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Foreword

The livestock sector is fundamental to global agrifood systems, supporting livelihoods, food security and economic development for millions worldwide. However, it faces significant challenges, including transboundary animal diseases, antimicrobial resistance and the impacts of climate change. The FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines, held from 23–25 September 2024 at the headquarters of the Food and Agriculture Organization of the United Nations (FAO), brought together global experts to address these critical issues and promote sustainable livestock transformation.

The conference provided a collaborative platform for policymakers, scientists, private sector stakeholders and FAO Member Nations to advance innovative solutions for improving animal health. Key themes included strengthening the network of reference centres, enhancing access to safe and effective veterinary vaccines, and advancing One Health approaches to tackle zoonotic diseases and antimicrobial resistance.

FAO's reference centres play a crucial role in building capacity for disease diagnostics, epidemiology and veterinary research. Their contributions, especially in low- and middle-income countries, are essential for fostering resilience in livestock systems. Vaccination, as a cornerstone of disease control, was emphasized, with discussions underscoring the importance of equitable access to high-quality vaccines for all livestock keepers.

The conference also celebrated significant milestones, including the 20th anniversaries of EMPRES-Animal Health (EMPRES-AH) and the Emergency Centre for Transboundary Animal Diseases (ECTAD), and the 30th anniversary of the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs), highlighting FAO's long-standing commitment to enhancing animal health and food security. These achievements, coupled with the insights shared during the event, underscore the vital role of multistakeholder collaboration in addressing global challenges.

Aligning with FAO's four betters – *better production, better nutrition, a better environment and a better life* – the conference set the stage for transformative action. The outcomes provide a roadmap for sustainable livestock systems that contribute to global health, economic growth and environmental protection.

As we move forward, the strengths and gaps in veterinary services at the country level, along with the innovations and strategies presented during this event, will guide our collective efforts to build a resilient and inclusive livestock sector that safeguards human and animal health while supporting sustainable development. Together, let us work to ensure that no one is left behind in our pursuit of a healthier, more equitable world.

The main objectives achieved by the conference were:

- Provide Member Nations with a platform for collaborative support in addressing key priorities and challenges across diverse regions.
- Offer a comprehensive overview of FAO's mandate in controlling animal and zoonotic diseases, managing health emergencies, facilitating vaccine procurement and advancing capacity building aligned with the United Nations Sustainable Development Goals (SDGs).
- Create a platform between FAO Members and stakeholders to develop targeted solutions, drive innovation and advocate for sustainable livestock transformation.
- Highlight the critical role of veterinary vaccines in disease control and eradication, underscoring current challenges, exploring innovative approaches in vaccinology, and ensuring the availability and accessibility of high-quality vaccines for effective animal health protection.

Nine thematic sessions were organized with more than 60 speakers and panellists from around the world:

- Session 1: Setting the scene: International visions in advancing animal health
- Session 2: Improving animal health for sustainable livestock transformation
- Session 3: Animal health innovation and emerging technology
- Session 4: Reference centres and support networks
- Session 5: Regional support laboratory and national capacity building for the future
- Session 6: Securing the supply of safe, effective and affordable veterinary vaccines
- Session 7: Maximizing vaccination impact and enhanced quality
- Session 8: Sustainable solutions for animal health and climate resilience
- Session 9: Strengthening multistakeholder collaboration/public-private partnerships

In addition, six side events and a three-day exhibition enriched the programme.

Acknowledgements

The successful organization of the FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines was made possible by the dedication and commitment of many individuals.

The combined efforts of the external advisory panel, the FAO advisory task force and the conference secretariat were instrumental in ensuring its success. We extend our sincere gratitude to all the members of these groups whose collective effort and dedication made the conference a significant milestone in the advancement of animal health practices worldwide.

The general role of the external advisory panel and the FAO advisory task force was to provide advice and guidance to the conference secretariat on the thematic areas and overall structure of the conference. The conference secretariat, which was hosted by the FAO Animal Production and Health Division (NSA) in cooperation with other FAO divisions and the Joint FAO/IAEA Centre of Nuclear Techniques in Food and Agriculture, was responsible for making all decisions regarding the development and delivery of the conference.

We would also like to thank our partners at the Istituto Zooprofilattico Sperimentale delle Venezie (IZSve) for their contribution.

The tireless efforts of NSA staff and all the organization's security personnel, conference services, audiovisual teams, interpreters and translators are also gratefully acknowledged. Their work behind the scenes underpinned the success of the conference.



Abbreviations

ADB	Asian Development Bank
AfCFTA	African Continental Free Trade Area
AI	avian influenza
AIV	avian influenza virus
AMR	antimicrobial resistance
AMU	antimicrobial use
ANIMUSE	antimicrobial use and resistance surveillance in animals
APHIS	Animal and Plant Health Inspection Service
ASF	African swine fever
ASFV	African swine fever virus
AT	African trypanosomosis
AU-IBAR	African Union Inter-African Bureau for Animal Resources
AU-PANVAC	African Union Pan African Veterinary Vaccine Centre
AI	avian influenza
BAIF	Bharatiya Agro-Industries Foundation
CALF	Centre of Analysis and Learning in Livestock and Food
CBPP	contagious bovine pleuropneumonia
COSALFA	South American Commission for the Fight Against Foot-and-Mouth Disease
COVID-19	Coronavirus disease 2019
CVB	Center for Veterinary Biologics
CVOs	chief veterinary officers
CVP	Comité Veterinario Permanente del Cono Sur
DIVA	differentiating infected from vaccinated animals
DTRA/BTRP	Defense Threat Reduction Agency's Biological Threat Reduction Program
ECTAD	Emergency Centre for Transboundary Animal Diseases
EMC	Emergency Management Centre
EMPRES	Emergency Prevention System
EMPRES-AH	Emergency Prevention System for Animal Health
ES	environmental sampling
EuFMD	European Commission for the Control of Foot-and-Mouth Disease
FAO	Food and Agriculture Organization of the United Nations
FMD	foot-and-mouth disease
FMDV	foot-and-mouth disease virus
GALVmed	Global Alliance for Livestock Veterinary Medicines
GDP	gross domestic product
GF-TADs	Global Framework for Transboundary Animal Diseases
GHG	greenhouse gas
GISSA	global integrated surveillance of antimicrobial resistance
GLASS	Global Antimicrobial Resistance Surveillance System
HA	hemagglutinin
HPAI	highly pathogenic avian influenza
HPAIV	highly pathogenic avian influenza virus
IAEA	International Atomic Energy Agency
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
iiMS-PCR	integrated index multisegment PCR
IPCC	Intergovernmental Panel on Climate Change

ISO	International Organization for Standardization
LBM	Live bird market
LMICs	low- and middle-income countries
LSD	lumpy skin disease
MoU	Memorandum of Understanding
NA	native neuraminidase
NABH	National Accreditation Board for Hospitals & Healthcare Providers
NABL	National Accreditation Board for Testing and Calibration Laboratories
NDCs	nationally determined contributions
NDDB	National Dairy Development Board
NWS	New World screwworm
OAU	Organization of African Unity
OHHLEP	One Health High-Level Expert Panel
PANAFTOSA	Pan American Center for Foot-and-Mouth Disease
PCR	polymerase chain reaction
PHEFA	Hemispheric Program for the Eradication of Foot-and-Mouth Disease
PiiP	pan-family integrated index primers
PPEM	progressive pathway for emergency management
PPEP	progressive pathway for emergency preparedness
PPP	public–private partnership
PPR	peste des petits ruminants
PREZODE	PREventing ZOonotic Disease Emergence
PRRS	porcine reproductive and respiratory syndrome
qRT-PCR	quantitative real-time PCR
RBP	Ration Balancing Programme
RCs	reference centres
R-FETPV	Regional Field Epidemiology Training Program for Veterinarians
RSLs	regional support laboratories
RVF	Rift Valley fever
SARS	severe acute respiratory syndrome
SARS-CoV2	severe acute respiratory syndrome coronavirus 2
SCC	somatic cell counts
SDGs	United Nations Sustainable Development Goals
SDGU	sucrose density gradient ultracentrifugation
SEC	size exclusion chromatography
SIZE	Information System for Zoonoses and Emerging Infectious Diseases
SHIC	Swine Health Information Center
TADs	transboundary animal diseases
UNEP	United Nations Environment Programme
UNICEF	United Nations Children’s Fund
USDA	United States Department of Agriculture
VETLAB	Veterinary Diagnostic Laboratory Network
VSTA	Virus-Serum-Toxin Act
WHO	World Health Organization
WOAH	World Organisation for Animal Health
WFF	World Food Forum
WRLFMD	World Reference Laboratory for FMD

CHAPTER 1

Opening plenary session and high-level panel

1.1 OPENING REMARKS

Beth Crawford, Chief Scientist ai



Excellencies, distinguished guests, representatives of international organizations, FAO reference centres and the private sector, ladies and gentlemen,

Welcome to the FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines.

With this conference, we are building on the success of the 2023 Global Conference on Sustainable Livestock Transformation – a historic event that set the stage for today's discussions. We continue to emphasize the importance of innovation and collaboration to improve animal health for the sustainable transformation of livestock systems.

Sustainable livestock systems are crucial for enhancing food security, improving nutrition and promoting economic development and livelihoods – especially in low- and middle-income countries.

Yet the productivity and resilience of livestock systems worldwide are threatened by infectious diseases, emerging pathogens, endemic disease burdens and climate change.

That is why we need a united effort, leveraging our collective expertise and resources.

Over the years, FAO has made significant strides in animal health.

One of our greatest achievements was the eradication of rinderpest – a historic victory that demonstrated the power of global collaboration and scientific innovation.

FAO, through the One Health approach, remains fully committed to tackling high-impact transboundary, emerging and zoonotic animal diseases, as well as antimicrobial resistance, which threaten both animal and human health.

This conference is a unique opportunity to explore how to integrate existing mechanisms and knowledge with new and improved tools to reduce the global burden of animal disease.

It highlights the critical role of FAO's reference centres, which provide crucial expertise, capacity and training in disease diagnostics, epidemiology and applied veterinary research.

I take this opportunity to extend my heartfelt thanks to the sixty FAO reference centres for their generous contributions and support to FAO's work.

Indeed, they represent the spirit of global partnership and solidarity.

Vaccination is a cornerstone of disease control and eradication, but challenges persist in securing an affordable supply of safe and effective vaccines.

This conference will address these issues, emphasizing the importance of innovative approaches in vaccinology and the accessibility of high-quality vaccines for all livestock keepers.

We will also spotlight the key role of youth – the drivers of change and leaders of tomorrow.

We must recognize, engage and empower young scientists, veterinarians and innovators to bring fresh perspectives and energy that are essential for the future of animal health.

I want to assure you that FAO is committed to integrating your insights, recommendations and innovative ideas into our broader work to support our Members in the sustainable transformation of the livestock sector.

Together, we can build a more efficient, inclusive, resilient and sustainable future for the livestock sector – for better production, better nutrition, a better environment and a better life, leaving no one behind.

Thank you, and I wish you a successful conference.

1.2 HIGH-LEVEL MINISTERIAL SESSION

Alka Upadhyaya, Secretary, Department of Animal Husbandry and Dairying, Government of India

Girma Amente, Minister of Agriculture, Ethiopia

Rwamirama Bright Kanyontore, Minister of State for Agriculture, Animal Industry and Fisheries, Uganda



Alka Upadhyaya, Secretary, Department of Animal Husbandry and Dairying, Government of India

Good morning to all of you, the Director-General of FAO in absentia, excellencies, ladies and gentlemen.

I am Alka Upadhyaya, representing India as Secretary for the Department of Animal Husbandry and Dairying. I would like to congratulate FAO for organizing this global conference, especially the Director-General of FAO, for inviting India to the workshop and providing the opportunity to share our experiences and advancements. Our world is interconnected in many ways, and the health and well-being of our animals are critically linked to our own. Ensuring the health and welfare of animals is not just a moral obligation – it is essential for food security, economic development and safeguarding public health, as we have all learned from the recent events related to COVID-19.

We know that nine of the 17 United Nations Sustainable Development Goals (SDGs) are linked to the livestock sector. We also know that 40 percent of the protein consumed comes from animal sources, and that one in five people depends on livestock for their livelihoods globally. India is the largest producer of milk – known as the “dairy of the world” – with an overall output of about 230.6 million metric tonnes. We are also the second-largest producer of eggs and the eighth-largest producer and exporter of meat. As far as buffalo meat is concerned, India ranks first in the world. Livestock is an integral part of agriculture and provides livelihoods to more than two-thirds of the rural population of the country.

India also has the second-largest livestock population in the world. We understand the importance of livestock, livestock health and the necessary innovations.

Given that two-thirds of the population depends on the livestock sector for their livelihoods, it is crucial to prioritize

animal health to ensure that farmers have sustainable income. The livestock sector plays a key role in food security. India is currently implementing one of the world's most extensive vaccination programmes to fight foot-and-mouth disease (FMD), with about 860 million vaccine doses produced. The programme – endorsed by the World Organisation for Animal Health (WOAH) – is ongoing. Some zones of the country have already been declared FMD-free, and we hope to achieve national FMD-free status by 2029–2030. India has become self-reliant in vaccine manufacturing for several animal diseases and is now positioned to supply vaccines to neighbouring countries.

Our vaccination programme also addresses several other animal diseases. Good-quality vaccines, supported by robust testing protocols, have become the norm in India.

Lumpy skin disease (LSD) emerged in 2022–2023, and we were able to control it effectively with the use of the goat pox vaccine. We have also developed a dedicated vaccine for LSD, which will soon be commercially available in India and offered to neighbouring countries.

India has long been known as the “pharmacy of the world” for human vaccines and medicines, and we are now on track to assume a leadership role in animal health as well.

A stringent regulatory mechanism has been established to ensure vaccine quality, and we remain committed to upholding these standards.

I would now like to highlight some of the innovations India has undertaken.

A National Digital Livestock Mission has been launched to create a unique identity for each animal. This allows information about vaccination, artificial insemination and inputs to be stored digitally. It enables accurate traceability and is expected to boost exports. To date, approximately 520 million livestock and 90 million livestock farmers have been registered. Every 19 seconds, one transaction is recorded. This is a major achievement in digital public infrastructure, which will soon be integrated with agricultural systems.

