camels being examined by veterinarians in Saudi Arabia.

Brucellosis: a disease of risk to animals and people

Brucellosis is a silent, yet devastating disease that affects both animals and humans, causing reproductive issues in livestock, economic losses for farmers and debilitating illness in people. It is caused by Brucella bacteria, a zoonotic pathogen that spreads from animals to humans, with symptoms resembling the flu, including fever, joint pain and fatigue. However, unlike the flu, brucellosis can persist for weeks or even months and may recur, making it a serious public health issue.

Those at highest risk of contracting brucellosis include farmers, veterinarians and abattoir workers who are in close contact with infected animals, aborted foetuses or placentae. The disease spreads primarily when infected animals give birth or abort, releasing large amounts of bacteria into the environment. The bacteria can survive outside the animal for several months, particularly in cool, moist conditions, making environmental contamination another major concern. The bacteria also colonise the udder and contaminate milk, which can be a direct source of infection for humans, especially if consumed raw or unpasteurised. Beyond the human-health risks, brucellosis takes a heavy toll on livestock, leading to poor reproductive performance in infected animals. This includes abortions, infertility, stillbirths and weak offspring, which result in significant economic losses for farmers, particularly in dairy, sheep, goat and pig production. In dairy farming, brucellosis can decrease milk production, which is a major concern for producers. The economic burden extends beyond direct losses due to decreased productivity; farmers may also face costs related to disease control measures, such as testing, culling infected animals, and implementing biosecurity measures to prevent the spread of the disease. The economic impact is not limited to the affected farm, as brucellosis can also disrupt local and international markets. For example, brucellosis can lead to the suspension of exports from countries with widespread infections, further exacerbating the financial strain on agricultural economies.

Brucellosis affects a diverse range of animals, including cattle, pigs, sheep, goats, camels, dogs and even marine mammals, making eradication particularly challenging. In many cases, infected animals show no obvious signs of illness, even as they continue to shed the bacteria into their surroundings. This silent transmission allows the disease to spread undetected within herds and to new areas, complicating both diagnosis and control efforts. The ability of Brucella bacteria to persist in asymptomatic carriers makes surveillance and containment far more difficult, requiring vigilant monitoring and proactive intervention strategies. This challenge underscores the need for effective control measures, and vaccination emerges as a crucial tool for breaking the cycle of silent transmission. By reducing the number of infected animals and limiting bacterial shedding, vaccination helps contain the disease, making it easier to detect and control outbreaks before they spread further.

Vaccination: a crucial tool in an integrated disease control strategy

Vaccination has proven to be one of the most effective tools in controlling brucellosis, especially in regions where the disease is endemic, such as the Middle East, the Mediterranean region, sub-Saharan Africa, Latin America, China and India. By vaccinating livestock, particularly cattle, sheep and goats, the incidence of infection can be significantly reduced, which in turn lowers human exposure. The primary vaccines used are Brucella abortus S19, Brucella melitensis Rev-1, and Brucella abortus RB51, each designed for specific animal species. Vaccination helps prevent the spread of the disease, reduces the contamination of milk and meat, and lowers the risk of transmission to humans and wildlife.

However, while vaccination is a powerful tool, it is not a standalone solution. Several challenges must be addressed for it to be truly effective in controlling brucellosis on a large scale. One of the most significant hurdles is achieving high vaccination coverage, as a large percentage of livestock must be immunised to disrupt the transmission cycle. In many low-resource settings, logistical and financial constraints make widespread vaccination difficult to implement. The transportation of vaccines, maintaining the necessary cold chain for their efficacy, and deploying trained personnel to administer them in remote areas all require substantial investment and coordination.

Another obstacle is the reluctance of some farmers to vaccinate their livestock. This hesitation often stems from concerns about short-term economic losses, such as temporary declines in milk production or minor reproductive issues following vaccination. Additionally, because brucellosis vaccines contain live bacteria, improper administration can lead to infections in animals, raising concerns among farmers about potential adverse effects. Some may also resist vaccination due to a lack of awareness about the long-term benefits or the misconception that vaccination alone will eradicate the disease without the need for other control measures.

Moreover, vaccination presents challenges in disease surveillance and diagnosis. Vaccinated animals may test positive for brucellosis in common diagnostic tests, making it difficult to distinguish between infected and vaccinated animals. This complicates efforts to track and control the disease, as false positives can lead to unnecessary culling or restrictions on trade. To address this issue, improved diagnostic tools that differentiate between vaccinated and naturally infected animals are essential for effective surveillance.

Given these challenges, vaccination must be integrated into a broader, multipronged approach to controlling brucellosis. Effective disease surveillance is crucial, with regular testing of livestock through blood and milk screening to monitor infection rates and detect outbreaks early. Culling infected animals, though often economically challenging for farmers, remains a necessary measure to reduce the reservoir of infection. Governments must also enforce strict regulations on raw dairy consumption, as unpasteurised milk remains a primary source of human brucellosis. Public education campaigns should emphasise the risks associated with consuming raw dairy and promote pasteurisation as a critical food safety measure.

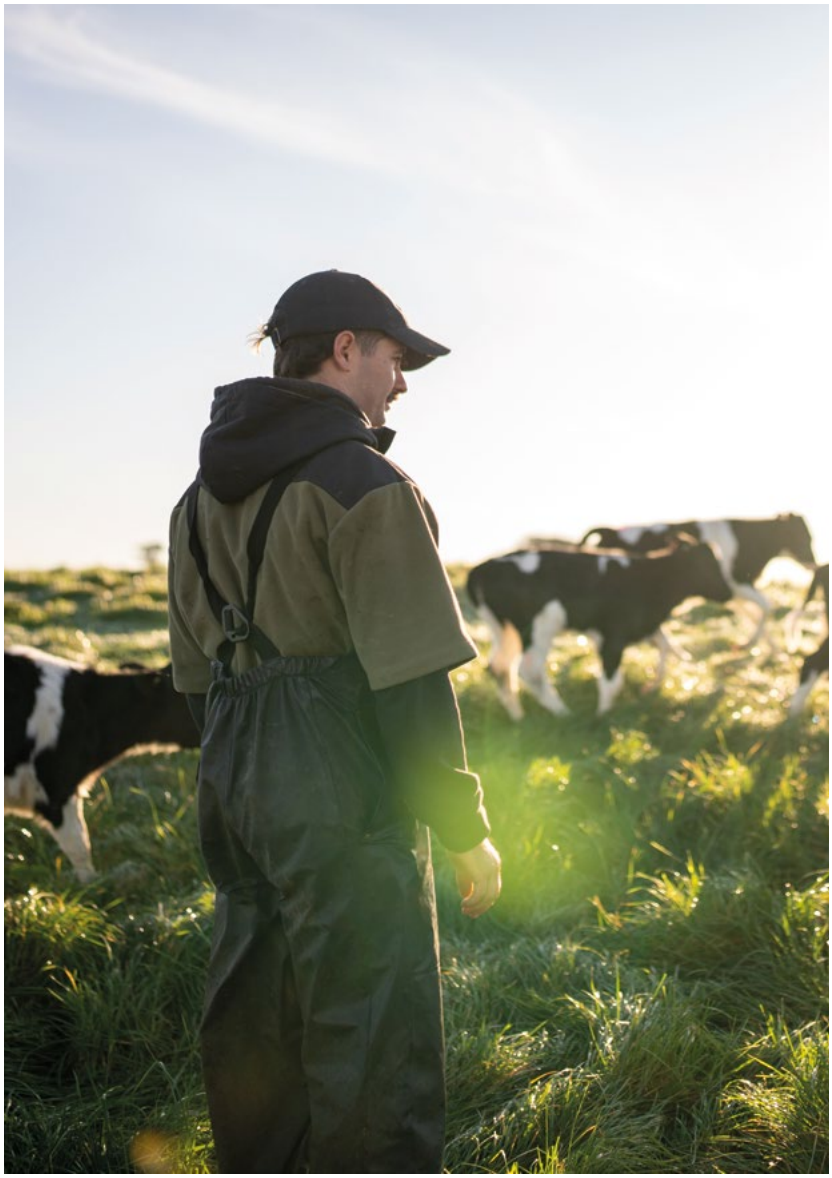
In addition to these measures, improving biosecurity on farms is essential for preventing the introduction and spread of Brucella bacteria. Farmers should be encouraged to adopt best practices such as disinfecting equipment, limiting the movement of livestock between farms, and using protective gear when handling potentially infected animals. Training veterinary professionals and farmers in proper vaccination techniques can also help minimise adverse reactions and improve vaccine effectiveness.

Countries that have successfully implemented comprehensive control strategies, including vaccination, surveillance, culling, dairy safety regulations and farm biosecurity, have seen dramatic reductions in brucellosis cases. For example, nations that combined rigorous vaccination programmes with strict movement controls and testing have achieved significant progress in controlling the disease, protecting both public health and agricultural economies.

While challenges remain, a well-coordinated, science-based approach can significantly reduce the impact of brucellosis. Vaccination remains a cornerstone of this strategy, but its success depends on addressing logistical barriers, improving farmer engagement, and reinforcing other disease control measures. With sustained efforts, brucellosis can be effectively managed, improving animal health, safeguarding human populations, and reducing the economic burden on farmers worldwide.



↑ Vaccination campaign against peste des petits ruminants in Mongolia.



↑ A farmer with a herd of calves.

WOAH in Action

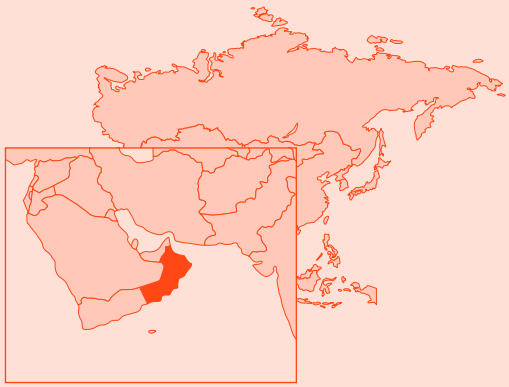
Tackling brucellosis requires a co-ordinated transboundary approach and control efforts that extend across regional, national and international partners. WOAH works jointly with the Arab Organization for Agricultural Development (AOAD) to highlight the urgent need to implement comprehensive strategies in controlling and limiting the spread of brucellosis.

This approach prioritises brucellosis as a transboundary disease within the AOAD-Transboundary Animal Diseases Control Program in Arab and African regions, resulting in the development of important initiatives such as the Workshop on the Surveillance, Diagnosis, Control and Prevention of Brucellosis in Arab Countries that took place in November 2024. The workshop's objectives were to enhance the brucellosis diagnostic and control capabilities of veterinary professionals in the Arab region; to promote knowledge-sharing and collaboration among experts in the field of animal health; to strengthen national and regional surveillance and reporting systems for brucellosis in livestock; and to foster the development and implementation of effective prevention, control and eradication strategies to safeguard animal welfare.

Case Study 11

Vaccination efforts against brucellosis, a success story from Oman

Location
Oman



Oman, located in the south-east of the Arabian Peninsula, has made significant strides in controlling brucellosis, a zoonotic disease that affects both livestock and humans. Recognising the serious health and economic implications of the disease, Omani authorities have adopted a multifaceted approach that combines mass vaccination, epidemiological research and public-awareness campaigns to mitigate its impact.

A cornerstone of Oman's brucellosis control strategy has been the vaccination of a large percentage of livestock in affected areas. In the Dhofar Governorate, which hosts the largest share of Oman's livestock, since 2004, over 237,000 cattle and 180,000 sheep have been vaccinated. These efforts have significantly reduced the prevalence of the disease in the region, contributing to improved animal health and economic stability for livestock owners.

The vaccination programme is executed by dedicated teams who work tirelessly in challenging terrains to ensure that as many animals as possible are immunised. To complement these efforts, the government established a diagnostic unit under the Veterinary Health Research Centre to conduct epidemiological surveys and monitor the immune response of vaccinated animals. This unit plays a crucial role in tracking the disease, identifying risk areas, and providing data-driven insights to refine control measures.

Oman has also engaged in regional efforts to combat brucellosis. As part of the cross-border animal disease control programme, AOAD has provided technical assistance by training Omani specialists in disease epidemiology and control methods. These training programmes, conducted in specialised centres in the Jordan, have enhanced local expertise in brucellosis prevention and management.