India has a comprehensive disease surveillance programme, including five regional diagnostic laboratories and one central laboratory. I am pleased to share that India hosts FAO reference centres for FMD and peste des petits ruminants (PPR), as well as WOAH reference laboratories for avian influenza (AI), rabies, PPR and leptospirosis. We are also working to secure recognition for glanders. We aim to accredit all laboratories through the National Accreditation Board for Testing and Calibration Laboratories (NABL), and all veterinary hospitals through the National Accreditation Board for Hospitals & Healthcare Providers (NABH).

We have also developed forecasting and predictive models for 15 major livestock diseases through the National Animal Disease Referral Expert System. In the poultry sector,

we have identified 32 disease-free compartments, endorsed by WOAHA.

These efforts reflect India's adherence to international norms and our commitment to establishing disease-free zones nationwide.

Another innovation is the mobile veterinary units – one for every 100 000 livestock. We have 3 420 mobile veterinary units, each handling 30–35 cases per day. To date, 10 million animals have been treated on-call through a centralized call centre.

We are also engaging communities by launching a skilling framework and accrediting agents for livestock health and extension. This initiative mobilizes rural women to manage livestock in their communities, enhancing productivity and promoting animal health.

In recent years, generic medicine has become widespread in human health. The Animal Husbandry Department is now promoting a list of high-quality generic medicines and vaccines for animals, to be distributed affordably through existing networks. We are also establishing veterinary hospital welfare committees to enhance infrastructure and services, utilizing a user-charge model. We are aware that veterinary hospitals often face funding shortages and lack critical infrastructure. To address these challenges, veterinary hospital welfare committees have been established as part of a public–private partnership (PPP) model, advocated by WOAHA.

The Animal Pandemic Preparedness Initiative has been launched to enhance readiness for emerging animal pandemics. In parallel, the National One Health Mission and National Joint Outbreak Response teams have been formalized. I am proud to share that India recently secured a USD 25 million grant from the G20 Pandemic Fund for animal health security and pandemic preparedness, to be administered jointly by FAO, the World Bank and the Asian Development Bank (ADB).

India currently chairs the Animal Production and Health Commission for Asia and the Pacific. We are working collaboratively to address transboundary animal diseases (TADs) in the region through resource sharing, knowledge exchange and best practices among Member Nations.

Antimicrobial resistance (AMR) is another global challenge. A national action plan has been developed to combat AMR by promoting responsible antibiotic use. We are also exploring ethnoveterinary and traditional medicines for animal health.

India enjoys a strong partnership with FAO. Initiatives include AMR surveillance through the Indian network for fisheries and animal microbial resistance – a national network of 36 veterinary and fish laboratories.

We are working closely with FAO's Emergency Centre for Transboundary Animal Diseases (ECTAD) on several fronts. Thanks to FAO support, we have developed national

standard treatment protocols and finalized disease prioritization frameworks – areas that previously lacked standard operating procedures and guidelines.

In closing, I thank all of you as we embark on this journey together – leveraging our collective wisdom, innovation and commitment – to protect our animals and communities and to promote a healthier, more sustainable future for all.

Thank you very much.

Girma Amente, Minister of Agriculture, Ethiopia

Greetings from Ethiopia.

Ministers, excellencies, ladies and gentlemen,

On behalf of the Government of the Federal Democratic Republic of Ethiopia and my ministry, I extend my gratitude to the organizers of this first-ever Global Conference on Animal Health Innovation, Reference Centres and Vaccines, with the theme of improving animal health for sustainable livestock transformation and One Health implementation. Thank you for allowing Ethiopia to participate in this global event.

Ethiopia holds the largest livestock population in Africa and ranks among the top ten globally. Our resources include approximately 7 million bee colonies and more than 200 species of fish, 40 of which are endemic. Livestock and fisheries contribute significantly to agriculture, accounting for 26 percent of the agriculture gross domestic product (GDP) and 4 percent of the national GDP. Beyond supporting economic growth, the sector also creates employment opportunities, particularly for pastoralist communities.

In 2023, His Excellency Prime Minister Abiy Ahmed launched Yelemat Trufat, a livestock-based homegrown initiative aimed at increasing the production of milk, poultry, eggs, fish and honey. Yelemat Trufat aligns with other key initiatives in Ethiopia, such as the successful national wheat production programme and the recently implemented Green Legacy initiative. Meaning "bounty of the basket", Yelemat Trufat emphasizes balanced, protein-rich food production through breed improvement, animal health, and feed and nutrition advancements. Over the past two years, we have successfully implemented this initiative with remarkable and promising results.

Excellencies, ladies and gentlemen, FAO has been working with us and providing technical support to the Government of Ethiopia in various areas, including animal feed development, livestock production and animal health surveillance systems. We focus on strengthening laboratory capacity, enhancing emergency preparedness and response, and improving frontline, public, private and community-based animal health services in remote and marginal areas.

We are promoting a One Health approach that emphasizes the interconnectedness of human, animal and environmental health and fosters collaboration across those sectors.

Ladies and gentlemen, to fully realize its livestock potential, Ethiopia requires strong institutional capacity – including laboratories, vaccine production centres and well-trained professionals – to prevent and control transboundary animal diseases and zoonotic diseases.

Currently, Ethiopia produces 23 types of vaccines for domestic use and exports them to other African countries in need. However, continuous improvement of those vaccines and delivery methods is necessary, along with preparedness for emergencies and re-emerging diseases.

Ethiopia also aspires to establish disease-free export zones, expand market destinations and meet importer countries' requirements in line with the World Organisation for Animal Health standards. Achieving these goals requires collaboration between national and international institutions and technical, logistical and financial support.

I would like to acknowledge the commendable efforts of FAO, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), in collaboration with the Ministry of Health and the Ministry of Agriculture in Ethiopia. These efforts have resulted in Ethiopia being selected as one of the initial recipients of the World Bank Pandemic Fund. This fund represents a pioneering multilateral financing mechanism dedicated to providing long-term grants and assisting low- and middle-income countries (LMICs) in improving their preparedness for future pandemics. It enhances surveillance, laboratory systems and human resource capacities through a One Health approach. This model should be extended to other animal diseases.

In closing, I express my gratitude for your commitment to this event and this cause. I look forward to the insights and partnerships that will emerge from our discussions here in Rome.

Thank you.

Rwamirama Bright Kanyontore, Minister of State for Agriculture, Animal Industry and Fisheries, Uganda

Colleague ministers, excellencies, distinguished ladies and gentlemen,

I bring you warm greetings from the Republic of Uganda, on behalf of the Government of Uganda and on my own behalf. I thank the organizers of this Global Conference on Animal Health Innovation, Reference Centres and Vaccines, which has been held under the theme of improving animal health for sustainable livestock transformation and One Health implementation.

The conference theme aligns with our national efforts to enhance animal health, prevent disease outbreaks and support sustainable livestock production while promoting One Health, protecting human health and ensuring safe food systems. These threats are interconnected and shared

among humans, animals, plants and the environment. One Health means that all stakeholders must find ways to work together and form collaborations that lead to long-term, innovative solutions for sustainable livestock transformation, food security and human welfare. When we speak of food and nutrition security, we must not overlook the importance of animal protein in our food systems.

Ladies and gentlemen, as we work together to improve animal health, we must also address human health and welfare. Approximately 60 percent of infectious diseases are zoonotic, and 75 percent of emerging human infectious diseases originate from animals. One of the greatest current threats to the One Health approach globally is antimicrobial resistance, which affects humans, animals, plants and the environment. This is a serious threat to global health and the achievement of the SDGs. We must abandon the siloed approaches of working in compartments as individual countries or organizations.

The major challenges affecting animal health fall into the following categories. The first is access to vaccines. We must invest more in prevention than in cure. Veterinary vaccines must be more available and affordable for farmers, especially for the control and prevention of transboundary animal diseases. The most effective way to address TADs is through collaboration at the level of regional economic communities, multilateral institutions and programme-based frameworks.

We must therefore prioritize animal vaccine production and ensure vaccines are accessible, affordable and of high quality. This requires dedicated investment in vaccine research, production, distribution and cold chain storage.

The second challenge is AMR. Antimicrobial medicines are critical for saving the lives of humans, animals and crops. However, their overuse and misuse have led to the emergence of resistance. Stakeholders must implement mechanisms to regulate the responsible use of antimicrobials and prevent misuse.

AMR increases the costs of treatment, reduces animal productivity, leads to lost market access for animals and animal products, and ultimately results in income losses for farmers, particularly smallholders. We must reduce reliance on antimicrobials to maintain animal health and production. This can be achieved through investment in innovative practices that sustainably transform our farming systems and animal industries.

We recommend the following interventions:

- i. Invest in innovations that promote good husbandry and production practices, including biosecurity, hygiene measures and efficient farm waste management.
- ii. Promote alternative approaches such as alternative feeds, feed additives, integrated pest management and biological control and treatment methods.

- iii. Increase investments in veterinary and extension services, establish appropriate and functional farm input supply chains, and strengthen collaboration with farmers and other stakeholders in the livestock value chain.
- iv. Raise awareness of the risks and implications of AMR.

In Uganda, we have approximately 16.4 million head of cattle, 17.4 million goats, 8 million sheep and 8.5 million pigs. All these species are susceptible to foot-and-mouth disease, and as a national policy, we have mandated vaccination of all susceptible animals to work towards achieving FMD-free status.

I am aware that this year, FAO launched the global initiative for reducing the need for antimicrobials on farms. This initiative aims to guide countries in implementing sustainable practices, and I urge us all to commit to it. I also commend FAO's current approach, which recognizes the importance of animal protein in food security – an area previously underemphasized.

Through the Ministry of Agriculture, Animal Industry and Fisheries, Uganda is promoting this initiative and has prioritized it in our food production agenda. We encourage FAO to continue playing a central role in AMR prevention.

The final challenge I would like to raise is data collection for evidence-based action. At present, AMR and animal disease surveillance systems are weak and require urgent attention. It is difficult to justify an investment without accurate and timely data. Strengthening this area will require significant financial commitment and institutional support.

We must therefore invest in innovations in animal health data collection, AMR monitoring and the gathering and dissemination of evidence. Distinguished participants, as we gather here to deliberate on the key priorities and challenges in animal health, I urge all stakeholders to prioritize the issues I have outlined. These are major obstacles not only to animal health, but also to addressing global One Health challenges and achieving the Global Health Security Agenda.

My heartfelt appreciation goes to all of you participating in this initiative for your dedication and commitment. I look forward to our continued collaboration. I would also like to extend my sincere thanks to the organizers of this conference and the Food and Agriculture Organization for inviting Uganda to be part of these important deliberations. On behalf of the Government of Uganda, and in my own capacity, I thank all participants for giving the Global Conference on Animal Health Innovation, Reference Centres and Vaccines the attention they deserve.

Thank you very much for listening.

CHAPTER 2

Setting the scene: international visions in advancing animal health

2.1 EMPOWERING ANIMAL HEALTH ACTORS TO FACE GLOBAL CHALLENGES

Emmanuelle Soubeyran, Director General, World Organisation for Animal Health



Excellencies, distinguished representatives of FAO Member Nations, dear FAO colleagues and representatives of reference centres, vaccine producers, research institutes, regional economic communities and resource partners,

Let me begin by warmly thanking Dr QU Dongyu, the FAO Director-General, for his invitation to take part in this global conference, and Thanawat Tiensin, Assistant Director-General, and his team for their support in preparing my participation.

It is with great honour that I address you all today. This event marks my first official visit to FAO since being elected Director-General of the World Organisation for Animal Health in May. I am grateful for the warm welcome and support from all present.

Animal health is a political issue.

Indeed, improving animal health:

- contributes to food security;
- boosts the economy;
- promotes safe trade;
- protects public health;
- preserves wildlife and biodiversity; and
- helps mitigate climate change.

Most of this audience knows that, but neither the general public nor decision-makers are necessarily aware of it.

That is why we need to continue to advocate and raise the visibility of animal health's impact. During my mandate, I am committed to advancing this cause.

Why do we need to do that? What is the situation worldwide?

Having just concluded my assignment as Chief Veterinary Officer of France, and as I begin to take on my new role at the global level, I fully acknowledge the extent of the challenges we face as an animal health community.

Over the years, we have achieved significant milestones and successes, such as the global eradication of rinderpest and the official recognition of numerous countries as free from transboundary animal diseases, including foot-and-mouth disease, African horse sickness and classical swine fever.

Yet, the global animal health situation remains concerning. Highly pathogenic avian influenza (HPAI) is spreading globally year-round and into new host populations. It has caused mass die-offs of wild mammals and wild birds, severely disrupted poultry farming operations, and continues to represent a threat to public health. African swine fever is present on three continents and is now at the doorstep of the Americas. The eradication of peste des petits ruminants by 2030 is far from guaranteed – the disease recently re-emerged in two European countries that were previously disease-free.

The burden of vector-borne diseases is increasing, driven by threats such as lumpy skin disease, bluetongue, West Nile fever, New World screwworm (NWS, *Cochliomyia hominivorax*) and other zoonotic diseases. Patterns of disease emergence are increasingly shaped – and often catalysed – by a combination of factors, including climate change, natural disasters, growing international movement of people and goods, as well as economic and sociopolitical crises across many societies. These influence both pathogen ecology and human behaviour.

Reactivity and resilience are urgently needed to address these global challenges effectively.

Regarding veterinary services, the 2022 WOAHObservatory report highlights that only 7 percent of WOAHObservatory Members have optimal capacities.

Globally, the situation is far from satisfactory, which is unacceptable, not only for animal health, but also for food security and overall human health. At the same time, we know that in order to ensure safe and sustainable production, we need strong veterinary services.

In such a complex context, I call on the animal health community to rally together. We have gathered here to

discuss innovation, and I believe that promoting innovation is a collective responsibility of decision-makers. More specifically, innovation in animal health is fundamental to addressing the ever-evolving challenges of today's world.

The COVID-19 pandemic highlighted the interconnection between human, animal and environmental health, underscoring the need for a One Health approach. We should seize the increased attention brought to these areas by the pandemic to foster innovation, promote knowledge exchange and better link research findings to animal disease control and support to veterinary services.

In this regard, WOAHA will continue to work with actors ranging from governments to veterinarians, farmers and pastoralists, community health workers, laboratories, conservationists, students and educators to bridge the gap between science and policy. For example, a landmark report resulting from collaboration between WOAHA and the EcoAMR consortium was published last week. It assesses the current health burden and economic impact of antimicrobial resistance in the human and animal health sectors. The report will inform the United Nations General Assembly High-Level Meeting on AMR and support bold, concrete action to address this global threat. At the national level, it will empower decision-makers to take science-based decisions when formulating policies and allocating domestic resources. Now more than ever, we must use economic, data-driven arguments to convince ministers, governments and donors that the cost of inaction is far greater than the cost of prevention.