Beyond Dhofar, isolated cases of brucellosis occasionally emerge in other regions of Oman. When this occurs, authorities swiftly collect samples, isolate infected animals and conduct thorough investigations to prevent further spread. If an animal tests positive for Brucella infection, livestock owners are strongly advised to cull the infected animal through slaughter, a practice that is widely accepted as an effective disease control measure. However, it is important to note that there is no mandatory law in Oman requiring the slaughter of infected animals, which sometimes presents a challenge in disease eradication efforts.

Given that brucellosis can also infect humans, Oman's Ministry of Health collaborates closely with Veterinary Authorities to address cases of human infection. One of the primary sources of human brucellosis is the consumption of raw, unpasteurised milk and dairy products. While cow's milk in Dhofar is pasteurised, many Omanis continue to consume raw camel's milk, which poses a significant health risk. Raising awareness about the dangers of consuming unpasteurised dairy is, therefore, a critical component of Oman's brucellosis control programme.

To reduce the risk of human infection, Oman has expanded its vaccination efforts to include not only cattle and sheep



↑ Omani couple with their cow at a market.

but also goats and camels. Vaccinating camels with the Brucella melitensis vaccine is expected to play a crucial role in reducing transmission rates and protecting public health. Oman's battle against brucellosis is a testament to the effectiveness of a well-coordinated, multipronged approach. By combining widespread vaccination, rigorous disease surveillance, regional cooperation and public health initiatives, the country has made notable progress in controlling this zoonotic disease. While challenges remain, particularly in eradicating human infections linked to the consumption of raw milk, continued efforts and enhanced community engagement promise a future with significantly reduced brucellosis cases in Oman.



Salmon fish farm, Bergen, Norway.

Infectious salmon anaemia: a threat to aquaculture and global trade

Salmon farming occurs in the waters of many countries around the world and plays a vital role in food production and local economies. But for salmon farmers, an outbreak of disease can be devastating both emotionally and financially. One such threat is infectious salmon anaemia (ISA), a disease caused by the infectious salmon anaemia virus (ISAV), which primarily affects farmed Atlantic salmon.

ISA causes anaemia, a reduction in circulating red blood cells in the body, along with internal bleeding and organ damage in infected fish. Salmon with ISA are lethargic or tired and do not swim around as much as usual, lose their appetite, and can have pale gills and swelling of the abdomen or belly. In severe cases, fish may also develop haemorrhages around their eyes and on their skin so these areas can appear blotchy and red. These signs are all too familiar to farmers who have experienced an outbreak and must take urgent steps to manage its impact.

While the effects of ISA can be severe, there is a way forward. Strong biosecurity measures and vaccination of young salmon offer effective tools to help prevent future outbreaks and support the long-term sustainability of salmon farming.

The economic burden of infectious salmon anaemia

ISA is a highly contagious disease that results in severe economic losses for the aquaculture industry, primarily due to the rapid spread of the disease and the high mortality rates among infected fish. The financial impact on aquaculture operators extends beyond fish deaths, as farms must also bear the significant costs of culling infected fish, disinfecting equipment and tanks, and implementing containment measures to prevent further spread.

In addition to these direct costs, many countries impose trade restrictions, such as banning the import of fish from regions experiencing ongoing ISA outbreaks. This disrupts market access and reduces export opportunities, not only harming individual farms but also impacting the broader aquaculture industry. The ripple effect of such restrictions can influence global salmon production and trade. For context, the global Atlantic salmon market was valued at approximately US$ 19.9 billion in 2023, highlighting the scale of the industry affected by ISA.

ISA was first reported in Norway in the mid-1980s and has since spread to countries including Canada, the UK, the Faroe Islands, the USA and Chile. The incidence of infection with ISAV may be greatly reduced by implementation of legislative measures or husbandry practices regarding the movement of fish, mandatory health control, transport and slaughterhouse regulations.

ISA is a WOAH-listed disease, meaning it is internationally reportable for monitoring and controlling its spread across regions and countries. Vaccination has emerged as one of the most effective strategies for preventing ISA outbreaks and managing the disease's spread, offering a critical tool in mitigating its economic and environmental impacts on the aquaculture industry.

Scaling up vaccination: ensuring timing and accessibility

Vaccination of salmon significantly reduces the incidence of ISA and protects against the widespread fish deaths typically associated with the disease, enabling salmon farms to continue production without the severe losses that would otherwise occur during an outbreak.

A further benefit of vaccination is the role it plays in reducing trade restrictions, as countries that implement ISA vaccination programmes are more likely to meet international health and safety standards for fish exports, allowing them to maintain access to global markets.

The primary method of ISA vaccination involves the use of inactivated vaccines, which are vaccines that contain killed viruses, that stimulate the salmon's immune system to recognise and fight the ISAV without causing the disease. ISA vaccines are usually administered to juvenile salmon before they reach the vulnerable stages of the disease, ensuring they are protected from infection as they grow.

However, the production and distribution of inactivated ISA vaccines can be costly, posing a challenge for smaller aquaculture operations. Additionally, accessing and storing these vaccines can be logistically complex, particularly in regions where cold storage infrastructure is limited. Maintaining proper cold-chain conditions is essential to preserving vaccine efficacy from production through to administration, yet this can be difficult in remote farming areas or countries with underdeveloped veterinary supply chains. Dr Gallardo, from WOAH's Collaborating Centre for Antimicrobial Stewardship in Aquaculture, at the University of Chile, explained: 'In some regions, vaccine availability is limited. In Chile and Norway, large companies produce vaccines for the salmon industry, and all smolts (young salmon) are vaccinated before entering seawater. In Chile, vaccination against infectious salmon anaemia is mandatory.'

For ISA vaccination to be effective, it must be administered at the optimal stage of the fish's development and under the right health conditions. Vaccine efficacy can vary depending on factors such as the age of the fish and the specific strain of ISAV circulating in the region. To achieve meaningful disease control, ISA vaccination must be implemented on a large scale across entire farming systems or regions. This requires careful planning, significant investment, and coordination between farmers, industry stakeholders and regulatory bodies.

However, vaccination alone is not enough to eliminate the risk of ISA. The virus can persist in the environment, meaning outbreaks can still occur if vaccination coverage is insufficient or if biosecurity measures are not strictly enforced. A successful ISA control strategy must integrate vaccination with strong biosecurity measures, effective monitoring, and regular surveillance to detect and respond to potential outbreaks promptly.

Dr Gallardo emphasised: "Vaccination is a key control measure for preventing bacterial diseases. It should be integrated into the biosecurity plan of an aquaculture establishment, as well as into national strategic aquatic animal health plans."By embedding vaccination within a comprehensive disease management framework, the aquaculture industry can better protect fish health, sustain production and mitigate the economic losses associated with disease outbreaks.



↑ Farmed Atlantic salmon are susceptible to the infectious salmon anemia, a viral disease threatening aquaculture health, sustainability, and global trade.



↑ Salmon jumping out of the water at a waterfall.

WOAH in Action

Since the mid-1990s, WOAH has developed several initiatives aimed at harmonising health standards for international trade in aquatic animals, such as the *Aquatic Animal Health Code and the Manual of Diagnostic Tests for Aquatic Animals.*

In 2021, *WOAH introduced the Aquatic Animal Health Strategy*, which reflects the recognition of the growing significance of aquatic animal health and its relevance in food security, and outlines a strategic approach to the management of aquatic animal health worldwide.

CASA at the University of Chile has been designated as a WOAH Collaborating Centre, focusing on AMR in aquaculture. Supported by Chile's Aquatic Animal Health Authority (National Fisheries and Aquaculture Service), CASA plays a key role in research, capacity-building, and advising WOAH Members on the responsible use of antimicrobials, particularly in salmon farming. As the first Collaborating Centre of its kind in the Americas, CASA supports the implementation of WOAH standards, provides expertise, and promotes national AMR surveillance and monitoring programmes. Through public–private partnerships, research initiatives, and guidance on antimicrobial use, CASA contributes to global efforts in mitigating AMR risks in aquaculture.

Why investing in Veterinary Services is key

As we have seen in this report, vaccination strategies can vary from country to country, reflecting each nation's unique epidemiological landscape, economic considerations and public health priorities.

Vaccination often stands as a strong strategy in the global effort to combat animal diseases, offering a powerful means by which to protect animal health, safeguard human well-being and ensure the sustainability of agricultural economies. The eradication of rinderpest serves as a testament to the transformative impact of vaccination campaigns, demonstrating their ability to eliminate devastating diseases.

However, the effective implementation of vaccination programmes is not without its challenges. To name but a few critical ones: the high costs associated with vaccine research, development, production and distribution can hinder widespread adoption, particularly in resource-limited settings. Logistical difficulties in ensuring timely and widespread vaccine distribution, especially in remote or conflict-affected areas, further complicate vaccination efforts. Moreover, achieving effective disease control necessitates cross-border collaboration, which can be impeded by political, economic or logistical obstacles.

Trade implications are a key consideration, as demonstrated by the case of avian influenza. While vaccination can be a vital tool to control the spread of this disease in poultry, it can also lead to trade restrictions. Countries may impose import bans on poultry from regions where vaccination is practised, fearing the potential for masked infections. This highlights the need for robust surveillance systems to assure trading partners that vaccinated animals are not infected.

Logistical challenges represent another hurdle, particularly in ensuring timely and widespread vaccine distribution. For instance, in the Sahel region, despite efforts to distribute vaccines against PPR, the vast and remote landscapes can delay vaccine delivery, affecting coverage and vaccine efficacy. This is further compounded by the shortage of trained veterinary personnel to administer vaccines and conduct surveillance. Economic factors also play a significant role. Vaccines often come at a high cost, which can be a barrier, especially in low-resource settings.

To fully realise the potential of vaccination, it is crucial to acknowledge and address the challenges that hinder its widespread and effective use. This requires a multifaceted approach that integrates vaccination with other disease control strategies, such as biosecurity, surveillance and movement controls.

Furthermore, strengthening Veterinary Services and the veterinary workforce is paramount. Well-funded and effectively managed Veterinary Services are essential for ensuring timely vaccine procurement and distribution, administering vaccines, conducting surveillance and responding to outbreaks. A skilled and motivated veterinary workforce is the backbone of any successful vaccination campaign,

providing the expertise and dedication needed to reach animals in diverse settings and ensure widespread coverage.

Increased investment in veterinary infrastructure, training programmes, and fair compensation for veterinary professionals is not merely something to be budgeted for but should be considered a critical investment in global health security. By empowering Veterinary Services and supporting the veterinary workforce, we can ensure that vaccination campaigns are implemented effectively, leading to healthier animal populations, reduced disease transmission and, ultimately, the preservation of human lives and livelihoods.

Because animal health is our health, it's everyone's health.

WOAH key calls to action for effective vaccination and disease control

- **Strengthen Veterinary Services**
  Invest in national Veterinary Services to ensure they are well-resourced, professionally trained and capable of implementing robust vaccination and surveillance programmes.
- **Support global and regional coordination**
  Foster international cooperation for disease monitoring, early warning systems and harmonised vaccination approaches – because diseases do not respect borders.
- **Enhance surveillance and diagnostic capabilities**
  Develop and implement advanced diagnostic tools to differentiate between vaccinated and infected animals, enabling accurate disease tracking and trade transparency.
- **Protect trade through transparency**
  Establish clear standards and traceability systems to assure trading partners that vaccination does not compromise product safety or mask infections.
- **Empower and train the animal health workforce**
  Invest in education, field training and fair compensation for veterinary professionals to ensure effective vaccine delivery and disease management at the grass-roots level.
- **Improve animal welfare through disease prevention**
  Implement disease control measures, including vaccination, to enhance the health and welfare of animals, reducing suffering and improving overall well-being.
- **Recognise animal health as global health**
  Acknowledge that protecting animal health is a critical pillar of public health, food security and sustainable economic development.



Collecting animal data on the field, Brazil.



Data-driven insights in animal health

Part II.

Harnessing data for a healthier future

In an increasingly interconnected world, animal health is a critical component of public health, food security and economic stability. The ability to track, analyse and act upon animal health trends is essential for mitigating disease outbreaks, ensuring sustainable livestock production and maintaining biodiversity. The World Organisation for Animal Health (WOAH), as the global authority on animal health, continues to strengthen its data-driven approach to disease surveillance and risk assessment. This section provides a comprehensive analysis of global animal health trends through 2024 and into early 2025, leveraging WOAH's core data systems to deliver a clearer picture of the challenges and opportunities shaping the future of animal health.



↑ Veterinarians examining a bat as part of the EBO-SURSY project, Cameroon.

WOAH's data-centric strategy is grounded in the principle of empowering its Members with the tools, systems and knowledge they need to produce and leverage high-quality data. This transformation is enabling timely, strategic, and coordinated decision-making in a world characterised by accelerating complexity. By strengthening the foundations of global animal health intelligence, WOAH fosters resilience, early action, and better preparedness for current and future threats.

WOAH's information systems, including the World Animal Health Information System (WAHIS), Performance of Veterinary Services Information System, and ANIMUSE (ANImal antiMicrobial USE), form the backbone of global health intelligence. These platforms provide invaluable insights into disease prevalence, antimicrobial use, veterinary capacity and regional disparities. Recognising the need for real-time, high-quality information, WOAH has significantly strengthened its data collection and reporting capabilities through WAHIS. This state-of-the-art platform enables early disease detection, trend analysis and evidence-based decision-making.

Transparency is a cornerstone of WOAH's approach and a critical enabler of trust – both among Members and with the broader international community. As the only international organisation mandated to collect official animal disease notifications, WOAH plays a unique role in global health governance. Members are obligated to report animal diseases detected in their territories, including those transmissible to humans and those introduced intentionally. WOAH then disseminates this information widely, enabling countries to act swiftly and limit spread. This transparent and timely sharing of data is essential not only for early preventive action and effective disease control but also for maintaining trust among trading partners and fostering international cooperation. In collaboration with other key global organisations, WOAH ensures that this information is interoperable and accessible, reinforcing collective efforts to safeguard animal and public health worldwide.

Collaboration with the Animal Disease Information System: a step towards integrated global animal health

WOAH's commitment to data integration extends to its collaboration with the Animal Disease Information System (ADIS), a platform developed by the European Union (EU) for managing animal health data. The connection between ADIS and WAHIS is crucial for ensuring that animal health data is seamlessly exchanged, enhancing both regional and global disease control efforts.

ADIS simplifies data entry and reporting for EU member states and associated countries, ensuring timely notification of outbreaks like ASF in both ADIS and WAHIS. This fosters rapid global responses while minimising the administrative burden on national Veterinary Authorities.

The integration of ADIS and WAHIS offers several advantages:

- Improved data quality and consistency: The exchange of data between the two systems ensures accurate, up-to-date information, critical for global disease risk assessments.
- Streamlined reporting: EU member states can input data once into ADIS, which is then automatically shared with WAHIS, fulfilling both EU and WOAH requirements.
- Better decision-making: Access to comprehensive, real-time animal health data enables better-informed choices in disease surveillance and control measures.

The transfer process between ADIS and WAHIS is carefully managed to avoid data discrepancies. Special attention is needed when interpreting data before and after the transition, as some reopened events might temporarily increase the reported number of events and might increase the number of outbreaks.

The findings presented in this section highlight the key trends observed through 2024 and into early 2025, offering a data-driven perspective on major disease outbreaks, antimicrobial resistance and Veterinary Service performance. While some regions have made significant progress in disease control and prevention, others continue to face persistent challenges exacerbated by economic constraints, climate change and limited access to veterinary resources. Through rigorous analysis and transparent reporting, this section underscores the need for coordinated global efforts to strengthen animal health systems and improve disease management strategies.

Prevalent animal health issues in 2024 and early 2025

The past year has been marked by both progress and setbacks in global animal health. WOAH's data indicates continued threats from infectious diseases, with several regions experiencing significant outbreaks that required urgent intervention. Climate change, international trade and evolving pathogen dynamics have influenced disease distribution and severity, reinforcing the importance of robust surveillance and early warning systems.

WOAH's disease-monitoring efforts have provided critical insights into shifting epidemiological patterns, revealing emerging hotspots and highlighting areas where intervention efforts have been most effective. Data collected through WAHIS has helped identify new transmission pathways, offering a clearer understanding of how diseases spread across borders and between species. This knowledge is essential for designing targeted vaccination campaigns, improving biosecurity measures and strengthening regional coordination in disease response.

Regional disparities in animal health remain a key concern, as gaps in veterinary infrastructure and disease-monitoring capabilities create vulnerabilities in certain parts of the world. The analysis presented here seeks to provide a balanced perspective, acknowledging both the successes achieved through international collaboration and the persistent barriers that hinder progress in some areas.



↑ Disease-monitoring and data collection can help identify and control the spread of animal diseases.

[1] Trends and new strains of global foot and mouth disease outbreaks

During the reporting period, 18 countries reported a total of 216 foot and mouth disease (FMD) outbreaks to WAHIS, including 29 exceptional epidemiological events. The majority of outbreaks were caused by serotype O (57%), followed by serotypes SAT 1 and SAT 2 (16%). Notably, South Africa recorded the first occurrence of serotype SAT 3 in a zone, while China reported the first occurrence of serotype O in a zone. Additionally, new strains were detected in South Africa (SAT 1), Palestinian Autonomous Territories (O), and Comoros (SAT 1). A recurrence of the disease was also observed in 15 countries, including Germany, Hungary and Slovakia.

In January 2025, Germany confirmed an outbreak of FMD serotype O in buffaloes, marking the first outbreak in the country since 1988 and the first FMD outbreak in Europe since Bulgaria's case in 2011. The disease was detected in three buffaloes on a free-range farm, triggering an extensive investigation. Authorities conducted testing on all cloven-hoofed animals within a 3 km and 10 km radius, and traced potential sources of infection, but no further positive cases were identified. As of 3 February 2025, the investigation was ongoing.

At the time of this report's publication, 180 FMD outbreaks linked to 19 exceptional epidemiological events remained ongoing globally. Some of these outbreaks, reported by Comoros, Mozambique, Palestinian Autonomous Territories and South Africa, had not been updated in WAHIS between February and December 2024, leaving their current status unknown.

Given that FMD serotypes do not provide cross-protection and even differ within serotypes, WOAH underscores the importance of accurate strain identification. This is essential for effective vaccine development and informed global disease control strategies to mitigate the spread of new and re-emerging strains.

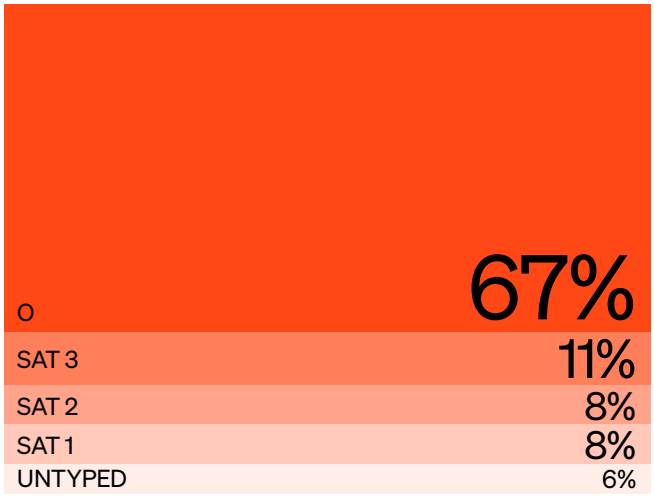


Fig 1. Proportion of outbreaks caused by each FMD serotype from 1st January 2024 to 1st April 2025.

[2] Peste des Petits Ruminants: 2024–2025 outbreaks and regional threats

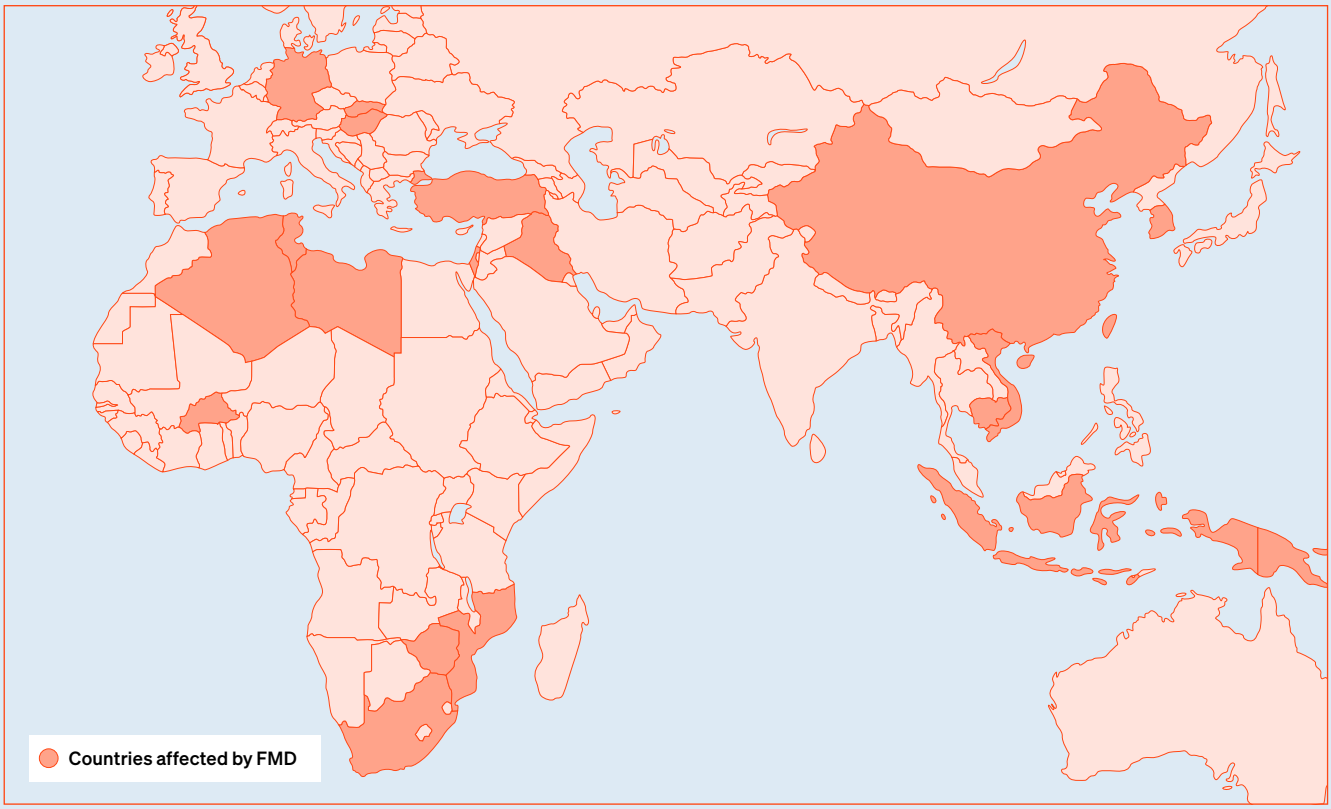
Between January 2024 and April 2025, a total of 165 peste des petits ruminants (PPR) outbreaks were reported to WAHIS by 9 countries.

In early 2024, PPR outbreaks were reported in the Caucasus region, with eight outbreaks in Türkiye between 1 January 2024 and 4 July 2024, as reported by ADIS1, and detections in Georgia for the first time since 2016, as reported by WAHIS.

In July 2024, the contagious disease was detected for the first time in Greece and Romania, both previously officially free of the disease. As of April 2025, Greece has reported 86 outbreaks, with over 5,317 cases, while Romania notified 68 outbreaks, with over 226,829 cases. Greece and Romania were historically free from PPR, meaning that the disease had not been detected for at least 25 years.