We must also continue to support investment in research and vaccine development to improve animal health outcomes and empower veterinary services with cutting-edge knowledge and tools. Vaccine producers are essential partners in ensuring equitable access to products in our mission to protect animal health. The development of safe, effective and affordable vaccines requires significant investment in research and infrastructure.

Public-private partnerships can play a key role in ensuring that innovation reaches the communities and animals that need it most, even in less accessible areas. Surveillance capacity and diagnostic tools – from the field level to reference laboratories – are equally important. Continued efforts to promote dialogue among stakeholders are essential to optimize funding allocation and improve the efficiency of systems that deliver scientific innovation.

In this context, in 2016, WOAHA entered into a partnership with the International Research Consortium on Animal Health (STAR-IDAZ IRC) – a global network of funders and programme owners for research on animal health. STAR-IDAZ IRC serves as a platform for research coordination, aiming to accelerate the development of tools to improve disease control. To enhance animal health globally within the One Health paradigm, the economic dimension must be acknowledged. Sustainable progress in disease control can

only be achieved when all those in need have access to vaccines and other essential technical and scientific resources.

While having an ambitious vision is important, we must not overlook the need to ensure that new technologies and procedures are safe and effective. WOAHA's standard-setting process is critical for ensuring that innovative technologies can be integrated into animal health systems and policies and adopted globally through better harmonization and mutual recognition. A key partner for WOAHA in this area is its network of reference centres.

Reference laboratories and collaborating centres play a vital role in disseminating best practices and providing technical support to Members. With over 300 reference centres globally, these institutions constitute the WOAHA Expertise Network and represent the core of WOAHA's scientific expertise and excellence. Their knowledge is invaluable for regularly updating standards and for implementing effective disease prevention and control strategies. We must continue to support and strengthen these networks, ensuring they are diverse, representative and prepared to respond to global emerging challenges.

Our presence here is a testament to our collective commitment to improving animal health globally, recognizing its crucial importance for food security, livelihoods, and public and environmental health. Collaboration among our organizations and institutions is essential to addressing global health challenges under the auspices of the Quadripartite partners and through the Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADs), which celebrates its twentieth anniversary this year and serves as an important bridge between our organizations.

FAO and WOAHA have a long-standing history of cooperation. The agreement between our organizations dates back to 1952. This collaboration is natural – while WOAHA's mission is to foster international commitment to improve animal health and welfare and support veterinary services worldwide, FAO plays a central role in promoting global food security and livestock development – missions that are necessarily interconnected.

Each of our organizations has its own history and specific mandates, but we share many values and strategic goals. Working together is vital for advancing our shared objectives in the interests of our respective Members. The partnership between WOAHA and FAO has been exemplary in addressing issues such as disease control and eradication, and in implementing effective surveillance and response systems. This conference presents an opportunity to strengthen our collaboration and explore new areas for joint action.

I hope that, together with FAO and other partners – particularly at the regional level – we can engage in impactful advocacy with decision-makers, resource partners and the private sector in the follow-up to this conference. This will help strengthen the capacity of veterinary services, both public and private, to deliver high-quality animal health services.

We must not forget that veterinary services preserve and develop animal resources, reduce poverty and hunger, and serve as a global public good. They play a vital role in global health security, economic stability and the social well-being of humanity – by protecting and supporting communities at every level, from local to global.

WOAH is celebrating its one hundredth anniversary this year. From its origins in 1924 as a group of 28 countries convinced of the need for collective action and transparency in tackling animal diseases, it has evolved into an organization of 183 Members, recognized globally for its expertise in animal health and welfare. Its standards are recognized by the World Trade Organization.

I pledge today to collective action and cooperation. I am confident that this conference will be a significant milestone in strengthening our relationship and our joint efforts. May we leave here with new ideas, renewed commitment and a clear vision.

Thank you for your attention.

2.2 TRANSFORMING ANIMAL HEALTH TOWARDS SUSTAINABLE AGRIFOOD AND LIVESTOCK SYSTEMS

Thanawat Tiensin, Assistant Director-General, Director of Animal Production and Health Division and Chief Veterinarian, Food and Agriculture Organization of the United Nations



Global food security is intricately tied to the sustainable transformation of agrifood and livestock systems, with animal health playing a pivotal role. Livestock contributes not only to nutrition and food supply, but also to livelihoods, rural development, and resilience against crises. Yet the sector faces profound challenges, ranging from climate change and biodiversity loss to the growing threat of antimicrobial resistance. If we are to secure a sustainable future, livestock must be at the centre of our transformation agenda.

Since 2023, FAO has spearheaded efforts to drive this change through the Sustainable Livestock Transformation Framework. This initiative highlights the urgent need for innovation, resilience, and inclusiveness in livestock production,

so that we can simultaneously address environmental sustainability, prevent emerging zoonotic and transboundary animal diseases, combat antimicrobial resistance, improve food security, and strengthen climate adaptation. The framework brings together FAO's long-standing work on One Health in agrifood systems and on sustainable livestock transformation, ensuring that human, animal, plant, and environmental health are treated as interconnected priorities.

Often, discussions on food security focus primarily on crops. Ministers and policymakers speak about wheat, maize, or rice. Yet livestock and aquaculture are equally central to global nutrition, food safety, and rural livelihoods. Livestock provides vital animal protein that combats hunger and malnutrition, including child stunting. At the same time, the sector faces mounting pressure from soil and water pollution, greenhouse gas emissions, loss of biodiversity, food safety concerns, and demands for improved animal welfare. Confronting these multiple challenges requires systemic solutions that ensure livestock contributes positively to health, equity, and the environment.

FAO's commitment is to support its 195 in this transformation. With country offices in 130 nations and active operations in 121 countries, FAO works through more than 370 projects with a budget of over USD 615 million, reaching more than 25 million direct beneficiaries. This global footprint underscores FAO's role as a trusted partner at both the policy and the field level, ensuring that livestock transformation brings real impact for farmers, producers, and communities.

The past years have demonstrated what is possible when investments are targeted and partnerships are strong. FAO has distributed more than 89 million doses of animal vaccines across 25 countries, including over 50 million doses of vaccine for Peste des Petits Ruminants (PPR), advancing the global eradication campaign. More than 800 training sessions have been organized in 40 countries, directly building the capacity of over 7 000 professionals in animal health, production, and feed management.

Beyond this, FAO has trained 2 000 veterinarians through the European Commission for the Control of Foot-and-Mouth Disease and 1 500 para-veterinary professionals across Africa and the Pacific, ensuring that essential services reach even the most remote communities. New technologies have been introduced: more than 40 000 disease events were reported last year through mobile surveillance applications developed by FAO, and these tools are now used in at least 16 countries. In response to outbreaks, FAO deployed missions to over 250 events, working quickly alongside governments to contain disease spread.

The Organization has also supported 23 countries in strengthening biosecurity along borders, farms, and supply chains. More than 160 laboratories worldwide have benefited from FAO support to enhance diagnostic capacity.

Importantly, FAO has worked with over 70 countries to design and implement national action plans to address antimicrobial resistance. To strengthen systems, 61 million US dollars were mobilized through the Pandemic Fund in 2023, supporting 16 countries to upgrade surveillance, laboratories, and workforce capacity. Altogether, 49 countries were also assisted through global health security programmes, reinforcing their ability to prevent, detect, and respond to transboundary animal diseases.

These achievements show the scale of FAO's commitment: to translate high-level strategies into direct impact, improving the tools, knowledge, and resilience of farmers and animal health professionals worldwide.

Yet, despite progress, gaps remain. Many countries still lack robust policies and regulatory frameworks to guide sustainable livestock development. Surveillance systems are under-resourced, and shortages of veterinarians, para-veterinarians, and animal health workers leave countries vulnerable to new outbreaks. Access to vaccines, medicines, and innovations remains uneven, with smallholders often the last to benefit.

Climate change compounds these vulnerabilities, as shifting ecological zones expand the reach of vectors and diseases into new territories. Rapid globalization and intensified trade accelerate the spread of transboundary animal diseases. Meanwhile, antimicrobial resistance continues to pose a serious risk to animal and public health, undermining the effectiveness of life-saving medicines. Finally, the challenge of financing remains: building resilient animal health systems requires sustainable investment in infrastructure, services, and innovation.

FAO's Sustainable Livestock Transformation Framework was designed precisely to address these challenges. Endorsed in 2023 by the FAO Sub-Committee on Livestock, the framework provides a holistic, evidence-based approach that integrates environmental, social, and economic dimensions of sustainability. It underscores the need for science-based policymaking, context-specific solutions, and responsible investment along the livestock value chain.

The framework advocates improvements in animal husbandry, health, feed, welfare, waste management, and biosecurity, ensuring that transformation is practical, inclusive, and adaptable. It is also closely linked to the RENOFARM initiative – Reduce the Need for Antimicrobials on Farms for Sustainable Agrifood Systems – which provides concrete pathways to lower antimicrobial use while sustaining productivity and resilience.

The next step is the development of a Global Plan of Action for Sustainable Livestock Transformation, which will guide countries in scaling up adoption of these practices, supported by evidence, partnerships, and investment.

FAO has set an ambitious roadmap for livestock transformation in the coming years. This includes scaling up

sustainable poultry and feed production in Africa, launching an International Forum on Sustainable Beekeeping and Pollination, and advancing the International Year of Camelids in 2024. In 2026, the international community will mark the International Year of Rangelands and Pastoralists, further highlighting the vital contribution of extensive livestock systems to biodiversity and food security. An International Day of Milk is also being advanced at the United Nations General Assembly, underscoring the nutritional and cultural importance of dairy worldwide.

Regional dialogues will continue to enrich the global agenda: a forum on sustainable livestock strategies has already been held in Africa, with upcoming events planned for Latin America in Uruguay and for Asia-Pacific in Thailand. These regional platforms are critical to ensuring that strategies are context-specific and that solutions are shaped by those most affected.

Central to FAO's work is the One Health approach, which recognizes the interconnection between human, animal, plant, and environmental health. Through frameworks such as EMPRES and GF-TADs, FAO supports prevention, preparedness, and rapid response to animal health emergencies, in close collaboration with WOA, IAEA, and other partners. The Joint FAO/IAEA laboratory network provides cutting-edge diagnostic support, while reference centers and national laboratories are strengthened to ensure early detection.

FAO is committed to improving the quality and accessibility of vaccines worldwide. Every year, the Organization procures tens of millions of doses, and it works with governments to ensure that procurement systems favor quality and reliability. Pandemic preparedness has also been reinforced through new funding, including support for African countries in response to the Mpox outbreak. At the same time, FAO continues to lead on antimicrobial stewardship, supporting national plans, training veterinarians and farmers, and embedding responsible use of medicines in livestock systems.

The benefits of transforming livestock systems extend far beyond animal health. Livestock contributes to poverty reduction, rural development, and employment, supporting millions of households worldwide. Sustainable livestock systems can empower women and youth, who are often central to animal husbandry but remain underrepresented in decision-making. By enhancing resilience, sustainable livestock also strengthens food security, improves nutrition, and delivers ecosystem services such as soil fertility, carbon sequestration, and landscape management.

In this way, livestock transformation is not only a technical necessity – it is also a social and economic opportunity. A reformed livestock sector will be central to achieving the Sustainable Development Goals, advancing better production, better nutrition, a better environment, and a better life for all.

The task ahead is clear: talk alone will not suffice. We must act. Governments, international organizations, the private sector, producers, and civil society all have a role to play in accelerating the sustainable transformation of livestock.

FAO's vision is to harness cutting-edge technology, innovative practices, and global partnerships to enhance disease monitoring, strengthen biosecurity, improve resource management, and ensure that farmers and communities are resilient. The livestock sector must be positioned as part of the solution – contributing to healthier diets, stronger economies, thriving ecosystems, and a safer planet.

Together, we can close policy gaps, strengthen capacity, mobilize investment, and accelerate transformation. Together, we can build livestock systems that are sustainable, resilient, and equitable. And together, we can ensure that livestock continues to be a driver of food security, nutrition, livelihoods, and rural prosperity – leaving no one behind.

2.3 OUTCOMES OF THE QUESTIONNAIRE ON ANIMAL HEALTH PRIORITIES

Samia Metwally, Senior Animal Health Officer, Food and Agriculture Organization of the United Nations

Strengthening global animal health systems requires a comprehensive understanding of national priorities and challenges. To support this effort, FAO developed a detailed questionnaire aimed at capturing the perspectives of chief veterinary officers (CVOs) from its Member Nations. In 2024, the questionnaire was distributed to CVOs in 182 of the 193 FAO Member Nations, across five regions: Africa (RAF), Near East (RNE), Europe and Central Asia (REU), Asia and the Pacific (RAP), and Latin America and the Caribbean (RLC). The instrument comprised 20 questions and was administered via a web-based platform (SurveyMonkey), facilitating broad participation and timely data collection.

Response rates varied significantly by region. The highest engagement was observed in the REU and RAP regions, while the RLC and other regions recorded lower response rates. The survey addressed multiple dimensions of animal health priorities, asking participants to evaluate a list of nine key concerns. Over three-quarters of responding countries identified strengthening surveillance systems (92.5 percent), adopting One Health approaches to address zoonotic diseases (86.7 percent) and enhancing training and capacity building (76.6 percent) as primary priorities. Although these concerns were broadly shared, regional differences emerged. A higher percentage of countries in the RAF and RNE regions prioritized establishing and improving vaccination programmes, whereas a notably lower percentage of REU countries emphasized training and capacity building in laboratories.

Follow-up questions probed deeper into the specifics of training and capacity building. Veterinary field services (91.1 percent) and laboratories (81.6 percent) were

predominantly identified as areas requiring urgent enhancement, compared to policy development (52.8 percent) and other domains (33.2 percent). Additional queries asked respondents to rank various support measures; over 90 percent placed strengthening disease surveillance and monitoring among their top three priorities, with modest regional variations in the importance assigned to facilitating access to laboratory diagnostic services.

Additionally, the questionnaire evaluated national preparedness for animal health emergencies and the effectiveness of existing disease surveillance systems, while also capturing how countries prioritize diseases and their corresponding interest in veterinary vaccines. Significant differences in ratings and rankings across regions underscored the diversity of animal health challenges and resource allocations among FAO Member Nations. The survey also explored barriers to accessing high-quality veterinary vaccines, regulatory challenges and the nature of engagement with FAO. Key priorities identified through these inquiries included enhanced surveillance, capacity building, One Health integration and vaccine development. FAO reference centres emerged as critical resources supporting veterinary training, diagnostic capacities and emergency preparedness.