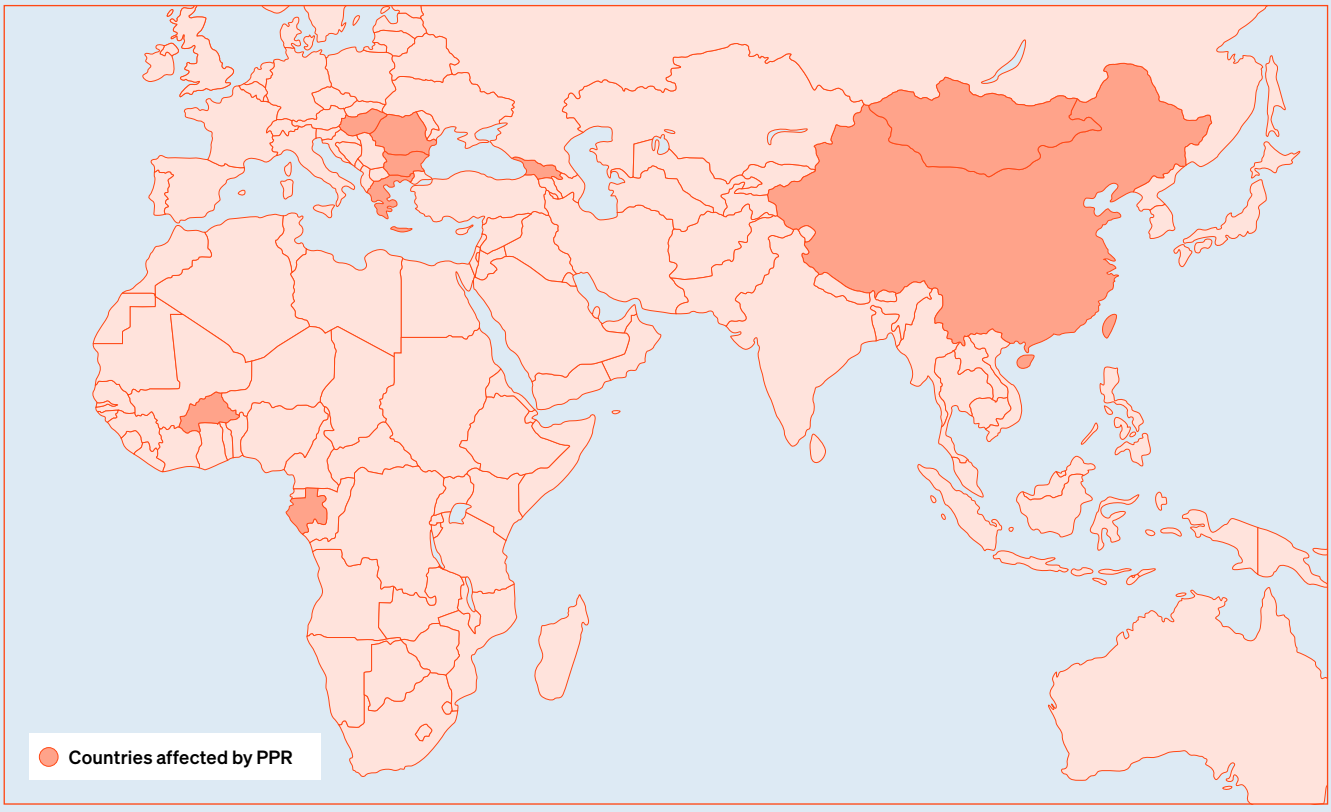
Due to the highly contagious and transboundary nature of PPR, the disease poses a persistent threat to small ruminant populations across regions with shared borders and livestock trade routes. Uncontrolled animal movements, porous frontiers, and informal trade networks facilitate the rapid spread of the virus across national boundaries, particularly in areas with limited veterinary infrastructure. WOAH underscores the importance of coordinated regional surveillance, timely data sharing, and harmonised vaccination strategies.

Countries affected by foot and mouth disease between 1 January 2024 and 1 April 2025.



Source: WAHIS

Countries affected by peste des petits ruminants between 1 January 2024 and 1 April 2025.



Source: WAHIS

[3] New occurrences of lumpy skin disease outbreaks

During the period under study, 319 LSD outbreaks were reported to WAHIS from 11 countries, including 11 exceptional epidemiological events (see Table 1). The disease was detected for the first time in northern Africa – with outbreaks reported in Algeria, Libya and Tunisia – and Japan. It also reoccurred in Eastern and Southern Asia.

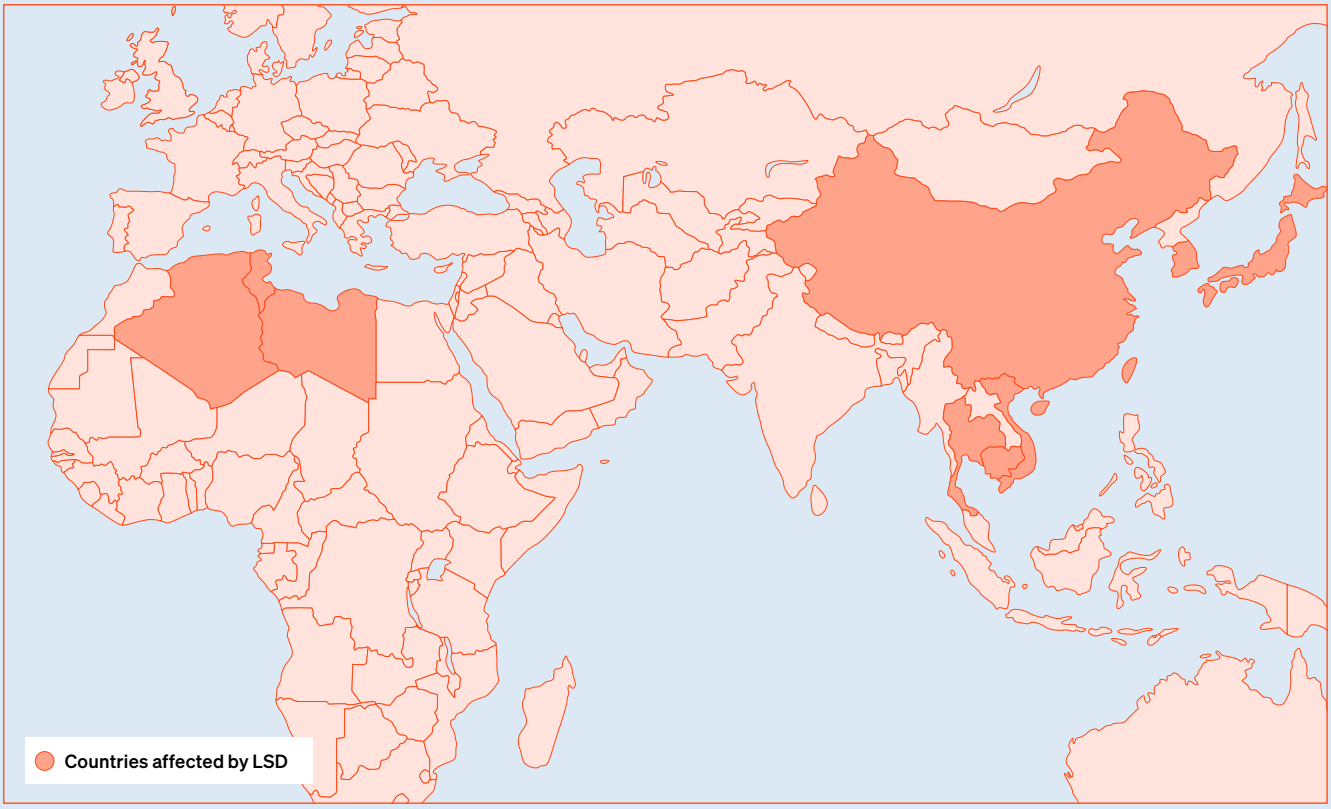
In Libya, outbreaks occurred between April 2023 and June 2024, and the event has since been resolved. However, in Algeria and Japan, outbreaks were reported from June 2024 and December 2024, respectively, with the event in Japan still ongoing at the time of publication.

In areas where LSD had previously reoccurred, all outbreaks were resolved by the publication date, except in Korea (Rep. of) and Cambodia. Notably, 80% of the reported events employed vaccination as a control strategy to combat the outbreaks.

Reason for notification	First occurrence in a country	Recurrence of a disease
No. of countries	4	7
No. of outbreaks	212	107
No. of cases	455	796
No. of deaths	47	94
No. of killed and disposed of	86	270
No. of vaccinated	1399	506

Table 1. Summary of lumpy skin disease outbreaks that occurred between 1st January 2024 and 1st April 2025 and were reported through the early warning module.

Countries affected by lumpy skin disease between 1 January 2024 and 1 April 2025.



Source: WAHIS

[4] The European spread of bluetongue virus

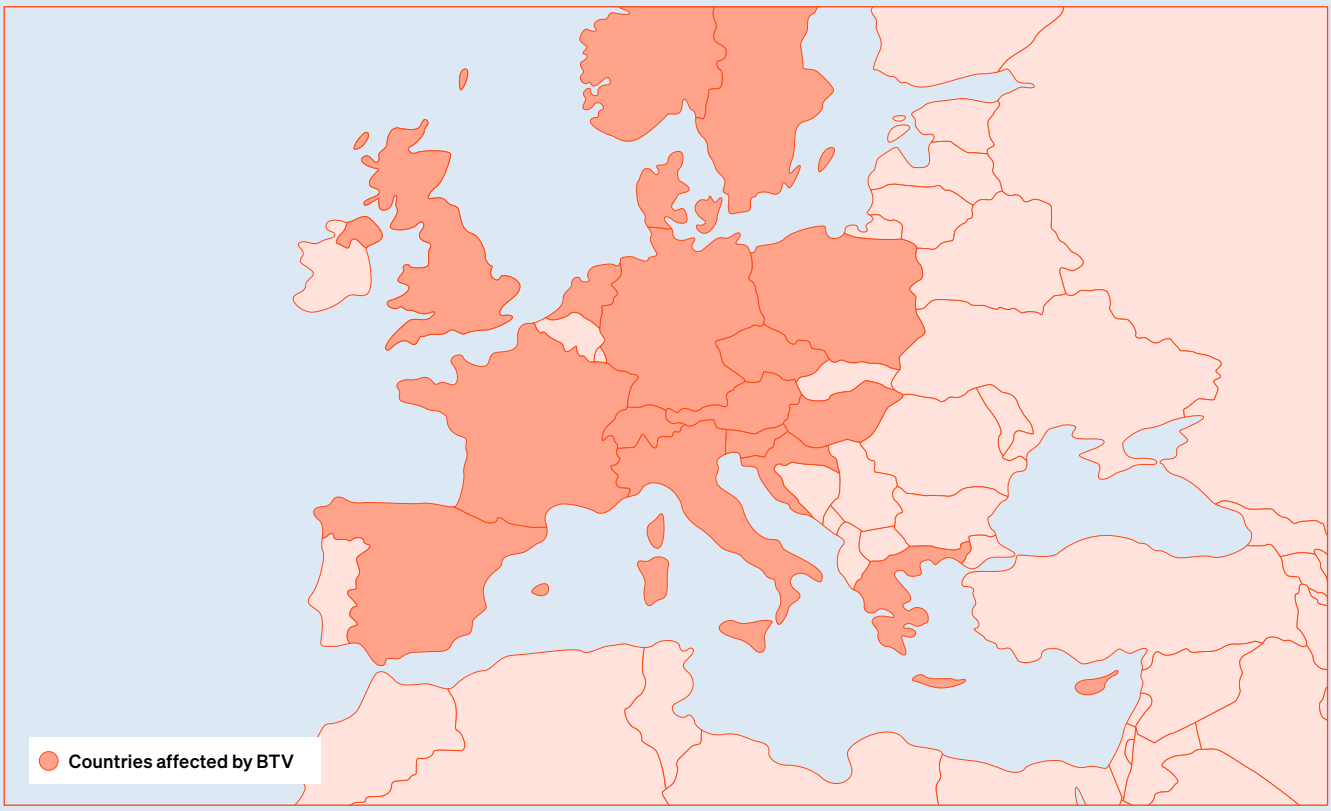
Bluetongue is a viral disease that affects ruminants like sheep, cattle and goats, spread by tiny biting midges. Once mostly confined to tropical and subtropical areas, it has steadily made its way into the Mediterranean basin and parts of Southern Europe since the late 1990s. While it poses no risk to human health, its impact on animals can be devastating, particularly for sheep. The disease not only leads to high mortality and reduced milk production but also disrupts trade and burdens farmers with costly control measures.

During the reporting period, a total of 3,626 bluetongue outbreaks were reported to WAHIS by 24 countries, involving 58 exceptional epidemiological events. The majority of these outbreaks (87%) were caused by serotype 3, followed by serotype 8 (11%).

In Europe, serotype 3 caused outbreaks in several countries, including Austria, Czech Republic, Denmark, France, Germany, Greece, Liechtenstein, Luxembourg, Norway, the Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Additionally, serotype 12 was reported for the first time in the Netherlands, while serotype 8 was reported for the first time in Portugal and North Macedonia. Elsewhere, serotype 4 reoccurred in Cyprus, and Libya and Peru detected the disease, although the serotype had not been determined by the time of the report's publication.

Given the widespread presence of serotype 3 and the reporting burden on Animal Disease Notification Focal Points, some European countries have declared their outbreaks as stable. These countries, including Austria, Belgium, Denmark, Luxembourg, Sweden and Switzerland, have declared the disease situation stable nationwide, while France, Germany, Portugal and Spain have done so for specific zones.

European countries affected by bluetongue virus outbreaks between 1 January 2024 and 1 April 2025.



Source: WAHIS

[5] Regional outbreaks of New World screwworm (Cochliomyia hominivorax)

New World screwworm is an endemic disease in certain Caribbean and South American countries, with Chile being the only exception where it was last reported in 1947. The disease was eradicated in Central America in the early 2000s, the United States of America (USA) in the 1960s, and Mexico in the 1970s.

During the reporting period, 8,363 outbreaks were reported to WAHIS by 7 countries, involving 13 exceptional epidemiological events. The disease was detected for the first time in Mexico in December 2024, while it reoccurred in Nicaragua, which accounted for over 60% of the reported outbreaks. Other affected countries included Belize, Costa Rica, El Salvador, Guatemala and Honduras.

As of the report's publication, Costa Rica, Honduras and Nicaragua had resolved their events as stable in WAHIS and planned to update their status through SMR. The remaining countries have periodically updated their events in WAHIS, with the exception of Guatemala which last updated its event in October 2024, which means that their disease situation was unknown at the date of publication of this report.

The emergency response strategy in affected regions involved the production of sterile flies for aerial and ground release, along with surveillance and control of animal movements. Raising awareness among livestock producers and promoting good livestock practices are essential to control the disease's spread and prevent future incursions into North America.

Countries affected by New World screwworm between 1 January 2024 and 1 April 2025.



Source: WAHIS

[6] African swine fever: widespread outbreaks and first occurrences

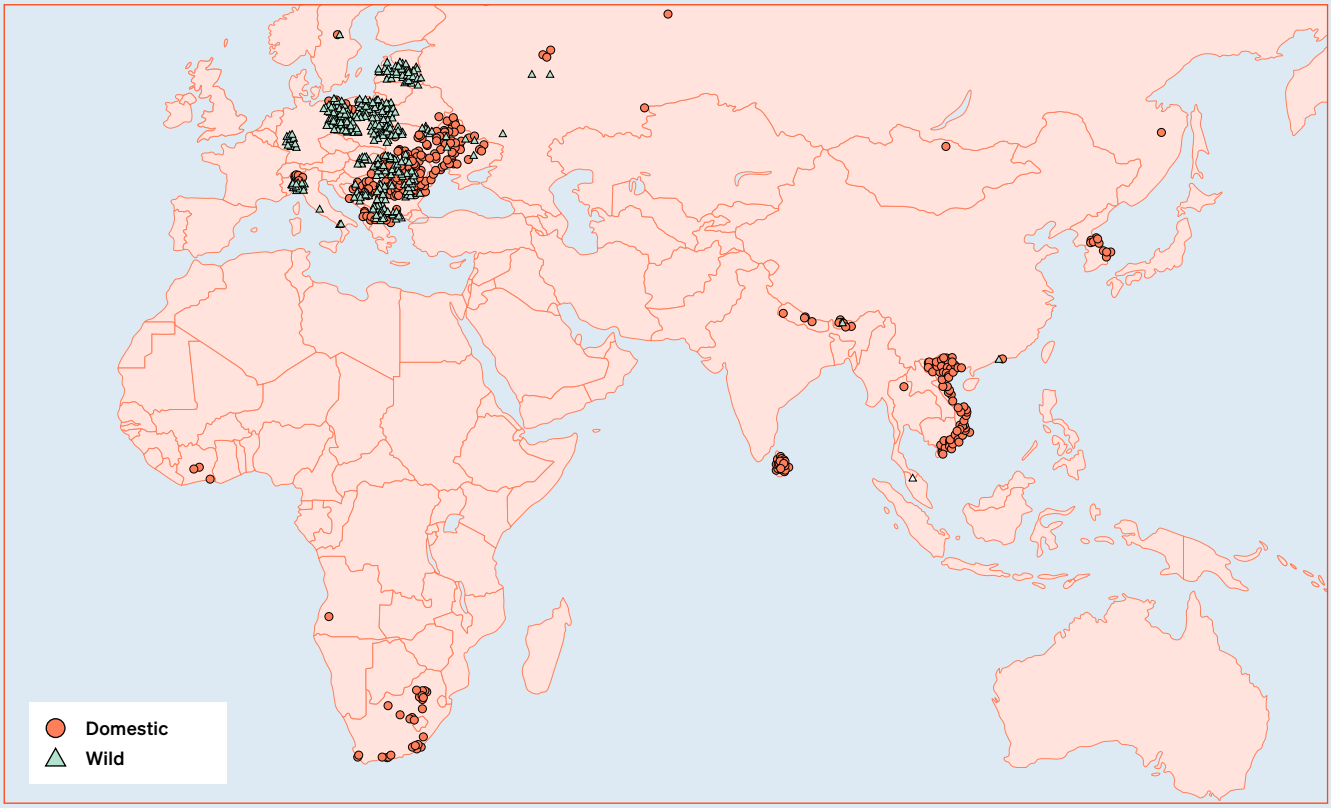
African swine fever has expanded its geographical range significantly, making control and eradication increasingly challenging. Despite these obstacles, global control of ASF remains possible with sustained efforts and international cooperation. WOAH and the Food and Agriculture Organization of the United Nations have launched a joint initiative under the Global Framework for the Progressive Control of Transboundary Animal Diseases, aimed at bringing together governments, industries and specialists to assist countries in controlling ASF.

For 2024, WOAH received 68 immediate notifications from 16 countries and territories, reporting a total of 6,807 outbreaks (1,532 in domestic pigs and 5,275 in wildlife). These outbreaks resulted in 195,191 reported cases, with 222,174 animal losses in domestic pigs. The geographical distribution of the outbreaks in 2024 highlights the expansion of the disease across borders. Notably, three countries reported the first occurrence of ASF during the year: Montenegro in January, Albania in February, and Sri Lanka in October. The spread of ASF to Sri Lanka marked the most significant 'disease jump' of the year, with a transmission distance of more than 1,800 km from the nearest outbreaks.

Among the countries already affected, significant spread occurred in regions such as Bhutan, Côte d'Ivoire, Germany and Poland, which reported outbreaks in 2024. Vietnam and Italy reported the highest number of outbreaks in domestic pigs (573 outbreaks) and wildlife (1,149 outbreaks), respectively. The disease also poses a serious threat to biodiversity, with ASF detected in the Visayan warty pig in the Philippines, a critically endangered species according to the International Union for Conservation of Nature.

Given the global impact of ASF on the pig industry and wildlife, the development of ASF vaccines has become a priority. Recent advancements in modified live vaccines have provided hope for controlling ASF. However, WOAH has cautioned against the use of substandard vaccines, as they may not provide effective protection and could even exacerbate the spread of the disease. The Organisation continues to develop standards for ASF vaccines, aiming to ensure that any vaccines used in the field are safe and effective.

Countries affected by African swine fever between 1 January 2024 and 1 April 2025.



Source: WAHIS

[7] High pathogenicity avian influenza: global spread and increasing mammal infections

High pathogenicity avian influenza remains a major global threat to both poultry and wildlife. WOAH continues to monitor HPAI's evolution globally, providing updates on risks identified by experts.

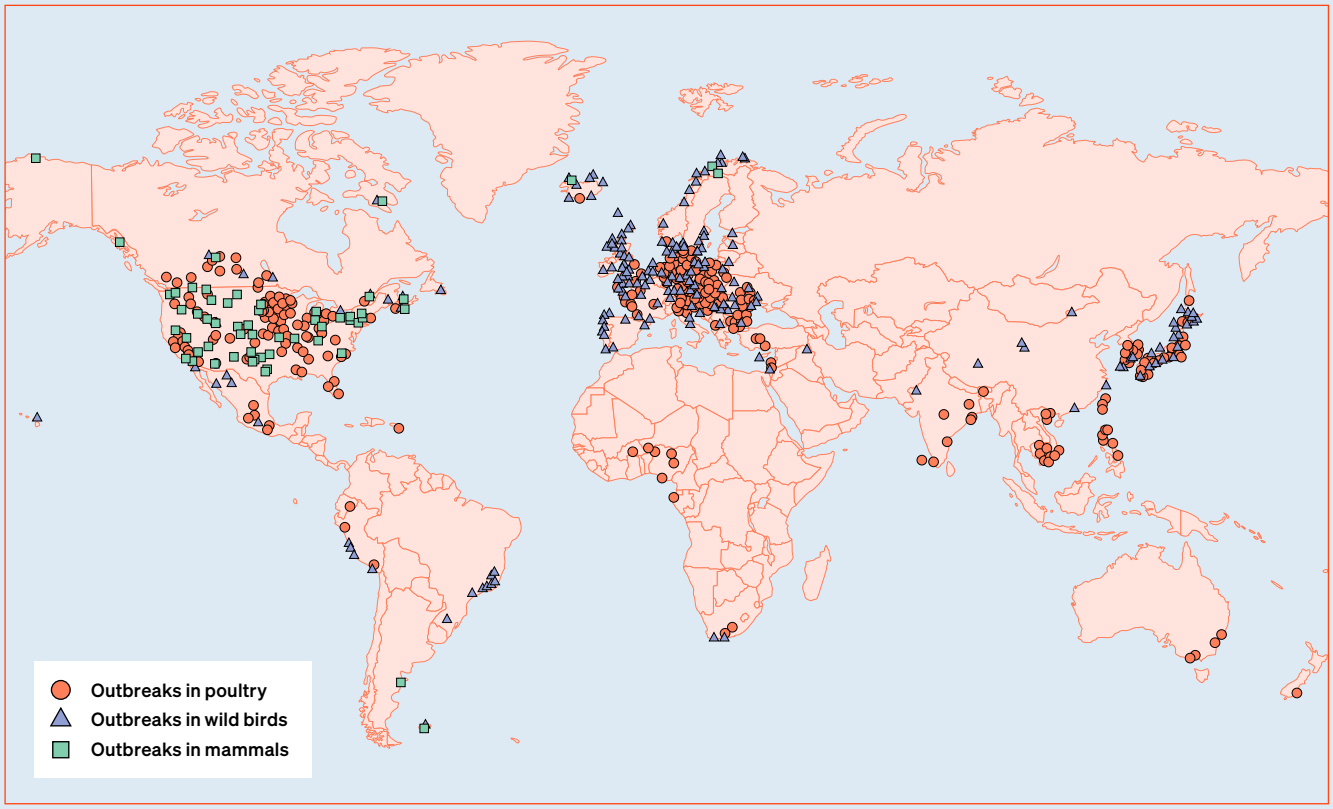
For 2024, 42 countries/territories reported new outbreaks of HPAI in poultry, while 55 countries/territories reported new outbreaks in non-poultry, including wild birds and mammals. A total of 943 outbreaks were reported in poultry, alongside 2,570 outbreaks in non-poultry species, including 1,548 outbreaks in wild birds and 1,022 outbreaks in mammals. The reported figures included 6.18 million poultry cases and 82.1 million poultry losses. Wild birds accounted for 11,866 cases, and mammals had 325 reported cases.

As of 31 December 2024, 19 countries had self-declared freedom from HPAI in poultry, with 2 countries reporting HPAI-free zones and 3 countries declaring HPAI-free compartments.

A notable development in 2024 was the increase in HPAI outbreaks in mammals. Following the first report of HPAI in dairy cattle in the USA in March 2024, the number of outbreaks in mammals significantly increased. In total, 1,022 outbreaks in mammals were recorded, compared to 459 outbreaks in 2023. Among these, 926 outbreaks occurred in cattle in the USA.

HPAI's global spread has been unprecedented, affecting areas previously unaffected by the disease, including Latin America and Antarctica. In March 2024, an unprecedented case of HPAI was reported in South Polar Skua in mainland Antarctica, highlighting the severe risk the virus poses to Antarctic wildlife and biodiversity. This spread marks a serious concern for experts, and WOAH urges Members to maintain vigilance in their surveillance, enforce biosecurity measures and adopt preventive strategies at the farm level. The Organisation also emphasises safeguarding people in close contact with infected animals and advises against unjustified trade restrictions.