By leveraging these insights, FAO can establish a strategic framework to guide regional and global efforts, ensuring that Member Nations are better equipped to tackle shared challenges. Strengthening international cooperation, expanding capacity building and enhancing engagement with reference centres are pivotal steps in advancing global animal health. These initiatives are expected not only to improve animal health systems but also to contribute substantially to global food security, public health and agricultural resilience. In collaboration with international partners, FAO remains committed to driving progress through evidence-based solutions and fostering meaningful partnerships.

2.4 SUMMARY OF THE PANEL DISCUSSION

Huyam Salih, Director, African Union Inter-African Bureau for Animal Resources (AU-IBAR), Kenya

Anna Rose Ademun Okurut, Commissioner for Animal Health, Ministry of Agriculture, Animal Industry and Fisheries, Uganda

Imon Suandi, Director of Animal Health, Directorate General of Livestock and Animal Health, Indonesia

José Guajardo, Director, National Agricultural and Livestock Service, Chile

The panel identified several major challenges for animal health in the next five to ten years. The first among them is the transboundary nature of many diseases, which demands stronger surveillance systems, timely information exchange among countries and enhanced collaboration between public and private sectors. Climate change, water scarcity and

the increasing frequency of disease outbreaks require coordinated regional action under a shared vision. Other major concerns include AMR and rising resistance to antiparasitic drugs. Vaccine efficacy is also at risk due to the continued use of outdated vaccines and the emergence of new viral strains. Disease spillover and spread are amplified by the movement of people and animals and by the degradation of wildlife habitats. High-impact diseases – such as PPR, African swine fever (ASF) and rabies – are expected to expand into new areas and potentially become endemic, especially in the context of growing trade and climate change. For the African region, the strengthening of veterinary services and the development of sustainable AMR policies, supported by improved resource coordination, will be especially critical.

The panel also underscored a number of opportunities. These include harnessing pastoralism in Africa as a driver of sustainable animal protein production and expanding the use of information technology to strengthen animal health systems. Digital tools such as the One Health Data Alliance for Africa and other digital surveillance platforms

are helping to improve early detection and control of disease. Collaboration between the public and private sectors is key to advancing science, technology and vaccine development, as demonstrated by the eradication of diseases like FMD and porcine reproductive and respiratory syndrome (PRRS), and by Chile's efforts to eliminate brucellosis. Within a One Health framework, such initiatives could significantly contribute to building more resilient and sustainable animal health systems. FAO's support for control and surveillance programmes was highlighted as a best practice that should be shared more widely.

The panel concluded that, while vaccination remains vital, prevention and control measures are equally important in addressing animal diseases. Greater attention must be paid to disease awareness, hygiene, biosecurity and sound animal husbandry practices. Advancing innovation and enhancing coordination at both international and national levels will be essential. This includes promoting transparency among countries and encouraging open information sharing across sectors and disciplines.

CHAPTER 3

Improving animal health for sustainable livestock transformation

3.1 PROMOTING PANDEMIC PREVENTION THROUGH BOLSTERING PANDEMIC PREVENTION, PREPAREDNESS, AND RESPONSE CAPACITIES

Samuel Mills, Senior Health Specialist, Pandemic Fund Secretariat, World Bank Group



The devastating human, economic and social impacts of the COVID-19 pandemic underscored the urgent need for coordinated global action to build stronger health systems and address long-standing underinvestment in pandemic prevention, preparedness and response. In response, with strong backing from the G20, the Pandemic Fund was established at the World Bank on 30 June 2022.

The Fund envisions a world in which all people are protected from the risk of pandemics and other health threats by strong, resilient health systems capable of preventing, detecting and rapidly responding to infectious disease outbreaks. Its objective is to provide a dedicated stream of additional, long-term funding for critical pandemic prevention, preparedness, and response functions in World Bank-eligible countries through targeted investments and technical support.

Guided by its Strategic Plan (2024–2029) (The Pandemic Fund, 2024), adopted by the Governing Board on 21 May 2024, the Fund aims to help countries and regional or global networks improve their capacity to prevent, detect, contain and respond to pandemics. The plan focuses on three core programmatic priorities: surveillance, laboratory systems and workforce development. In addition, the Fund supports two cross-cutting enablers – national and regional public health institutes (or relevant public institutions) and regional or global networks, organizations or hubs – as well as four cross-cutting themes: community engage-

ment, gender equality, health equity and the One Health approach. These elements are integrated throughout the Fund's portfolio to promote coordination and ensure inclusive, impactful investments.

The Fund's first call for proposals received 179 applications from over 130 countries. The initial round of grants will mobilize over USD 2 billion to help 37 countries strengthen their pandemic-related capacity.

The One Health approach recognizes the interconnectivity of human, animal and environmental health and the importance of holistic, multisectoral strategies to promote antimicrobial stewardship, reduce the risk of zoonotic disease spillover and respond to the challenges of climate change.

Countries involved in 18 of the 19 first-round projects reported alignment with the One Health approach. One Health mechanisms are being used to coordinate across government departments, develop national strategies and action plans, and inform integrated surveillance, laboratory systems and multisectoral capacity-building efforts. Notably, 58 percent of projects report strong coordination with ministries of agriculture and livestock, while 46 percent cite robust engagement with ministries of environment and ecology – reflecting the critical role of animal and environmental health sectors in pandemic prevention, preparedness, and response.

3.2 COUNTRY PREPAREDNESS FOR ANIMAL HEALTH EMERGENCIES

Carlos Orellana Vaquero, Head of Livestock Protection Division, Ministry of Agriculture, Chile

In recent years, Chile has collaborated closely with FAO, particularly with the Emergency Management Centre (EMC), to strengthen its capacity to manage animal health emergencies. In 2021, Chile became one of the first countries to implement the progressive pathway for emergency preparedness (PPEP) programme – now a flagship FAO initiative used to assess emergency preparedness at both regional and national levels.

In 2022, a follow-up workshop was held for Latin American countries through the Comité Veterinario Permanente del Cono Sur (CVP), advancing the region's shared goal of improving emergency management capacities. Since then, two additional workshops have been organized,

with another planned for the Caribbean in October 2024. Notably, Latin America and the Caribbean is the first region to complete the full PPEP assessment process.

Lessons from recent outbreaks – including ASF in La Hispaniola, HPAI across the Americas, and the resurgence of New World screwworm in Central America – have shaped regional preparedness and underscored the importance of continuous learning and adaptation. These experiences have informed updates to procedures and tools, enabling countries and regions to respond more effectively to a range of threats.

The knowledge gained and new partnerships established during these events have helped to refine operational processes and inspire the next generation of emergency support tools. In a significant step towards addressing complex, cross-sectoral emergencies under a One Health approach, Chile in 2024 became the first country to receive FAO support for a **non-sanitary emergency** – wildfires. This milestone reflects FAO EMC's commitment to innovation in emergency management.

The progressive pathway for emergency management (PPEM) framework adopts an all-hazards and One Health approach to improve country and regional resilience. It aligns emergency systems with modern global standards and applies to both sanitary and non-sanitary crises. The PPEM framework is built around four core areas: preparedness, response, coordination and a continuous cycle of testing and learning. Each area is designed with tailored processes to strengthen emergency systems and ensure they are ready for future crises.

Chile and FAO, through the EMC, continue to advance a holistic and integrated strategy to manage emerging and re-emerging threats to animal health, food security and livelihoods. In line with FAO's four betters – *better production, better nutrition, a better environment and a better life* – these efforts prioritize innovation in emergency management and the development of sustainable, resilient solutions. Ultimately, they aim to secure food systems that are robust, adaptable and capable of responding to the evolving global landscape.

3.3 STRENGTHENING NATIONAL ANIMAL HEALTH SYSTEMS IN MEMBER NATIONS

Mathioro Fall, Head of the Animal Health Protection Division, Veterinary Services Department, Ministry of Agriculture, Food Sovereignty and Livestock, Senegal

Strengthening the governance of national animal health systems is essential to protect public health, ensure food safety, support the trade of animals and animal products, and maintain economic stability.

TADS and zoonotic animal diseases cause significant socioeconomic losses to the livestock sector. These losses

are both direct – including mortality, morbidity, reduced fertility, abortions and stunted growth – and indirect, through decreased meat and milk production and high costs for veterinary treatments.

Livestock farming continues to face pressure from endemic, emerging and re-emerging diseases such as PPR. Preventing and controlling future pandemics requires harmonized and coordinated strategies at the national, regional and global levels. These strategies should be based on the following key pillars:

- **Policies and regulations:** Develop and implement robust animal health policies and regulatory frameworks. These include food safety standards, vaccination protocols, outbreak management guidelines, disease surveillance plans and contingency plans for priority animal diseases. A formal, sustainable multisectoral framework is also needed to address zoonosis control.
- **Surveillance and detection:** Establish effective surveillance systems for early detection of animal disease outbreaks, including zoonoses. Leverage advanced technologies for monitoring and adopt animal identification systems to ensure full traceability of animals and animal products.
- **Infrastructure and resources:** Strengthen veterinary diagnostic and vaccine production laboratories, as well as livestock-related infrastructure, such as administrative facilities, vaccination parks, border inspection posts and quarantine centres. Invest in training centres equipped with modern technologies and skilled personnel. It is also crucial to recruit adequate staff to ensure national coverage and improve the quality of local veterinary services. Public-private partnerships should be reinforced through formal health mandates.
- **Disease prevention and control:** Develop and implement programmes for vaccination, stamping out, compensation, pest control, biosecurity and epidemic prevention.
- **Capacity of veterinary services:** Increase the capacity of veterinary services by investing in budgets, personnel, logistics, infrastructure, training, communication and modern legal frameworks. Establish and update response plans for managing epidemics and other health emergencies. These plans should include clear strategies for communication, resource mobilization and inter-agency coordination.
- **Coordination and collaboration:** Ensure effective coordination among government agencies, non-governmental organizations and private sector actors. Foster international cooperation to combat cross-border animal diseases more efficiently.

- **Funding and investment:** Advocate for sufficient and sustainable financing for animal health programmes. Investments should focus on improving infrastructure and supporting research and development.
- **Public awareness:** Implement strategic communication plans to inform and engage the public, farmers and stakeholders on the importance of animal health and the practices required to prevent, detect and control animal diseases, including zoonoses.
- **Training and education:** Provide ongoing training for veterinarians, technicians and farmers on best practices in animal health management, diagnostics, disease prevention, outbreak investigations and field epidemiology.
- **Research and development:** Support innovation and scientific research to develop new tools for preventing, diagnosing and treating animal diseases. Advancements in this area will enhance the effectiveness and sustainability of animal health programmes.

3.4 SUPPORTING VETERINARY VACCINE AVAILABILITY – LEARNINGS FROM HUMAN IMMUNIZATION AND ONE HEALTH APPROACHES

Michael Schunk, Senior Vaccine Industry Specialist, International Finance Corporation (IFC)

No abstract available

3.5 IDENTIFYING PIONEER FARMERS FOR IMPROVED ANIMAL HEALTH AND CLIMATE-RESILIENT DAIRY SYSTEMS

Birgit Habermann, Scientist, Climate Change Technologies in Practice, International Livestock Research Institute (ILRI)

Innovations that improve animal health and support climate-resilient dairy systems will only succeed if they are endorsed and adopted by a supportive community of actors. This kind of endorsement cannot be achieved through short-term incentives alone – it must be rooted in a locally led, co-design process that fosters **endogenous innovation**. This approach challenges how many institutions traditionally engage with livestock keepers. Ideally, effective solutions are shared from farmer to farmer, as learning is often based on trust, observation and lived experience. Farmers draw on a range of learning methods, from conventional training and social media to exchange visits and informal advice from relatives. As such, their knowledge is dynamic and constantly adapting to rapidly changing environmental and social conditions.

One promising approach is **pioneer-positive deviance**, which supports co-design through equal collaboration among all involved actors. This model replaces linear knowledge transfer with practice-oriented, farmer-led learning pathways. We define positive deviant farming households as those that succeed where others struggle – particularly in managing animal disease, maintaining livelihoods and responding to climate change. These “pioneer households” operate in a family-farm context common across LMICs, and they tend to generate their own innovations rather than simply adopting external recommendations. Their learning processes are distinctive and context-specific.

This approach has been piloted at several sites in East Africa and one in Colombia. In Kenya, for example, the initiative works with 45 households focused on improving feed management in dairy farming. These pioneers have participated in 37 field days, directly reaching over 2 000 other households. They are also embedded in a broader knowledge network, which includes extension services, private sector actors and financial institutions.

We are currently exploring how to involve pioneers more directly in animal health research. This involves five key steps:

- Identify** positive deviance in animal disease management.
- Understand** and assess these practices through citizen science methods.
- Implement and scale** the most effective practices developed by pioneers.
- Tailor existing protocols** to local contexts using insights from pioneers.
- Disseminate** these refined practices through face-to-face (F2F) extension channels.

Achieving this requires a new level of inter- and trans-disciplinary collaboration. Animal health researchers must work closely with teams assessing greenhouse gas (GHG) emissions, the pioneers themselves, their knowledge networks and social scientists.

We advocate for a shift in how learning is facilitated – creating space for **farmer-led innovation** in disease management. Lessons learned from the pioneer networks will inform the co-design of extension materials, videos, field days, digital tools and farmer field schools. Positive experiences have already emerged from partnerships with agricultural training centres, a “living lab” at one of those centres, and collaborators offering digital extension services. Other valuable learning partners include dairy cooperatives and private sector actors with existing training programmes that could be integrated into pioneer efforts.

This joint, diverse and peer-to-peer model will enable pioneer households to expand their methods and influence, helping to scale both learning and innovation in animal health and climate-resilient dairy systems.

3.6 SUMMARY OF THE PANEL DISCUSSION

Relebohile Lepheana, *Director of Veterinary Services, Ministry of Agriculture and Food Security, Lesotho*

Sith Premashthira, *Senior Professional Veterinarian, Department of Livestock Development, Thailand*

Helen Roberts, *Senior Policy, Science and Risk Advisor, Department for Environment, Food and Rural Affairs (Defra), United Kingdom of Great Britain and Northern Ireland*

The panel explored key strategies to enhance the preparedness of countries for animal health emergencies. A central recommendation was the development of comprehensive, multilayered strategies that strengthen veterinary and public health systems. These strategies should include the training of professionals and the establishment of well-equipped laboratories. Training programmes should prioritize disease detection and surveillance and be complemented by exchange initiatives that expose professionals to diseases not currently present in their home countries. This approach enhances early detection and timely response, recognizing that diseases do not respect national or regional borders.