Countries affected by high pathogenicity avian influenza between 1 January 2024 and 1 April 2025.



Source: WAHIS

[8] Wildlife health monitoring: surveillance gaps and disease threats to biodiversity

Wildlife health has become an increasingly important focus of WOAH, especially since the expansion of its efforts in 2020. Through the Wildlife Health Framework, WOAH has aimed to improve surveillance systems for wildlife health at national, regional and international levels. The framework encourages a One Health approach, advocating for the integration of human, animal and ecosystem health management to address emerging diseases. It also emphasises the need for political and scientific environments that enable effective wildlife health surveillance and management.

However, global wildlife disease surveillance still faces significant gaps. According to a 2019 study, 165 countries and territories reported surveillance for at least 1 of the 81 diseases listed by WOAH, with countries reporting surveillance for 19 diseases on average. Despite this, large regional discrepancies remain, as evidenced by the distribution of wildlife disease outbreaks. In 2024, 64 countries and territories reported a total of 6,917 outbreaks in wildlife, with the majority occurring in Europe (90.6%). Africa and the Americas had much fewer outbreaks (0.4% and 2.2%, respectively). Notably, 15,855 cases of wildlife disease were reported, with a high concentration in Europe. The diseases reported included significant public health threats like HPAI (1,312 outbreaks) and West Nile fever (138 outbreaks), as well as animal health risks like ASF (5,276 outbreaks) and classical swine fever (131 outbreaks).

In terms of biodiversity, 33 species impacted by these diseases were listed as near threatened, vulnerable, or endangered by the International Union for Conservation of Nature, underlining the potential long-term consequences for global biodiversity. WOAH continues to support Members in improving their wildlife disease surveillance systems and in notifying significant epidemiological events to enhance global disease control efforts.

[9] Aquatic animal health in 2024: surveillance efforts and disease management

WOAH's Aquatic Animal Health Strategy, launched in 2021, aims to improve the global health management of aquatic animals. This initiative is complemented by the Aquatic Animal Health Situation Reports launched in 2023, which monitor the health status of aquatic animals across four categories: fish, molluscs, crustaceans and amphibians. These reports highlight trends, significant disease outbreaks and emerging health concerns for these groups of animals.

In 2024, 26 disease outbreaks were reported through immediate notifications and follow-up reports, with 17 outbreaks in fish, 5 outbreaks in molluscs, 2 in crustaceans and 2 in amphibians (see Table 2). However, disparities in global aquatic animal production must be considered when analysing these reports. For instance, fish production is reported by 219 countries, while amphibian production is reported by just 38 countries. China remains the leading producer of all four categories of aquatic animals, significantly influencing global health data.

Surveillance gaps in aquatic animal health are also evident. Disparities exist between the animal categories in terms of surveillance measures reported by WOAH Members. This highlights the need for further development of surveillance systems, particularly in under-reported species like molluscs and amphibians. Effective management of aquatic diseases depends not only on surveillance improvements, but also on a global understanding of production levels and geographical disparities.

	Farmed	Wild
Fish	85%	54%
Crustaceans	76%	53%
Molluscs	66%	37%
Amphibians	53%	34%

Table 2. Percentage of reporting WOAH Members which notified surveillance measures through World Animal Health Information System by animal category and type of aquatic animals.

Outbreaks in wildlife in 2024

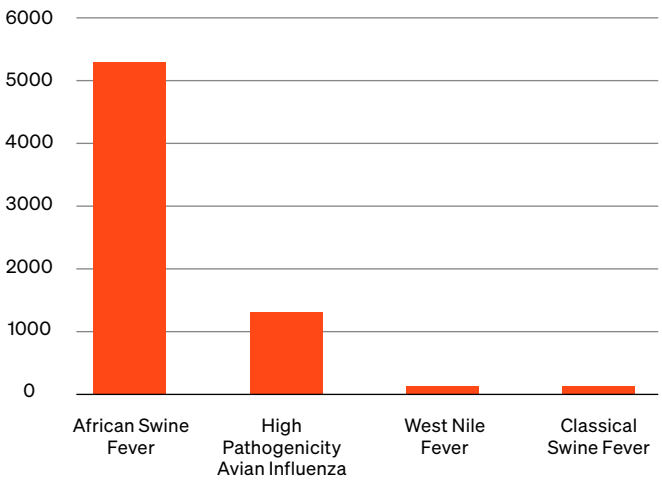


Fig 2. Breakdown of Wildlife Disease Outbreaks by Disease (2024)

Tracking and managing antimicrobial use through ANIMUSE

The WOAH Ninth Annual Report on Antimicrobial Agents Intended for Use in Animals published in May 2025 provides granular, data-backed insights into trends in global antimicrobial use (AMU), covering 71% of the world's animal biomass. The report (referred to as the Ninth Annual AMU Report) highlights a 5% decrease in AMU in animals between 2020 and 2022, demonstrating progress in reducing unnecessary antimicrobial use. However, challenges remain, particularly in monitoring use in aquaculture and assessing regional disparities – not to mention the continued use of antimicrobials for growth promotion.



↑ Antimicrobial use in aquaculture is a significant concern due to its potential to contribute to antimicrobial resistance.

Global antimicrobial use decrease: encouraging progress

Over the past few decades, antimicrobials have been widely used to treat diseases and to prevent them. However, indiscriminate use contributes to antimicrobial resistance (AMR), a major threat to both animal and human health. The Ninth Annual AMU report reveals that, between 2020 and 2022, antimicrobial use in animals decreased from 102 to 97 mg/kg of animal biomass, marking a 5% reduction.

Key insights:

- AMU reduction was recorded across 62% of the global animal biomass, distributed between 85 countries and territories.
- A total of 157 countries and territories participated in the data collection for the Ninth Annual AMU Report.
- When focusing on 2022 data, 111 countries provided validated quantitative data on AMU, reflecting a growing commitment to surveillance and monitoring.

Challenges in aquaculture

For the first time, the report provides a granular analysis of antimicrobial use in aquaculture compared to terrestrial food-producing animals (Figure 3). Findings indicate that fluoroquinolones accounted for 15.8% of antimicrobial quantities in aquaculture, raising concerns about the use of critical antibiotics in aquaculture environments.

- Fluoroquinolones are classified as highest-priority critically important to human health, yet their widespread use in aquaculture persists.
- 64% of the global aquatic biomass is now covered in the AMU dataset, improving the precision.

Use of antimicrobials for growth promotion: a persistent issue

WOAH discourages the use of antimicrobials as growth promoters in animals, yet 22% of WOAH Members still report using them for this purpose (Figure 4). Among those, 7% use antimicrobials classified as highest-priority critically important to human health, including colistin, enrofloxacin and fosfomycin.

Regional disparities in antimicrobial use

While many regions have successfully reduced AMU, the Middle East reported a 43% increase in antimicrobial use.

Key insights:

- Africa (–20%), the Americas (–4%), Asia and the Pacific (-–2%), and Europe (–23%) all reported decreases in AMU, demonstrating positive trends in antimicrobial stewardship (Figure 5).
- The Middle East, despite the increase, represents only 0.3% of the global animal biomass and 0.04% of total antimicrobial use, indicating a relatively low overall contribution to global AMU. However, it is important to note that validated data represent only 17% of the total regional animal biomass, underscoring the need for standardised and comprehensive reporting to ensure a fairer and more accurate assessment of the region's actual contribution to global antimicrobial use.

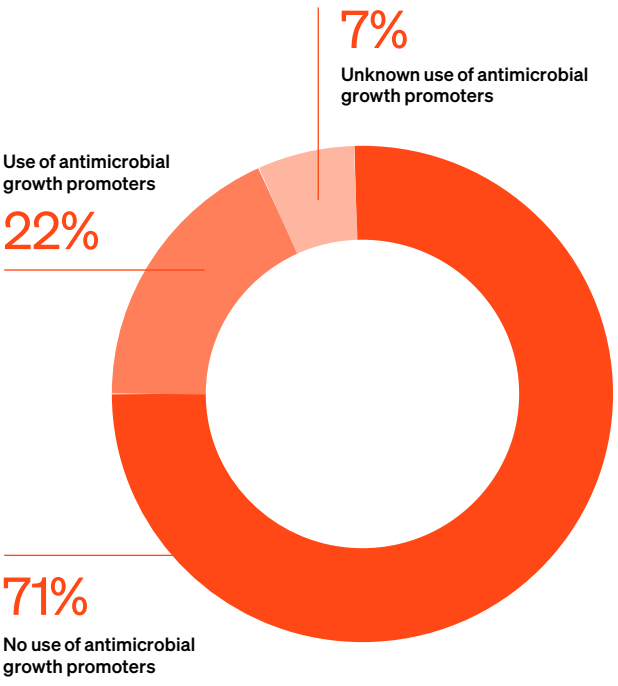


Fig 4. Reported use of antimicrobials as growth promoters in 2022.

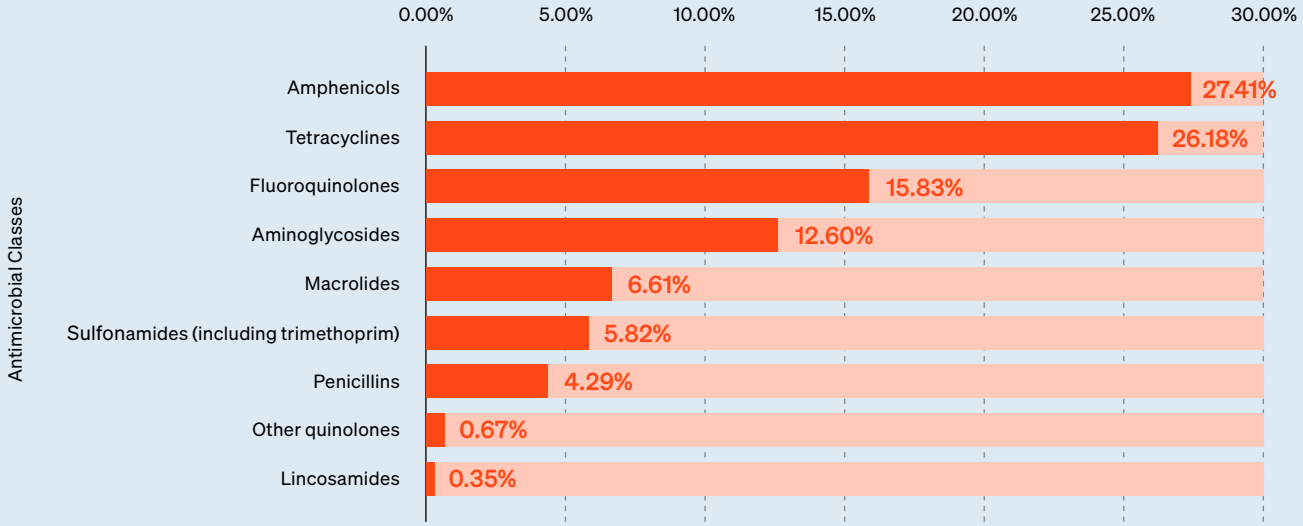


Fig 3. Proportion of antimicrobial classes by aquatic food-producing animals as reported by 18 participants in 2022.