Other critical elements include both active and passive surveillance and an evidence-based decision-making approach. Early detection was repeatedly underscored as essential for rapid and effective response. Thailand was cited as a case study: the country has invested significantly in building surveillance capacity, training its workforce and engaging in collaboration with neighbouring countries. The Regional Field Epidemiology Training Program for Veterinarians (R-FETPV), supported by FAO's ECTAD, plays a crucial role. It combines surveillance, data analysis and outbreak investigation, equipping participants with epidemiological skills they can apply in their own countries – thus contributing to a stronger regional surveillance network.

Community engagement also emerged as a priority, particularly to compensate for workforce limitations. Engaging local communities plays a vital role in expanding both animal and human health surveillance and ensuring broad coverage.

With experts warning that the next pandemic could emerge within the next five to twenty years, the panel emphasized the importance of adopting a medium- to long-term perspective. Particular attention should be given to the potential of diseases such as avian influenza to evolve into global zoonotic threats. Global leaders and stakeholders must recognize and prioritize the most impactful innovations to ensure that veterinary systems are resilient, equitable and capable of preventing future pandemics. Lessons from COVID-19 must not be forgotten. There is an urgent need to strengthen predictive capabilities and implement initiatives such as the “100-Day Mission” within the veterinary sector to accelerate vaccine development for

TADs. Equally important is ensuring that manufacturing capacity for vaccines is both sufficient and geographically distributed.

The 100-Day Mission, launched by the G7 and supported by international organizations including the WHO, aims at developing and deploying effective vaccines, diagnostics and therapeutics within 100 days of identifying a new or emerging pandemic threat. This approach aims to significantly mitigate the impact of a pandemic through a rapid and coordinated response. While originally conceived for human health, this initiative could be adapted to the veterinary field, especially considering the critical role of zoonoses in pandemic risk.

Stakeholder mapping was identified as an essential component of preparedness. This should include pastoralists, citizen science networks and private sector actors, including major manufacturers. This inclusive approach is particularly relevant in light of the limitations of intensive livestock production, which may not be sustainable under growing climate pressures. The panel also highlighted that current capacities are often insufficient to respond effectively to multiple simultaneous crises, pointing to the need for a more adaptable and comprehensive emergency management framework.

The session concluded with a strong call for equitable access to diagnostics, surveillance systems, data sharing mechanisms and vaccine development. These tools must be made available globally – not only to high-income countries. A globally coordinated partnership, supported by international organizations and based on mutual cooperation, was identified as the ideal model for improving animal health across regions and sectors.

CHAPTER 4

Animal health innovation and emerging technology

4.1 LEVERAGING TECHNOLOGICAL ADVANCES IN VACCINE DEVELOPMENT FOR PARASITIC DISEASE: THE CASE OF AFRICAN TRYPANOSOMOSIS

Jan Van Den Abbeele, Senior Researcher, Institute of Tropical Medicine, Belgium



Vaccines play a critical role in global health by preventing infection and limiting the transmission of numerous diseases worldwide. Ideally, an effective vaccine should induce a broad neutralizing antibody response that targets all circulating variants of a pathogen. However, in the case of parasitic diseases, vaccine development has long been a major challenge due to the complex biology of parasites and their high genomic and phenotypic variability – especially in relation to pathogenesis and immune evasion mechanisms.

Despite these obstacles, recent technical advances across the research pipeline are opening new avenues for innovation. Next-generation sequencing and improved bioinformatics tools now allow for rapid and high-resolution screening of parasite genomes and gene expression profiles at key life cycle stages. These technologies enable researchers to identify conserved antigens by mapping protein variability across circulating parasite populations and developmental stages. In parallel, developments in artificial intelligence, such as AlphaFold, now allow for highly accurate prediction of three-dimensional protein structures and epitope positioning.

Advances in antigen delivery systems have further contributed to progress in vaccine development, making the field more dynamic than ever before.

This technological momentum is reigniting efforts to develop vaccines against complex parasitic diseases, including African trypanosomiasis (AT). AT is caused by vector-borne protozoan parasites – primarily *Trypanosoma congolense* and *T. vivax* – and severely limits agricultural production across large areas of sub-Saharan Africa and beyond. The disease is recognized as a major contributor to malnutrition and food insecurity. Because tsetse fly control remains difficult, farmers rely heavily on trypanocidal drugs to combat the disease. Until recently, the development of an effective vaccine was considered unattainable, largely due to the parasite's capacity for antigenic variation and other immune escape mechanisms.

However, the recent discovery of an invariant surface antigen capable of inducing significant immune protection against experimental *T. vivax* infection has challenged this assumption. It has renewed hope in the possibility of developing a functional vaccine against animal trypanosomes.

Currently, a four-year research initiative – TRYPTACKLE – is underway to identify vaccine candidates against *T. congolense*. The project is led by the Institute of Tropical Medicine Antwerp and the University of Antwerp (Belgium), and it brings together a multidisciplinary team of experts in parasitology, structural biology, protein biochemistry, immunology and bioinformatics. Leveraging cutting-edge technologies for genome and protein functional analysis, the project aims at accelerating progress in vaccine discovery.

While scientific and technical hurdles remain, the pursuit of an effective anti-trypanosome vaccine is both urgent and promising. If successful, it could transform the fight against African trypanosomiasis and significantly improve animal health and food security in the region.

4.2 ADVANCEMENT IN ASSESSING THE QUALITY OF FORMULATED FOOT-AND-MOUTH DISEASE VACCINES

The efficacy of foot-and-mouth disease virus (FMDV) vaccines relies heavily on the quantity and structural integrity of whole viral particles present in the formulation. As such, simple and reliable quality control methods are essential to assess the whole viral antigen content in vaccines.

Traditionally, sucrose density gradient ultracentrifugation (SDGU) has been the gold standard for quantifying

FMDV particles. This method is particularly effective for detecting 146S particles – intact viral particles containing RNA – named after their sedimentation coefficient. While SDGU is highly reliable, it is technically demanding, requiring multiple preparation steps, specialized equipment and considerable time and cost.

To overcome these limitations, size exclusion chromatography (SEC), also known as gel filtration chromatography, has emerged as a viable alternative. SEC separates particles based on size and allows quantification of both 146S and 75S (non-RNA containing) particles. The method offers results comparable to SDGU. SEC is a versatile and scalable technology that uses a gel with defined pore sizes packed into a column, along with a detection system. It can be performed manually or it can be automated, making it more accessible and cost-effective.

To quantify whole viral particle concentration in formulated (oil-in-water) vaccines, we separated the aqueous phase from the oil phase by disrupting the emulsion with solvents. We successfully applied SEC to quantify whole viral particles in both experimental and commercial oil-based vaccines by extracting the aqueous phase. The particles identified in the extracted aqueous fraction were observed as a distinct “peak” allowing for accurate quantification. Extracted aqueous solutions were analysed by both SEC and SDGU. Our results demonstrated the accuracy of SEC and its concordance with SDGU in estimating the content of whole viral particles in the vaccines. Moreover, we identified a loss of viral content in expired vaccines. For multivalent vaccines, all viral strains eluted at the same volume, and using specific antibodies, each strain present as whole particles could be identified. Furthermore, SEC-purified particles were successfully used to coat ELISA plates without further treatment.

SEC offers several advantages over SDGU, including faster results, cost-effectiveness and adaptability across multiple sectors. SEC can be used by countries to control the content of protective antigens in FMDV vaccines. Its applications range from vaccine antigen purification in industry to research laboratories and quality control processes for manufacturers, regulatory bodies and vaccine banks.

4.3 INNOVATIVE APPROACHES TO STRENGTHEN THE FOOT-AND-MOUTH DISEASE VACCINE VALUE CHAIN IN EASTERN AFRICA THROUGH PAY-FOR-RESULTS

Nina Henning, Team Lead, AgResults Foot-and-Mouth Disease Vaccine Challenge Project, Global Alliance for Livestock Veterinary Medicines (GALVmed)

As one of the most infectious livestock diseases in the world, FMD presents a constant global threat to animal trade and national economies. Endemic throughout Eastern Africa,

FMD can devastate livestock productivity and severely compromise small-scale farmers’ livelihoods and food security. Vaccination is proven to effectively control FMD, but there is currently no single vaccine that can protect against all strains circulating in the region.

The AgResults Foot-and-Mouth Disease Vaccine Challenge Project is an eight-year, USD 17.34 million pay-for-results prize competition that supports the development and uptake of high-quality quadrivalent FMD vaccines tailored to meet the needs of Eastern Africa. Managed by GALVmed, the competition focuses on six countries: Burundi, Ethiopia, Kenya, Rwanda, the United Republic of Tanzania and Uganda.

The project is structured in two phases. In the Development Phase, participating manufacturers work to develop a regionally relevant quadrivalent FMD vaccine that meets a set of predefined technical and performance criteria. In the subsequent Vaccine Distribution Cost-Share Phase, the project uses a cost-sharing mechanism to drive the uptake and distribution of high-quality FMD vaccines. The cost-share aims to reduce the cost per dose for buyers, thereby enabling both public and private sector actors to more effectively combat FMD through increased access to effective vaccines. In this way, the project incentivizes the widespread use of prophylactic vaccination to improve animal health and enhance farmer livelihoods. The project was launched in February 2020 and is scheduled to conclude in July 2028.

Manufacturers participating in the competition may submit quadrivalent FMD vaccines containing serotypes A, O, SAT1 and SAT2. These submissions are assessed for regional relevance through a unique component of the project that requires screening against the Eastern Africa FMD Virus Reference Antigen Panel. This panel was assembled by the World Reference Laboratory for FMD (WRLFMD), based at the Pirbright Institute in the United Kingdom of Great Britain and Northern Ireland, in collaboration with the WOA/FAO FMD Reference Laboratory Network. To be eligible for the Cost-Share Phase, sera from vaccinated cattle must be evaluated and shown to meet a predefined neutralization titre threshold against the FMD virus strains included in the panel. Vaccines that meet this standard are confirmed as regionally relevant and can proceed into the next phase of the project.

The AgResults FMD project team presented an overview of the project’s goals, anticipated impact and progress to date. This innovative approach to enabling a regionally targeted FMD control programme was also discussed, offering a novel model for incentivizing private-sector engagement and improving vaccine availability in low- and middle-income settings.

4.4 NOVEL SAMPLE COLLECTION AND DIAGNOSTICS FOR ENDEMIC AND EMERGING PATHOGEN SURVEILLANCE: LESSONS FROM AVIAN INFLUENZA

Erik Karlsson, Deputy Head of the Virology Unit, Institut Pasteur du Cambodge, Cambodia

Emerging and endemic diseases, such as avian influenza, are already a persistent threat. In high-risk environments like live bird markets (LBMs), traditional surveillance methods – though effective – face several limitations: they are costly, time-consuming and logistically demanding. More importantly, these methods are often reactive rather than proactive, responding to outbreaks after they occur instead of preventing them. This leaves us vulnerable to the rapid spread of the disease, as these approaches rarely provide the foresight needed to stay ahead of emerging threats. What is needed are proactive systems that can actively detect and mitigate risks before they escalate into full-blown crises.

To address this, environmental sampling (ES), when paired with advanced field-forward detection technologies, offers a transformative approach to disease surveillance. Drawing on experiences from avian influenza surveillance using ES, this presentation highlighted how innovative tools can help us stay ahead of the next pandemic.

Environmental sampling – collecting air, surface and water samples – offers a practical, cost-effective alternative to direct animal sampling, particularly in hard-to-reach or resource-limited settings. In Cambodia, we combined ES with poultry sampling at LBMs and used quantitative real-time PCR (qRT-PCR) to detect avian influenza virus (AIV). The findings were decisive: ES effectively identified pathogens, offering distinct advantages in terms of speed, biosafety and cost. These characteristics make ES a scalable and adaptable solution for even the most challenging surveillance environments.

However, pathogen detection is only the beginning. The real shift occurs when this data is integrated into real-time genomic surveillance. One of our key innovations is the development of integrated index multisegment PCR (iiMS-PCR) and viral pan-family integrated index primers (PiiP). These technologies enable rapid amplification, detection and sequencing of pathogens like AIV. The result is high-throughput genomic sequencing that significantly reduces both the time and cost associated with conventional methods.

This capability to track pathogens in real time provides essential insights into viral evolution and transmission dynamics. As a result, these technologies offer enormous potential for outbreak control and prevention, enabling faster, data-driven responses that can help prevent emerging diseases from becoming widespread epidemics.

4.5 SUMMARY OF THE PANEL DISCUSSION

Khalid Omari Tadlaoui, General Manager, M.C.I. Santé Animale, Morocco

Alejandra Capozzo, Director of the Centre for Health Sciences (CAECIHS), the Interamerican Open University (UIA), Argentina

Geetha Srinivas, Director, Centre for Veterinary Biologics, United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), United States of America

The panel considered some of the most relevant innovative technologies for improving animal health in Africa and the Middle East, and how they might be applied in other regions. Across Africa, livestock are threatened by numerous diseases with severe consequences, particularly for smallholders. The availability of good-quality vaccines is not always assured, and livestock keepers may be sceptical about their effectiveness or concerned about the potential lack of return on investment. This underscores the need to improve access to new and better vaccines while also raising awareness among farming communities. One proposal put forward was the use of single-dose combined vaccines (e.g. PPR combined with sheep pox), which could be especially valuable in endemic countries. Such vaccines could significantly reduce overall vaccination costs by lowering both the time required for administration and associated logistical expenses. It was noted that vaccines themselves typically account for less than 20 percent of the total cost of vaccination. Diseases such as Rift Valley fever (RVF) are spreading more rapidly due to climate change and increasingly frequent flooding events. For this reason, a combined PPR–RVF vaccine could also prove essential, particularly since RVF vaccination is not commonly practised by farmers. Although both diseases have been reported in several countries, very few field trials for vaccines have been conducted to date. Additionally, a combination of contagious bovine pleuropneumonia (CBPP) and LSD live vaccines has shown promising results, with efficacy lasting up to one year.

During the discussion, the importance of developing vaccination strategies using live attenuated vaccines was emphasised. These vaccines are relatively easy to produce and provide rapid, durable and effective immunity. A recent advancement in this area is the development of a differentiating infected from vaccinated animals (DIVA) vaccine for PPR.