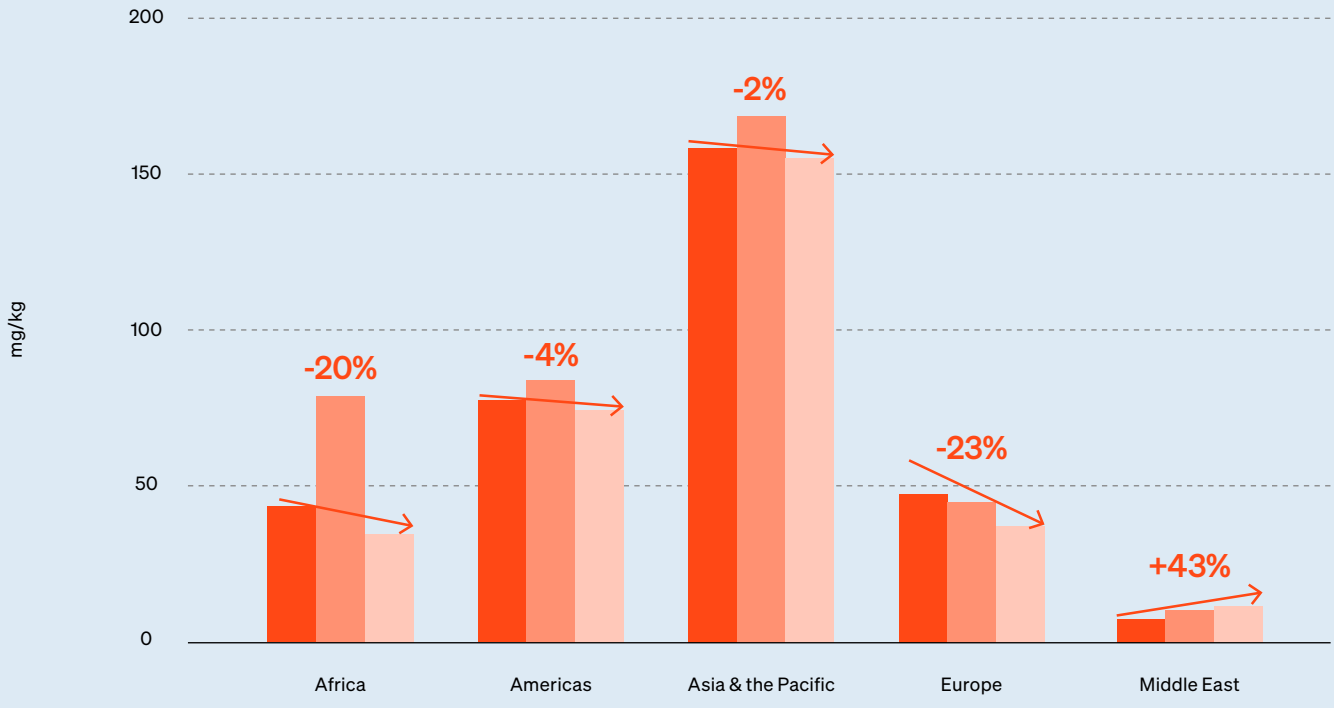


Fig 5. Reported antimicrobial use by region, 2020–2022.

Insights from the Health and Economic Impacts of Antimicrobial Resistance in Human and Food-Producing Animals report

The EcoAMR series (Health and Economic Impacts of AMR in Human and Food-Producing Animals), led by WOAH, used the latest data from 204 countries and 621 subnational locations to forecast the impact of AMR on mortality, healthcare costs, food security and the global economy.

Released ahead of a High-Level Meeting on AMR at the United Nations General Assembly, the modelling found that, if action is not taken now, drug resistance could cause annual global gross domestic product losses of up to US$ 1.7 trillion by 2050, while the spread of resistant pathogens from livestock to humans, could cost up to US$ 5.2 trillion. It also found that AMR could result in production losses in the livestock sector equivalent to the consumption needs of 746 million people, or more than 2 billion people in a more severe scenario by the same year.

The analysis, published in three reports, was produced by experts at WOAH, Animal Industry Data, the Center for Global Development, the Institute for Health Metrics and Evaluation and RAND Europe, with contributions from the World Bank.



↑ Scientist analysing samples in a laboratory.

Economic impacts of antimicrobial resistance in food-producing animals

By 2050, AMR could cause massive losses in livestock production, reducing the global supply of meat and dairy. The estimated loss is so large that it could equal the food consumption needs of up to 2 billion people per year.

- The impact will be especially severe in cattle and poultry farming, where antibiotic use is high.
- Farms may struggle to keep animals healthy, leading to lower meat and dairy output and higher food prices.

The financial impact of AMR in livestock is staggering. Between 2025 and 2050, global economic losses could reach:

- US$ 575 billion in the best-case scenario (if resistance grows slowly).
- US$ 953 billion if resistance spreads more aggressively.
- Up to US$ 5.2 trillion if AMR in animals also worsens human health and reduces workforce productivity.

This loss would slow economic growth, increase food insecurity and strain healthcare systems.

Cutting down on antibiotic use in livestock is not just good for public health – it makes economic sense. If farmers worldwide reduce antibiotic use by 30%, the global economy could gain US$ 120 billion by 2050.

- Investing in better disease prevention strategies, such as improved hygiene, vaccination, and biosecurity, would save money in the long run.
- Countries that act now will protect their livestock industries from future economic shocks caused by AMR.

Many countries still allow antibiotics to be used not just to treat sick animals, but to make them grow faster. However, this practice significantly increases overall antibiotic use.

- Countries that allow growth promoters use 45% more antibiotics per kilogram of livestock than those that do not.
- A total of 22% of WOAH Members still permit growth-promoting antibiotics. Some of the antibiotics used for growth promotion – such as colistin – are considered critically important for human medicine, meaning their misuse in animals could make life-saving drugs ineffective for people.

In 2022 alone, AMR was directly responsible for 1.15 million human deaths. Without urgent action, projections indicate that drug-resistant bacteria could cause 38.5 million deaths between 2025 and 2050, with the greatest burden falling on lower- and middle-income countries.

To combat AMR effectively, coordinated global action is needed. Farmers, policy-makers, and veterinarians must prioritise biosecurity, vaccination and responsible antimicrobial use. Investing in alternative disease-prevention strategies will be crucial to safeguarding both animal and human health.

WOAH remains at the forefront of AMU reduction efforts, working with its Members to improve surveillance, phase out non-essential antimicrobial use and strengthen One Health collaborations to ensure a healthier future for all.

30%

If farmers worldwide reduce antibiotic use by 30%, the global economy could gain US$ 120 billion by 2050.

$120 Billion

"The threat of drug-resistant infections to human health is widely recognised but the impact of AMR on the health of animals, our environment and our economy cannot be overlooked. On top of the drastic human death toll, drug-resistant pathogens can also severely impact animal health and welfare. It creates huge strains on the economy as well as on our sustainable development efforts. For the first time, we have an idea of exactly what's at stake unless the global community takes urgent action now."

Dr Emmanuelle Soubeyran
Director General, WOAH

Analysis of WOAH Observatory data on animal health standards

The WOAH Observatory serves as a key initiative for monitoring the implementation of animal health and welfare international standards by WOAH Members, while facilitating trade. By analysing existing data regularly collected from Members, the Observatory provides insights into the use of WOAH standards in relation to trade and sanitary measures, movement control and border precautions, zoning and compartmentalisation, antimicrobial use and antimicrobial resistance, and the One Health approach. This section synthesises findings from the WOAH Observatory's data analysis, highlighting trends and areas for improvement in global animal health.



↑ Veterinarian consulting data on a pig farm.

[1] Trade and sanitary measures

WOAH's international standards support the safe and transparent trade of animals and animal products, while ensuring effective control of transboundary animal diseases. In conjunction with the Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization (WTO), these standards help countries implement necessary health measures without imposing unnecessary trade restrictions.

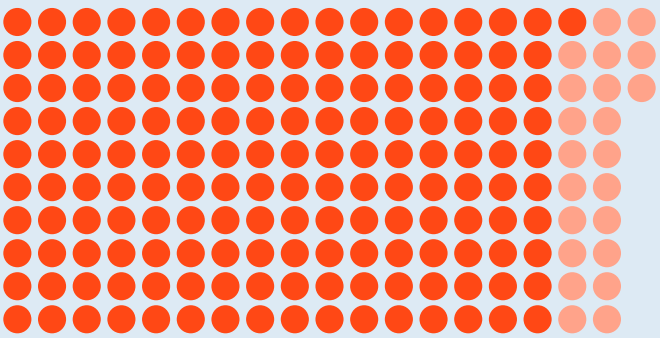
The SPS notification procedure is a system set up by the WTO. It helps countries know when another country is planning to introduce or change a regulation about food safety, or animal or plant health (these are called SPS measures). If a country might be affected by these new rules, they get a chance to review them and give feedback before they take effect.

- When a country shares a new notification, they are asked:
- Is there an international standard that relates to this rule?
- Does the new rule follow that standard, or is it different?
- If it is different, they need to explain how and why.

Key insights:

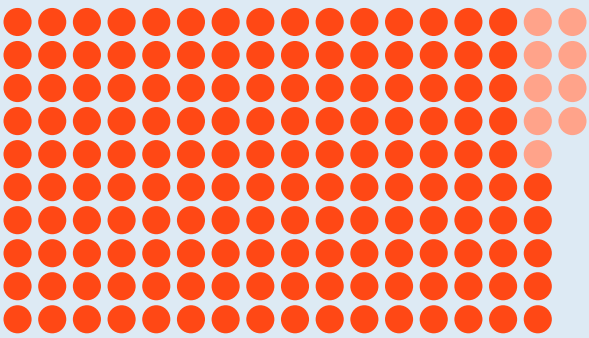
- A total of 62.5% of the SPS notifications submitted to the WTO between 2007 and 2023 related to WOAH standards were about avian influenza.
- Of these notifications 97% were about new or modified regulations that complied with existing WOAH standards.
- Between 1995 and 2023, 162 SPS-specific trade concerns were raised to WTO's SPS Committee referring to relevant WOAH standards:
  - A total of 88% were likely associated with *Terrestrial Codes or Manuals.*
  - A total of 12% were likely associated with *Aquatic Codes or Manuals*.

Mutual membership of WOAH and WTO
(as of 2023)



84% of 183

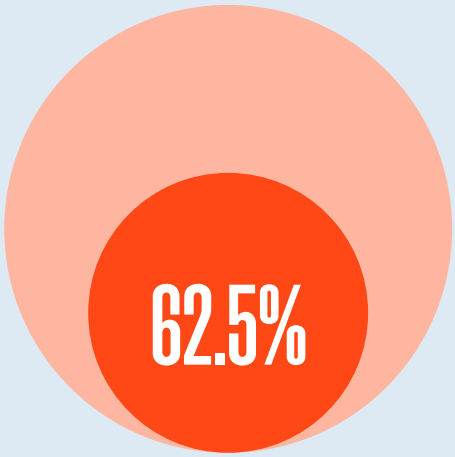
WOAH Members were also WTO Members.



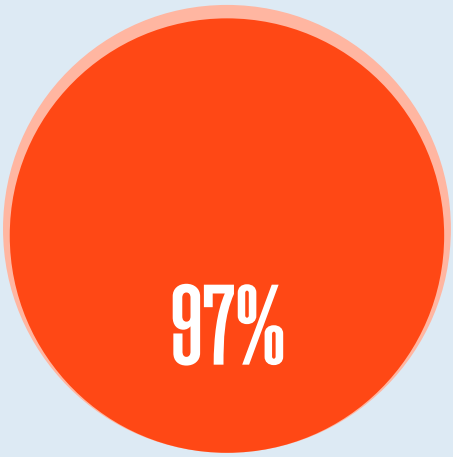
94% of 164

WTO Members were also WHO Members.

SPS Notifications to inform trade partners about new or modified sanitary regulations
(between 2007-2023)



62.5% of the SPS Notifications submitted to WTO related to WOAH standards were about avian influenza.

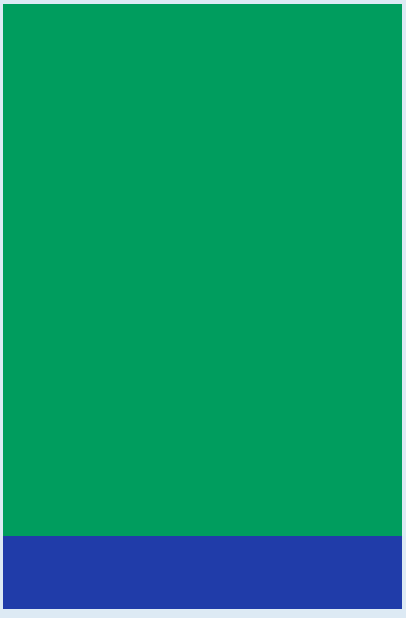


97% of these notifications were about new or modified regulations that compiled with existing WOAH standards.

Specific trade concerns discussed during SPS committee meetings
(between 1995 and 2023)

162

SPS-specific trade concerns were raised to SPS committee referring to WOAH relevant Standards.



88%

were likely associated with Terrestrial Codes or Manuals.

12%

were likely associated with Aquatic Codes or Manuals.

[2] Self-declaration and official status

WOAH allows its Members to self-declare freedom from WOAH-listed animal diseases. Additionally, official recognition is granted for disease statuses for African horse sickness, foot and mouth disease, peste des petits ruminants, bovine spongiform encephalopathy, classical swine fever and contagious bovine pleuropneumonia.