The need for a robust regulatory system to expedite the licensing of vaccines for emerging diseases was also raised. The example of the United States of America was cited, where flexibility in the regulatory framework has proven essential in addressing the time constraints and challenges posed by emerging diseases. In such cases, priority was given to vaccines that were reasonably effective and safe for use,

even if not yet ideal, allowing for their conditional licensing to enable rapid deployment – for instance, in response to severe acute respiratory syndrome (SARS) in minks. A further example is avian metapneumovirus, an emerging disease currently circulating in the United States of America. Given that the circulating strains are new, risk and gap analyses were conducted to assess mitigation strategies. This led to the decision to import only inactivated vaccines, which present a lower risk. The discussion also noted that regulatory mechanisms vary across countries, as does the mandate of CVOs to conditionally authorise the use of vaccines without formal licensing.

Proven innovative technologies are offering viable alternatives to the traditional use of animals in vaccine testing, particularly by replacing in vivo challenge studies. These advancements focus on direct vaccination and antibody measurement, offering a more ethical and efficient approach.

A compelling example of this comes from Argentina's methodology for evaluating vaccines against foot-and-mouth disease. In Argentina, vaccine efficacy is assessed

exclusively through the direct vaccination of cattle, followed by antibody level measurements. The challenge study, traditionally used in vaccine testing, is carried out only during the registration phase and is never repeated. This approach eliminates the use of additional laboratory animals and ensures that only those animals already intended for vaccination are involved.

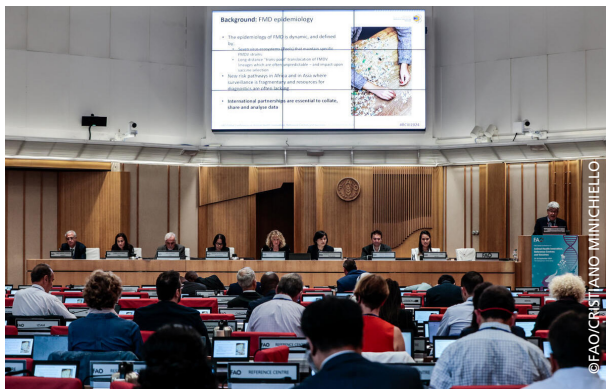
In conclusion, the discussion highlighted the need for increased basic and interdisciplinary research on vaccines, as well as broader availability in many countries – particularly in Africa and Latin America – through additional investments and enhanced global collaboration supported by international organizations. Manufacturers should be encouraged to participate in new funding models, such as the “pay-for-results” approach. A key advantage of this model is that it incentivizes multiple manufacturers to engage before any funds are disbursed. This not only fosters innovation and brings a wider range of stakeholders to the table, but also increases the likelihood of success. A localized, environment-focused approach was also identified as critical to effective strategy planning and innovation.

CHAPTER 5

Reference centres and support network

5.1 GOOD PRACTICES OF THE WORLD ORGANISATION FOR ANIMAL HEALTH/FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS REFERENCE LABORATORIES NETWORK FOR FOOT-AND-MOUTH DISEASE

Donald King, Head, Vesicular Disease Reference Laboratory Group, The Pirbright Institute, United Kingdom of Great Britain and Northern Ireland



The WOA/FAO FMD Laboratory Network (EuFMD, n.d.) was established in 2004 as a forum to exchange laboratory and epidemiological data on FMD, and to harmonize and improve the quality of diagnostic testing carried out by international and national FMD laboratories. In addition to the sixteen WOA and FAO FMD reference centres, the work of the network is enhanced by contributions from affiliate laboratories in Asia and Africa, which provide access to the latest intelligence about FMD cases in the field. A key role of the network is to monitor the spread of viral lineages that are maintained in the seven endemic pools distributed across the world, and to continuously review the risks to livestock industries in countries that are free of FMD (with or without vaccination).

In addition to the circulation of pool-specific viruses, long-distance, trans-pool movement of FMD viral lineages has been a common theme of recent reports generated by laboratories within the network. Recent examples include the spread of the O/ME-SA/Ind-2001 lineage from South Asian countries (Pool 2), which has now become an important endemic virus lineage in Southeast and East Asia (Pool 1), and the emergence of FMD viruses from East Africa (Pool 4) causing FMD cases in the Middle East (Pool 3). Together, these events highlight the ease with which new

FMD virus lineages can emerge and cross international boundaries, and emphasise the importance of the work undertaken by the network to continuously monitor the global epidemiology of FMD.

This presentation described the management of the network, where open sharing of data is facilitated through a Memorandum of Understanding (MoU), signed by all partner laboratories. Annual meetings are used to collate information on recent outbreaks and provide opportunities to discuss key topics related to FMD control. The network has jointly prepared scientific papers addressing the availability of reference reagents for FMD diagnostics, reviewing trends in the global epidemiology of specific FMD serotypes, and highlighting the negative impacts of the Nagoya Protocol on the availability of tailored FMD vaccines. A series of new web-based dashboards (OpenFMD, n.d.) is currently under development to display and share data with the scientific community.

The work of the network is supported by WOA and EuFMD, with funding from the European Union and national contributions from the network partners.

5.2 ROLE OF THE WORLD ORGANISATION FOR ANIMAL HEALTH REFERENCE CENTRES IN SUPPORTING MEMBERS IN THE EARLY DETECTION OF EMERGING PATHOGENS

Charmaine Chng, Deputy Head of the Science Department, WOA

The presentation covered the role of WOA Collaborating Centres and reference laboratories in supporting its Members in the early detection of emerging pathogens, including risk analysis and guidance on surveillance and diagnostic systems. WOA reference centres form the central core of the organization's scientific excellence, playing a key role in knowledge acquisition and generation that inform animal health policy and regulatory decisions. WOA's network comprises 76 Collaborating Centres across 33 countries, addressing 36 specialized fields, and 274 reference laboratories covering 109 diseases operating in 40 countries worldwide.

Themes addressed by Collaborating Centres include risk analysis, animal health surveillance, epidemiology and modelling, zoonoses, wildlife health, diagnostics, genomics, vaccines, training and education. Specific Collaborating

Centres include those specializing in veterinary emergencies, such as the Centre for Environment, Fisheries and Aquaculture Science in the United Kingdom of Great Britain and Northern Ireland for emerging aquatic animal diseases, and the United States of America National Centre for Emerging and Infectious Diseases for zoonotic pathogens. Other centres worldwide focus on avian, swine and other species-specific disease issues, animal welfare, training and education, wildlife health and aquatic health.

Reference laboratories support Members by developing, validating and disseminating diagnostic tests, conducting laboratory proficiency testing and coordinating studies essential for disease surveillance and response. In addition, they provide technical and scientific advice and training to ensure accurate and efficient diagnostic and control measures.

By facilitating collaboration through the One Health approach with partners such as FAO and WHO, WOAHP's network integrates animal, human and environmental health disciplines to ensure the timely sharing of scientific knowledge and transparent information. This coordination enhances early warning systems and preparedness for threats, including unknown diseases or "disease X" scenarios, in which pathogens of unknown origin may pose a global risk.

This extensive infrastructure enables WOAHP to strengthen surveillance, control measures and data utilization, ensuring that Member Nations have access to robust tools and systems to confront emerging health challenges on a global scale.

5.3 GLOBAL SITUATION UPDATE ON AVIAN INFLUENZA VIRUSES. HIGHLIGHTING ZOOONOTIC POTENTIAL AND THE ROLE OF REFERENCE LABORATORIES

Ashley Banyard, Director, International Reference Laboratory for Influenza and Newcastle Disease Virus, Animal and Plant Health Agency (APHA), United Kingdom of Great Britain and Northern Ireland

The continued threat from AIVs and the emergence of H5N1 to cause a global epizootic has posed a significant challenge to both the veterinary and medical communities. Before 2020, notifiable avian influenza often emerged as a seasonal threat in many geographical locations, generally causing outbreaks linked to the movement of migratory wild birds. However, in 2020, the 2.3.4.4b H5N1 AIV clade emerged and triggered devastating outbreaks worldwide, fundamentally altering virus infection dynamics: novel species, including mammals, became infected, and the virus persisted in bird populations throughout the summer months, whereas previously, impacts had been largely confined to the winter. The extent and severity of infection with this virus across both wild and kept bird populations since

2020 is unprecedented. The cost of outbreaks to commercial sectors and the impact on various wild bird species has necessitated dynamic local responses, including both culling and vaccination of kept birds in different parts of the world.

The role of international reference laboratories is evolving in response to the emergence of novel rapid diagnostic technologies. Reference laboratories are no longer solely receivers and diagnostic authorities; they now serve as hubs of knowledge, empowering local entities to undertake diagnosis themselves. Although significant gaps in diagnostic capacity persist globally, these can be addressed through the support of reference centre networks (e.g. the WOAHP–FAO Network of Expertise on Animal Influenza, OFFLU). Crucially, laboratories need sustained access to appropriate reference materials, technical training and expert advice. Wherever possible, laboratory networks should be established – ideally designed to support surveillance and diagnosis across multiple diseases, not just a single target. Multipathogen and One Health approaches must be advanced to enable the rapid scaling up of capacity and capability. Dedicated funding mechanisms are needed to support this development.

Finally, the adoption of modern diagnostic techniques, accompanied by appropriate validation and accreditation, will enable faster and more reliable disease diagnosis on a global scale.

5.4 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS REFERENCE CENTRES ON ANTIMICROBIAL RESISTANCE ARE KEY PARTNERS IN TRANSFORMING APPROACHES TO ANTIMICROBIAL RESISTANCE IN AGRIFOOD SYSTEMS

Rungtip Chuanchuen, Head, Research Unit in Microbial Food Safety and Antimicrobial Resistance, Chulalongkorn University, Thailand

In response to the global emergence and spread of AMR, FAO has been an active player in tackling AMR in the food and agriculture sectors through a One Health approach. FAO optimizes its efforts through close collaboration with key partners, particularly its established network of reference centres for AMR. Since 2019, nine institutes have been designated as FAO RCs for AMR, including:

1. Freie Universität Berlin, Germany
2. Ohio State University, United States of America
3. Denmark Technical University, Denmark
4. Chulalongkorn University, Thailand
5. National Service for Agrifood Health, Safety and Quality, Mexico
6. Fondation Institut Pasteur du Dakar, Senegal
7. FBIS CRI of Epidemiology of Rospotrebnadzor, Russian Federation

8. Defra, United Kingdom of Great Britain and Northern Ireland
9. ANSES, France

Each RC has key planned activities aligned with FAO's Action Plan on AMR. The RCs provide technical expertise and leadership to deliver sustainable solutions. Initiatives to control and contain AMR have been designed with a broad perspective, within the framework of national, regional and global networks, and some have become integral to the operationalization of AMR management in countries.

Progressively building capacity toward a sustainable AMR surveillance system in the food and agriculture sectors lies at the core of the FAO action plan. The RCs support the implementation of FAO Assessment Tool for Laboratories and AMR Surveillance Systems (FAO-ATLASS) to assess laboratory and surveillance capacities for AMR, the results of which guide the prioritization of improvement actions. Assessment missions have been conducted worldwide (e.g. more than 40 missions in Asia by the Thailand FAO RC). Training workshops have been organized to support the effective generation of AMR data. Some participants trained by the RCs are now key actors leading AMR initiatives in their countries. Protocols and guidelines have been developed to ensure standardization and harmonization of methodologies and data quality (e.g. the *Regional Guideline Volume 1 for AMR* by the Thailand FAO RC and *Volume 6 for Antimicrobial Residues*, drafted by the United Kingdom of Great Britain and Northern Ireland FAO RC). External quality assurance programmes have been established to strengthen AMR data generation (e.g. VETQAS by the United Kingdom FAO RC, PTAST by the Thailand FAO RC, and EQAsia by the Denmark FAO RC). The RCs are well-positioned to enhance AMR data generation and management.

The RCs have supported the implementation of the InFARM system for collecting, analysing, interpreting and sharing data to integrate AMR and antimicrobial use (AMU) data in the animal sector with data from the Global Antimicrobial Resistance Surveillance System (GLASS), AMU and resistance surveillance in animals (ANIMUSE) and global integrated surveillance of antimicrobial resistance (GISSA).

The RCs have also engaged in raising awareness of AMR and AMU, and in implementing antimicrobial stewardship programmes for veterinary and agricultural production settings. In addition, they have participated in collaborative research on AMR and AMU-related topics (e.g. epidemiological studies, diagnostic tests, alternatives to antimicrobials and enhanced biosecurity) and translated research findings into meaningful action.

FAO has synergized these activities to transform agri-food systems and build capacity to strengthen the resilience of countries to the risks and impacts of AMR. These efforts are accelerated through collaboration with the other Quadripartite partners (WHO, WOAHA and the United Nations

Environment Programme) to ensure AMR mitigation across all sectors and at all levels.

5.5 SUMMARY OF THE PANEL DISCUSSION

Rainelda Dela Peña, Veterinarian V – Division Chief.

Veterinary Laboratory Division. Bureau of Animal Industry – Department of Agriculture, Philippines.

Mo Salman, Professor, Animal Population Health Institute, Colorado State University, United States of America

Isabella Monne, Veterinarian, Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe), Italy

Labib Bakkali Kassimi, Head of Biopic Team, French Agency for Food, Environmental and Occupational Health and Safety (ANSES), France

The panel explored the mandate of FAO RCs and the types of capacity-building programmes they provide according to their respective fields of expertise. These programmes include training activities targeting a variety of stakeholders, such as animal health workers, laboratory technicians and policymakers. The main training topics cited included disease surveillance and control, sample collection and testing, and biosecurity and biosafety, both in the field and in laboratories. The panellists agreed that while state-of-the-art digital tools allow for frequent interaction and protocol sharing, face-to-face training remains essential for gaining an in-depth understanding of country-specific contexts. Flexibility in the training approach was highlighted as key to addressing emerging needs.

Although innovation is often linked to the adoption of new technologies, the panel emphasised that the most effective solutions can sometimes come from innovative applications of existing technologies. An example provided was the use of real-time PCR tests for pathotyping in place of genome sequencing.