Key insights

- Between 2016 and 2023, 103 Members (equivalent to 56.3% of WOAH membership as of 2023) had at least one country-level official disease status, while 18 Members had at least one zonal official disease status.
- Between 2018 and 2023, 151 self-declarations by 54 Members were published; 51% were self-declarations for high pathogenicity avian influenza.

Self-declaration of freedom from terrestrial and aquatic diseases

Terrestrial disease

53 Members

139 self-declarations

Aquatic disease

3 Members

12 self-declarations

[3] Movement control and border precautions

WOAH standards emphasise traceability and identification systems to support movement control of animals and animal products, quarantine, and border-security measures. These standards are crucial to controlling the spread of diseases within a territory and across borders, while facilitating production and trade.

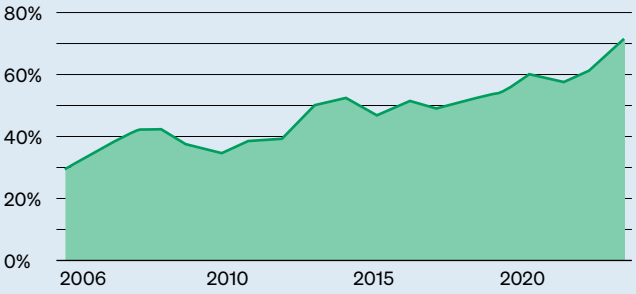
Key insights

- Over 80% of Members report border precautions for most of the important terrestrial diseases.
- The percentages of affected Members that used movement control as a measure to control the disease tended to increase for ASF and peste des petits ruminants, while for FMD and HPAI in poultry, the figures appeared stable.
- For aquatic diseases, it is more difficult to identify clear trends in border precautions and movement control.

**2021 is used as an example year as it is the latest year when the available data are the most complete.*

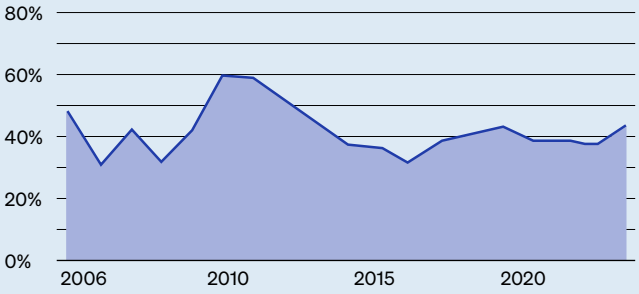
Movement control reported to WOAH for terrestrial and aquatic diseases

Peste des petits ruminants (PPR)



For most of the terrestrial diseases, the percentage of affected Members reporting movement control for the given disease was stable or tended to slightly increase over years.

White spot disease



For most of the aquatic diseases, the percentage of affected Members reporting movement control for the given disease fluctuated over years.

Border precautions reported to WOAH for terrestrial and aquatic diseases

Over 80%

of Members reported border precautions while the disease was absent in 2021 for the terrestrial diseases studied.

36-68%

of Members reported border precautions while the disease was absent in 2021 for the aquatic diseases studied.

[4] Zoning and compartmentalisation

Zoning and compartmentalisation help limit the spread of diseases and support international trade even during outbreaks. WOAH provides international standards for defining and recognising disease-free zones and compartments. The Observatory assessed the adoption of these standards by WOAH Members.

Key insights:

- The number of countries reporting zoning as a control measure for a disease increased from 40% of affected Members in 2005 to 67% in 2021.
- The use of compartmentalisation as a control measure increased from 1% in 2017 to 8% in 2021 for terrestrial diseases.

The use of compartmentalisation as a control measure for aquatic diseases increased from 4% in 2017 to 23% in 2021.

[5] One Health Implementation

The One Health approach recognises the interconnectedness of human, animal and environmental health. To promote this approach, WOAH pursues strong collaborative initiatives with other international organisations including FAO, UNEP and WHO, specifically focusing on zoonotic diseases, which are indeed one of the most relevant topics for WOAH under the One Health agenda. WOAH Members have the obligation to notify the Organisation about outbreaks of WOAH-listed diseases as well as emerging diseases through WAHIS.

Key insights:

- A total of 47% of the WOAH-listed diseases notified to WOAH between 2005 and 2023 were considered to have zoonotic potential according to the scientific information reviewed in 2024.
- A total of 68% of notifications to WOAH between 2005 and 2023 for emerging diseases were considered to have zoonotic potential.
- Three-quarters of WOAH Members' Veterinary Services have demonstrated formal external coordination mechanisms with clearly described procedures or agreements for some activities and/or sectors at the national level, or better, for external coordination.

The analysis of WOAH Observatory data highlights significant progress in the implementation of international animal health standards. However, challenges remain, particularly in regularly updating some data that are necessary to reinforce the Observatory's analysis. The Observatory's work pointed out the need to strengthen data collection regarding capacities of Members in areas such as workforce, simulation exercises and contingency plans. The quantitative analysis proposed so far may be further analysed through new thematic studies, where more qualitative approaches would be taken to identify success factors or persisting challenges by Members to implement WOAH standards. Discover more at www.woah.org/observatory.

**2021 is used as an example year as it is the latest year when the available data are the most complete.*

For more information about WTO indicators, see the factsheet for Trade & Sanitary Measures.

Increasing number of affected Members reported zoning

2005

40%

of affected members in 2005 reported zoning as a control measure.

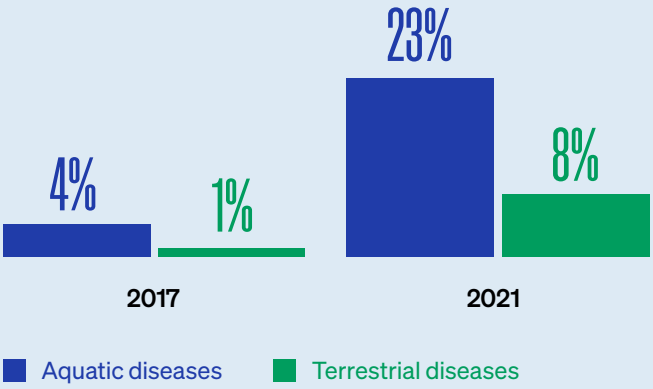
2021

67%

of affected members in 2021* reported zoning as a control measure.

Increasing percentage of Members reported compartmentalisation

Percentage of Members affected by the given diseases reported compartmentalisation as a control measure through six-monthly reports on WAHIS.



Half of the diseases reported to WOAH may have zoonotic potential

Between 2005 and 2023:

47%

of immediate notifications about WOAH-listed diseases had zoonotic potential

68%

of immediate notifications about emerging diseases had zoonotic potential

Majority of Veterinary Services had formal external coordination mechanisms

Out of 34 Members evaluated (2018-2023)

82%

maintained formal external coordination mechanisms with clearly described procedures or agreements for national level activities such as One Health

17% of them

had agreements in place for most activities, uniformly implemented throughout the country or territory, including at sub-national or provincial level.

A majority of Sanitary and Phytosanitary (SPS) regulations relevant to One Health conform to WOAH Standards



Between 2007 and 2023, there were 1035 SPS notifications about new or modified regulations referring to WOAH international standards

Improving animal health through data

The data presented in this section reflects the complexity of global animal health, highlighting both achievements and ongoing challenges. While improvements in disease surveillance and antimicrobial stewardship have contributed to greater resilience, persistent threats continue to demand coordinated global action. The insights gained from WOAH's data systems underscore the need for sustained investment in Veterinary Services, enhanced disease-monitoring capabilities, and stronger policy frameworks that align with international standards.

As WOAH continues to refine its data collection and analysis processes, the goal remains clear: to provide the most accurate, up-to-date and actionable information possible, ensuring that the world is better prepared to respond to emerging health threats. This commitment to a data-driven approach is essential for building a future where animal health is not only protected but proactively strengthened in the face of evolving global challenges.

WOAH key calls to action for better data-driven animal health

- **Enhance global data-sharing** to ensure real-time access to accurate information for timely responses to animal-health threats.
- **Strengthen data-collection systems** to capture more comprehensive and standardised information across the globe.
- **Promote transparency and data-sharing** among countries and stakeholders to ensure a coordinated, global approach to animal health management.

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Acknowledgements

The State of the World's Animal Health: 2025

This publication was made possible with the endorsement and support of : Dr Emmanuelle Soubeyran, Director General of WOAH

Strategic and editorial oversight: Gerrit Beger

This report was written by: Elise Pierrat, Shyuan Seah and Phil Tucak, and was edited by Lucy Hogan

Production and dissemination: Omotolani Badara, Camilla Caraccio, Paolo Casagrande, Elise Pierrat, Paula Pinet, Tanvi Rakesh, Kevin Tschierse, Janelle Wilson, Antonia Wong

We gratefully acknowledge the technical contributions of the following staff members from WOAH: Montserrat Arroyo, Viola Chemis, Charmaine Chng, Mariana Delgado, Yael Farhi, Delfy Gochez, Jenny Hutchison, Nahoko Ieda, Morgan Jeannin, Peter Melens, Caroline Paquier, Min-Kyung Park, Rita Rizk, Rachel Tidman, Paolo Tizzani, Gregorio Torres and Javier Yugueros-Marcos

Graphic design, typesetting and cover design: Allie Heesh

Cover image: ©Unsplash

We extend our sincere thanks to the following experts and WOAH Members, whom we had the pleasure of interviewing and whose insights were invaluable in shaping this report (listed in alphabetical order):

Dr Ahmad Al-Majali, WOAH Regional Representative for the Middle East;

Prof Peter Borriello, former Chief Executive Officer, Veterinary Medicines Directorate, United Kingdom;

Dr Francisco D'Alessio, WOAH Regional Representative for the Americas;

Dr Mohamed Idriss Doumbouya, WOAH Delegate for Guinea and Director of Guinea's National Directorate of Veterinary Services;

Dr Sergio Duffy, Consultant and Senior Technical Advisor, Center for Animal Health and Food Safety, University of Minnesota, United States of America;

Dr Abderrahman El Abrak, WOAH Delegate for Morocco;

Dr Alicia Gallardo, President, WOAH Aquatic Animals Commission; Expert, WOAH; Collaborating Centre on Antimicrobial Stewardship in Aquaculture, Chile;

Dr Marie-Christine Le Gal, WOAH Delegate for France; Deputy Director and Head of Veterinary Services, French Directorate General for Food – Ministry of Agriculture and Food;

Mr Julian Madeley, Director General, World Egg Organisation, United Kingdom;

Ms Rinzin Pem, Chief Veterinary Officer of Bhutan;

Dr Felicity Wynne, Head of TB Science Advice, Animal and Plant Health Agency, United Kingdom, and her APHA colleagues Dr Camille Szmaragd Harrison, Bovine TB Lead Scientist, Prof Mark Chambers, Bovine TB Immunology & Vaccines Workgroup Leader, Dr Susan Withenshaw, Lead Analytical Epidemiologist, Dr Fraser McPhie, TB Science Advisor, and Department for Environment, Food & Rural Affairs (Defra) colleagues Dr Jamie McFadzean Cattle Vaccination & Research Policy Lead, Dr Andrew Robertson, Badger Vaccination Policy Lead.

WOAH is the global authority on animal health: we work to ensure the health of animals and their environments across the world, recognising that animal health is fundamentally connected with our health and the health of the planet. Since 1924, we have focused on the complexities of animal health. We disseminate information on animal diseases and use science-based strategies to limit their potentially negative impact on society. We monitor the emergence and development of animal diseases, whether they affect livestock, aquatic animals or wildlife to address them before they become a threat to public health. We partner with leading international organisations like FAO, UNEP and WHO on global health initiatives. Our 183 Members know that adhering to our veterinary standards is essential to ensuring safe trade, public health and economic growth within and beyond their borders. We believe that collaboration is the key to obtaining results, which is why we strive to achieve solidarity among all our Members to effectively prevent and control animal diseases. We proudly collaborate with a substantial network of leading experts and laboratories globally, heavily contributing to our solid knowledge base and a pool of resources, information and assets that can be easily accessed and shared.

We seek to empower our Members by providing data and solutions to help them with their specific animal health challenges. We also work to reassure those who may be concerned about threats to their own health and livelihood by offering tools, knowledge and our track record of success in controlling animal diseases.

Our purpose is to improve animal health globally and contribute to a more sustainable ecosystem balance, so that livelihoods are transformed, economies are boosted, and the world is a safer and healthier place.

Animal health is essential to our future.
Because animal health is our health. It's everyone's health.

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