FAO RCs face several challenges in fulfilling their mandate. Chief among them is the lack of sustainable and dedicated funding, as limited resources hinder their ability to carry out activities such as field surveillance for FMD. Close coordination and collaboration with other RCs in different fields and geographical areas offer a broader perspective for addressing emerging diseases, as illustrated in the example of AMR. Another major challenge noted was the increased cost of sample shipping, particularly since the onset of the COVID-19 pandemic. It is therefore essential for RCs to develop cost-effective and biologically safe methods for shipping samples at ambient temperature and to support the validation and acceptance of such methods. In addition, simple field tests for farmers were identified as crucial tools for enabling participatory surveillance and facilitating early detection and disease characterization.

Integrated surveillance systems – such as collecting samples for multiple diseases simultaneously – could be

efficient for the control of TADs, provided that national governments have a clear understanding of the intended outcomes and data that will be made available. Appropriate funding must also be allocated. FAO RCs can play a vital role in designing and implementing such systems through their support for disease control strategies. This is primarily achieved through education and training, especially within the public sector across countries. RCs can also benefit from support from WOA and FAO through twinning programmes (as in the example of the Philippines), proficiency testing for infectious diseases such as avian influenza, rabies, African swine fever and other swine diseases, and support for establishing ISO 17025 quality management systems in laboratories.

In conclusion, given the role of RCs in TADs control, capacity building and global data sharing, it is vital that they are established in diverse regions, are visible and are internationally recognized. Collaboration between FAO, WOA and other organizations enhances diagnostic capabilities and strengthens global responses to animal health challenges, while standardization, capacity building and research partnerships are critical to improving the global animal health response. Addressing logistical challenges, such as sample transportation and data sharing, is essential to ensuring the continued effectiveness of reference centres.

CHAPTER 6

Regional support laboratory and national capacity building for the future

6.1 BUILDING CAPACITIES TO FOSTER PARTNERSHIPS – THE ROLE OF THE VETERINARY DIAGNOSTIC LABORATORY NETWORK

Viskam Wijewardana, Head, Animal Production and Health Laboratory, Joint FAO International Atomic Energy Agency (IAEA) Centre of Nuclear Techniques in Food and Agriculture

The Veterinary Diagnostic Laboratory (VETLAB) is a global network of national veterinary laboratories coordinated by the Animal Production and Health Section and founded by IAEA and FAO, with support from South Africa through the African Renaissance Fund and from the United States of America and Japan through the Peaceful Uses Initiative. VETLAB aims to strengthen collaboration among veterinary diagnostic laboratories by offering a range of capacity-building and training opportunities, sharing knowledge and experience to enhance national and regional capacities for early and rapid diagnosis, and improving Member Nation emergency response capabilities to control animal disease outbreaks and respond quickly and effectively to animal health threats. The network currently includes veterinary laboratories across Africa and Asia.

VETLAB remains committed to enhancing Member Nation laboratory capabilities to combat TADs and zoonotic diseases. It provides innovative and advanced methods for pathogen detection and monitoring that can be implemented in laboratories worldwide, particularly in low- and middle-income countries. VETLAB is currently the only provider of free-of-charge proficiency testing for PPR, an acute and economically devastating viral disease affecting goats and sheep.

Each year, VETLAB organizes ring trials, training courses and gatherings of African and Asian laboratory directors. Directors from partner laboratories attend in person to share firsthand experiences in TAD and zoonotic disease control and prevention. For example, in 2023, the VETLAB organized two major training courses at the Animal Production and Health Laboratory in Seibersdorf, Austria: Multiparametric Detection of Pathogens Causing Major Transboundary Animal Diseases and Zoonoses and Next Generation Sequencing Bioinformatics and Molecular Phylogeny. These were conducted alongside several on-site and remote support activities delivered by laboratory experts. Between 2014 and 2023,

VETLAB hosted 16 training courses, training 342 scientists from 31 countries. It conducted 19 field missions between 2014 and 2020 in 17 countries, training 195 scientists. It also supports doctorate training, with three candidates having completed their degrees and two more expected to defend their theses in 2025.

Rapid response to disease outbreaks and laboratory preparedness are key objectives of VETLAB. These are supported through training, the sharing of protocols and emergency toolboxes (reagents, positive controls), and assistance with sample submission for viral genetic characterization. As a result, some Member Nations have been able to identify and report outbreaks of diseases previously considered non-endemic.

VETLAB distinguishes itself through its commitment to ongoing research and development, which supports long-term laboratory sustainability by promoting the use of cutting-edge technologies. The publication of high-quality research in reputable journals and the widespread adoption of diagnostic assays developed by VETLAB scientists during the lumpy skin disease incursion in Europe between 2015 and 2017 demonstrate how VETLAB supports Member Nations in adopting advanced pathogen identification technologies, even beyond its current membership.

For these reasons, VETLAB is expanding its efforts to support countries in Central and Eastern Europe, the Caribbean and Latin America. Laboratories collaborate with experts from the Joint FAO/IAEA Centre to apply nuclear, nuclear-derived and other technologies for disease surveillance, early detection, diagnosis and control.

6.2 FAO REGIONAL SUPPORT LABORATORIES

Maryam Muhammad, Director, National Veterinary Research Institute (NVRI), Vom, Nigeria

The early detection and identification of pathogens by standard diagnostic laboratories, strengthened by organized system-wide surveillance programmes, are crucial to achieving the control and eradication of emerging and re-emerging transboundary animal diseases and zoonoses. With the increasing interaction between wildlife, humans and domestic animals – further exacerbated by climate change – public health security is also continuously threatened. Strategic vaccination programmes that utilize appropriate and efficient

vaccines are equally critical for effective disease prevention. National laboratories and vaccine manufacturing centres require sustained support to deliver these services effectively.

Regional support laboratories (RSLs) serve as FAO's collaborating centres for emergency preparedness for TADs, as IAEA ZODIAC national laboratories, and as national antimicrobial resistance reference laboratories. They can also support One Health activities at the regional level.

In Africa, partners including WOAHA (formerly OIE), FAO and FAO ECTAD, the African Union Pan African Veterinary Vaccine Centre (AU-PANVAC), the African Union Inter-African Bureau for Animal Resources (AU-IBAR), the West African Health Organization (WAHO) and the ECOWAS Regional Animal Health Centre (RAHC) have provided various forms of support to regional laboratories. This support has included training, laboratory equipment, consumables and reagents, the development of strategic roadmaps for disease surveillance, and sponsorship of conferences and meetings.

Nevertheless, there is an urgent need for further support to upgrade laboratories, replace obsolete equipment, obtain International Organization for Standardization (ISO) accreditation, provide specialized training and enable technology transfer – particularly in new vaccine manufacturing methods. Capacity development for biomedical engineers remains a major challenge, especially in Africa.

Twinning programmes for selected laboratories could facilitate the attainment of regional reference laboratory status, thereby strengthening regional capacity. RSLs aspire to establish twinning partnerships toward gaining reference status for rabies, anthrax, African swine fever and peste des petits ruminants, as well as to maintain accreditation and expand testing scopes.

There is a pressing need to upgrade some laboratories and replace ageing equipment. A lack of sequencing capacity is a particular limitation. In vaccine production, aspirations include scaling up manufacturing, especially for anti-rabies and PPR vaccines, to support global eradication programmes for these diseases. Challenges persist with cold chain infrastructure and the need to train young scientists in vaccine development and technology transfer.

Overall, regional laboratories and vaccine manufacturing centres require expanded support through the RSL programme of FAO and its partners. This would enhance regional capacity for early outbreak detection, timely and accurate pathogen identification, and the implementation of appropriate prevention and control strategies.

6.3 EMPOWER AND ADVANCE THE COUNTRIES' CAPACITIES TO BECOME REFERENCE CENTRES AND REGIONAL SUPPORT LABORATORIES

Giovanni Cattoli, Director of Health, Istituto Zooprofilattico Sperimentale delle Venezie (IZSVe), Italy

In the fields of animal health and food safety, international RCs have specific roles and responsibilities defined by international organizations such as FAO and WOAHA and endorsed by national competent authorities. According to WOAHA, laboratories aspiring to become RCs “should have the real potential to make significant improvements in terms of capacity and expertise. They will need adequate facilities and infrastructure, and be able to demonstrate that they have the commitment and resources to sustain improvements.” Furthermore, “it is important that diagnostic samples, reagents and equipment can be transported to and from the laboratory safely and effectively with minimal delay,” (WOAHA, n.d.) The ability of candidate reference laboratories to receive diagnostic samples and reagents from other countries is another important factor to consider.

These conditions present serious challenges for many veterinary and medical laboratories in low- and middle-income countries. As a result, the global distribution of international reference laboratories is uneven, with most of them located in high-income countries. To address this imbalance and support the diagnostic, surveillance and research capacities of veterinary laboratories in LMICs, international organizations and donors have supported several major initiatives. Notable examples include the WOAHA Twinning Programme and FAO's identification of RSLs. These and other initiatives share the goal of achieving laboratory sustainability.

At a meeting sponsored by the IDENTITY project, conducted by FAO in Ethiopia in 2012, representatives of African RSLs identified key constraints that hindered the fulfilment of their regional mandates. These included insufficient budgets, poor quality and low volume of samples submitted by other laboratories, shortages of reagents, absence of quality management systems and high turnover of laboratory management staff.

Despite the international efforts made over the last two decades or more, many of these challenges persist across laboratories in LMICs. Although progress has been made and there are documented success stories, the improvements resulting from international capacity-building and cooperation projects are often difficult to sustain over the long term.

Pursuing sustainability for laboratories embedded within national systems that face structural and financial sustainability challenges themselves can be unrealistic. This is especially the case given the typically short timeframes – often three to five years – of many international cooperation projects. To empower and enhance the capacities of countries to become RCs and RSLs over the long term, the donor–beneficiary

model must be reconsidered. A shift toward long-term, balanced partnerships based on equitable sharing of resources, knowledge and expertise is needed. Rather than relying on donations, countries and institutions should engage in mutual, formalized collaborations.

At the laboratory level, this shift can be supported through the development of long-term twinning arrangements and technical partnerships. At the national and global levels, moving away from the donation model and ensuring the functionality of laboratories and accessibility of diagnostic services would contribute to greater stability, prosperity and self-sustained national capacity over time.

6.4 STRENGTHENING THE ONE HEALTH APPROACH AND COLLABORATION FOR CONTROLLING ZOOBOTIC/EMERGING DISEASES IN INDONESIA

Dharmayanti Niluh Putu Indi, Doctoral Researcher, Indonesian Research Center for Veterinary Science, Indonesia

There are 1 415 species of infectious organisms known to be pathogenic to humans, including 217 viruses and prions, 538 bacteria and rickettsia, 307 fungi, 66 protozoa and 287 helminths. Of these, 868 (61 percent) are zoonotic, and 175 are associated with diseases considered to be emerging. The One Health approach calls on health researchers and practitioners working at the human, animal and environmental interfaces to collaborate in mitigating the risks posed by emerging and re-emerging infectious diseases.

Indonesia has established two key regulations to promote One Health: Regulation No. 7 of 2021 from the Coordinating Ministry for Human Development and Cultural Affairs on the National Action Plan for Antimicrobial Resistance Control, and Regulation No. 7 of 2022 on Guidelines for the Prevention and Control of Zoonotic Diseases and Novel Infectious Diseases. Additionally, Law No. 17 of 2023 on Health (UU 17/2023), Article 91, states that, "Infectious disease control is carried out in a coordinated and integrated manner with the animal health, agriculture, environment and other sectors."

One Health implementation in Indonesia involves:

- i. Collaboration with partners
- ii. Assessment of national capacity – in the human health sector through joint external evaluations (WHO), and in the animal health sector through performance of veterinary services assessments (WOAH)
- iii. Joint risk assessments for emerging infectious diseases, including H9N2, Nipah, mpox, zoonotic tuberculosis and zoonotic COVID-19
- iv. Establishment of the Information System for Zoonoses and Emerging Infectious Diseases (SIZE), among other ongoing initiatives

To support national research institution capacity, Indonesia joined VETLAB, a global association of national veterinary laboratories that offers broad opportunities for

communication and information exchange. It allows countries facing similar challenges to coordinate their efforts through training, fellowships, information dissemination, knowledge exchange, development of common disease control strategies, and collaborative research and development.

The major impacts of VETLAB on our laboratory include:

- i. Access to expert knowledge through workshops and short- and long-term training and fellowships, thereby enhancing staff competencies
- ii. Receipt of laboratory equipment, materials and standard operating procedures for practical application
- iii. Trust-building through increased transparency, which fosters dynamic international collaboration
- iv. Improved information sharing among national veterinary laboratories in the region
- v. Enhanced diagnostic capacity at national and regional levels
- vi. Strengthened coordination and harmonization of regional approaches for early and efficient disease detection and surveillance preparedness
- vii. Boosted regional capacity and cross-border collaboration to enable more effective responses to TADs and zoonotic diseases

Additionally, we are conducting a Global Burden of Animal Diseases case study for Indonesia. The study aims to:

- viii. Estimate the value of livestock production systems
- ix. Assess the animal health loss envelope and related expenditures
- x. Quantify the economic and social impacts of animal diseases on production systems

The outcomes will provide critical information for improving the prioritization of resource allocation for animal health, especially to support small-scale farmers.

6.5 SUMMARY OF THE PANEL DISCUSSION

Dilmara Reischak, Federal Agricultural Inspector, Ministry of Agriculture and Livestock, Brazil

Aida Tlatli, General Director/Quality Manager, Institute of Veterinary Research in Tunisia (IRVT), Tunisia

Maryam Muhammad, Director, National Veterinary Research Institute (NVRI), Vom, Nigeria

Hendra Wibawa, Medical Scientist, Molecular Diagnostics, Disease Investigation Centre, Indonesia

Leruo Tego Keokilwe, Acting Head, National Veterinary Laboratory, Botswana

The panel discussion focused on the main areas of expertise that require support from reference centres, particularly in Africa and Asia. At the country level, it is crucial to rapidly identify diseases and use the most appropriate diagnostic tests, especially in cases of emerging or exotic diseases in specific geographical areas. Data evaluation and risk-based

surveillance are essential, along with workforce development and ongoing training for both senior and junior staff to ensure proper laboratory diagnostic performance. Other key aspects of reference centre work include quality management of laboratories, accreditation pathways, and overall biosafety and biosecurity measures, particularly concerning sample transport and handling.

One example highlighted the challenges posed by several transboundary animal diseases (e.g. African swine fever) in Asia and underscored the need for specific expertise and knowledge to address these issues, particularly in the absence of vaccines and in contexts of low on-farm biosecurity. Surveillance, monitoring and rapid reporting systems should be strengthened to prevent the cross-border spread of disease.

Rabies in animals and its spill-over to humans remains a major issue in several regions, especially where dog population management is inadequate. Increasing antimicrobial resistance was also identified as a pressing concern. Overall, participants emphasized the importance of cooperation between institutions and organizations, through a One Health approach, to align efforts in a coordinated direction.

The establishment of a reference centre should not be considered the final goal. It is essential to build trust and earn the acceptance of countries in the region, encouraging the

submission of samples for testing. A structured approach is still needed, particularly the official accreditation of reference centres in some regions to ensure competence and reliability. Constant and direct communication, as well as strong connections with national and international authorities, are necessary to meet legal requirements. Building a reputation through participation in international scientific projects, publication of peer-reviewed research, involvement in proficiency testing, provision of technical assistance, and capacity to offer safe, fast and affordable sample transport via reliable international couriers are all seen as key to gaining recognition as a reference centre. Transparency, confidentiality and flexibility in responding to country-specific needs are essential for building trust in sample and data sharing.

Partnerships and collaboration between reference centres are especially important in regions where laboratories face limited resources, insufficient infrastructure and irregular government financial support. It is critical to recognize the role of reference centres in providing benefits not only to the host country but also to the region and globally. Building relationships with other organizations and countries through the establishment of technical and inter-laboratory networks is considered essential to achieving cost- and time-effective outcomes.

CHAPTER 7

Securing the supply of safe, effective and affordable veterinary vaccines

7.1 APPROVAL OF NEW BIOLOGICS, LICENSING, CERTIFICATION, INSPECTION AND FIELD TESTING

Geetha Srinivas, Director, Centre for Veterinary Biologics (CVB), USDA, APHIS, United States of America



The Centre for Veterinary Biologics (CVB), a division of the United States Department of Agriculture, regulates the licensure, manufacturing and marketing of veterinary biologics, including vaccines, bacterins, antisera, diagnostic products and other biological-origin products in the United States of America. The CVB implements the provisions of the Virus–Serum–Toxin Act (VSTA) to ensure that veterinary biologics available for the diagnosis, prevention and treatment of animal diseases are pure, safe, potent and effective.

The CVB issues different types of licenses depending on field needs. The data requirements vary by license type. Full licensure requires comprehensive data demonstrating a product's efficacy, safety, potency and purity. Licensure is contingent on satisfactory confirmatory testing at the CVB.

In the case of an emerging disease, a conditional license may be issued with limited data. The CVB can expedite licensure by concurrently testing master seeds, cells and pre-market serials while efficacy, field safety and other supporting studies are still in progress. Conditional licensure still requires a reasonable expectation of efficacy and full field safety data.

The CVB also grants licenses for autogenous products, which are prepared using killed bacterial or viral agents isolated from specific herds and administered under veterinary guidance to animals within the same or adjacent herds. Additionally, the CVB approves licenses for prescription platform products, which are based on the substitution of

the gene(s) of interest from a related infectious agent into the vector backbone of a fully licensed platform product to meet field needs and address emergencies.

Working within the mandate of the VSTA, the CVB applies regulatory flexibilities to address emerging disease situations and transboundary animal diseases. It continuously strives to bring high-quality, customized products to market quickly, supporting novel technologies, addressing highly mutable agents, combating emerging diseases and promoting alternatives to antibiotics.

Beyond licensing, the CVB enforces regulations to ensure well-documented and controlled manufacturing processes are in place prior to product approval and market release. The CVB also monitors the quality of licensed biologics through serial testing, robust pharmacovigilance field safety data and routine inspection of manufacturing facilities.

7.2. INNOVATION TO INCREASE THE AVAILABILITY OF ANIMAL HEALTH PRODUCTS FOR CONTROL OF LIVESTOCK DISEASES

Carolyn Schumacher, Chief Executive, GALVmed

Livestock diseases remain a major impediment to animal health and welfare across much of the southern hemisphere. It is widely acknowledged that disease prevention through vaccination and good livestock management is key to improving animal welfare and productivity. In turn, this supports the livelihoods of livestock farmers, contributes to food security for fast-growing populations and advances national economic development in many low- and middle-income countries.

Why, then, has product innovation been so sluggish, and why is livestock vaccination still so rarely practised?

Bringing affordable livestock vaccines to market and ensuring their consistent availability in the right quantity, quality and location requires careful planning and coordination among stakeholders across the complex animal health product value chain.

GALVmed's work shows that poultry and ruminant product value chains operate very differently, absorb innovation at different rates and yield vastly different outcomes for farmers. Despite strong engagement from academia and industry in developing new animal health products and

tools, evidence suggests that the animal health product value chain remains fragmented, misaligned with farmers' needs and often commercially non-viable, particularly for small- and large-ruminant owners.

This lack of alignment and coordination within the value chain has slowed the development of a predictable regulatory environment and an effective quality assurance system in sub-Saharan Africa. In addition, government restrictions on vaccine use and the reliance on free, single-disease-focused vaccination campaigns prevent the emergence of product offerings that reflect farmers' actual needs. These policies also stifle the development of functioning supply chains and markets for animal health products, especially vaccines.

The situation is further compounded by limited awareness at the farm level and weak veterinary oversight of veterinary medicine use. This has led to the misuse of products, including antimicrobials, and the circulation of unregistered, falsified and counterfeit animal health products.

Improving the flow of innovation from research to the farm level is essential and requires innovations and action at all points where the animal health product value chain is disrupted. There is an urgent need for all stakeholders in the livestock product value chain to collaborate and progressively address the constraints that currently hinder the availability, accessibility and adoption of affordable, quality animal health products across sub-Saharan Africa.

7.3. THE CONCEPT OF INDEPENDENT QUALITY CONTROL OF VETERINARY VACCINES: PROGRESS AND FUTURE ROLES

Charles Bodjo, Senior Diagnostic Reagent Officer, African Union Pan African Veterinary Vaccine Centre (AU-PANVAC)

The concept of independent quality control of veterinary vaccines used in Africa began in the early 1980s as a prerequisite for funding the Pan-African Rinderpest Campaign. An international audit conducted by FAO in 1983 on the quality of rinderpest vaccines produced in Africa revealed serious deficiencies – only 20 percent of the vaccines met acceptable quality standards. In response, two regional training and vaccine quality control centres were established in 1986: one in Debre Zeit, Ethiopia, and the other in Dakar, Senegal, to support the control and eradication of rinderpest.

In 1993, the two centres were merged to form the Pan-African Centre for Veterinary Vaccines (PANVAC), reflecting a continent-wide mandate. In recognition of its critical role in rinderpest eradication in Africa, the 67th Ordinary Session of the Organization of African Unity (OAU) Council of Ministers (Addis Ababa, 23–27 February 1998) elevated PANVAC to the status of a Specialized Agency. On 12 March 2004, AU-PANVAC was officially launched as a Regional Centre of the African Union, headquartered in Debre Zeit, Ethiopia, under the Department of Agriculture,

Rural Development, Blue Economy and Environmental Sustainability. Its mission is to promote the use of high-quality vaccines and reagents for the control and eradication of animal diseases in Africa.

AU-PANVAC's primary objective is to promote quality improvement and harmonized standards for the production and quality control of veterinary vaccines. Whereas only two vaccine types were tested in the 1980s and 1990s, the centre now tests more than 50 types of vaccines sourced both from Africa and overseas. The vaccine pass rate has significantly improved, from 20 percent in the 1980s to around 90 percent today.

The centre has initiated the harmonization of standards for veterinary vaccine registration and manufacturing facility certification. This effort supports mutual recognition of quality standards in line with the goals of the African Continental Free Trade Area (AfCFTA).

AU-PANVAC also maintains a vaccine seed repository for Africa and has established a continental vaccine reserve that aims to ensure emergency preparedness to respond to any outbreak of rinderpest.

In recognition of its achievements in veterinary vaccine certification, AU-PANVAC has been designated a Collaborating Centre of the World Organisation for Animal Health and a reference centre for vaccine quality control by FAO.

Together with the United States Defence Threat Reduction Agency's Biological Threat Reduction Program (DTRA/BTRP), AU-PANVAC is developing a new high-containment laboratory and training facility to consolidate operations and enhance biorisk management.

Looking ahead, AU-PANVAC has been mandated to audit and certify vaccine manufacturers and, in collaboration with AU-IBAR, establish a network of African regulatory authorities. It is also considering the development of a continental vaccinovigilance platform to monitor vaccine safety, efficacy, adverse events and substandard products.

7.4 GLOBAL CHALLENGES IN ANIMAL VACCINES DEVELOPMENT: FORECASTING DEMAND

Jennifer Christelle Essolomwa, Regulatory Affairs Officer, Health for Animals

Animal vaccines play a pivotal role in protecting livestock health and preventing the spread of zoonotic diseases. Despite their significance, developing new and effective animal vaccines faces numerous challenges. This presentation offers an industry perspective on key challenges and opportunities in the field.

Key challenges and opportunities for the future include:

- i. Sustainability, as animal vaccines contribute to sustainable livestock production by reducing disease-related losses, optimizing AMU and limiting livestock-related greenhouse gas emissions intensity;

- ii. Technological advancements and innovations in vaccine technology, such as needle-free delivery systems and improved potency, which offer opportunities to enhance accessibility and efficacy;
- iii. Forecasting demand – to ensure adequate supply and minimize waste, it is crucial to accurately predict vaccine demand. This involves considering the four Ws:
 - **What:** Identify the specific vaccine types, strains, dosages and presentations that are in demand;
 - **Who:** Determine the target species, geographic locations and target audiences for the vaccines;
 - **Where:** Understand the distribution channels and supply chain infrastructure for vaccine delivery; and
 - **When:** Anticipate the timing and lead time for vaccine demand, considering factors such as seasonal fluctuations and disease outbreaks;
- iv. Regulatory hurdles, as navigating the regulatory landscape for animal vaccines, can be complex, with varying requirements across different regions. Harmonization of regulatory standards is essential to facilitate global market access.

In conclusion, addressing the challenges associated with animal vaccine development is critical to protecting livestock health, preventing zoonotic diseases and promoting sustainable food production. By fostering collaboration among stakeholders and mitigating the risks and uncertainties that can hinder the development, production and distribution of animal vaccines, the continued development and deployment of effective vaccines can be ensured to meet growing global demand.

7.5 SUMMARY OF THE PANEL DISCUSSION

Anand Kumar, Managing Director, Indian Immunologicals Limited, India

Mike Francis, Managing Director, BioVacc Consulting Ltd., United Kingdom of Great Britain and Northern Ireland

Carolin Schumacher, Chief Executive, GALVmed, Germany
Nikita Lebedev, Deputy Director, Federal Centre for Animal Health (ARRIAH), Russian Federation



The panel discussion first focused on key barriers to vaccine availability, access, and vaccination implementation in the southern hemisphere. One major issue highlighted was the need for greater transparency and cooperation in selecting vaccine strains. A successful example of data sharing was cited during the SARS-CoV-2 epidemic, which spread from South Africa to Ethiopia and the Middle East. Field strains were shared by Jordan with the Russian Federation, where vaccine matching was conducted. This collaboration enabled the rapid development of an effective vaccine, which was subsequently distributed to Azerbaijan, Armenia and other countries in the Middle East.

In certain regions, such as parts of Africa, it was noted that regulatory frameworks and pharmacovigilance systems need to be strengthened to better detect low-quality products on the market and identify post-marketing vaccine failures.

The panel also emphasized the importance of increasing the number of professionals – both veterinarians and veterinary paraprofessionals – capable of advising farmers on vaccine use. Greater transparency and collaboration would help build a more effective “ecosystem” in which the responsibility for vaccines and vaccination is shared among governments, manufacturers, and both large and small-scale livestock producers who share common interests in animal health.

COVID-19 significantly shifted perceptions of innovation in vaccine production. During the pandemic, effective vaccines were developed and released in a short time thanks to the use of innovative vaccine platform technologies. It was also noted that many of these innovations originated in the animal health field, particularly in the poultry, where rapid and cost-effective vaccines are now widely available. Vaccine platform technologies can be leveraged to meet country-specific needs and accelerate the introduction of new vaccines, particularly in low- and middle-income countries, where time-sensitive and effective responses can be transformative.

A broader regulatory perspective is needed to avoid duplicating studies for each new platform developed and to bridge the gap between academic research and commercial application.

CHAPTER 8

Maximizing vaccination impact and enhanced quality

8.1 VETERINARY VACCINE SELECTION, VACCINATION STRATEGY AND POST-VACCINATION MONITORING FOR LIVESTOCK

Baptiste Dungu, Director, Bonisa Solutions, United Kingdom of Great Britain and Northern Ireland



Effective management of transboundary animal diseases and other infectious livestock diseases requires a multifaceted vaccination approach that prioritizes both impact and quality. The key strategic components of vaccination interventions include vaccine selection, vaccination strategy and post-vaccination monitoring, all of which contribute to improving the efficacy and reliability of vaccination programmes.

Optimal vaccine selection entails evaluating pathogen strain specificity, vaccine efficacy, safety profile and duration of immunity. For some vaccines, such as those for peste des petits ruminants and lumpy skin disease, established characteristics can guide selection. However, for pathogens with high genetic diversity, such as foot-and-mouth disease virus and highly pathogenic avian influenza virus (HPAIV), effective vaccine selection requires confirmation or matching with circulating strains to ensure robust efficacy. A sound understanding of pathogenesis and protective immune mechanisms is therefore critical to developing a consensus target product profile that informs vaccine selection.

A robust vaccination strategy begins with clearly defining the disease control objective, where vaccination is one of several tools. It should be based on a comprehensive risk assessment to tailor programmes and identify target populations. Strategic planning includes determining the appropriate timing, coverage and frequency of both initial and booster doses, and ensuring vaccination is integrated

into broader disease control and surveillance frameworks.

Post-vaccination monitoring plays a critical role in evaluating both the safety and effectiveness of vaccines. This includes immediate observation for adverse reactions, routine health assessments and serological testing to measure immune responses. Effective monitoring allows for the timely adjustment of vaccination protocols. Post-vaccination monitoring and vaccine vigilance are essential components of disease control efforts based on vaccination.

8.2 SOUTH AMERICA FOOT-AND-MOUTH DISEASE CONTROL AND ERADICATION PROGRAMME

Manuel Jose Sanchez Vazquez, Coordinator of the Area of Epidemiology in (Pan American Center for Foot-and-Mouth Disease) PANAFTOSA, Pan American Health Organization (PAHO/WHO)

Several key components have contributed to the progress and success of FMD eradication efforts across South America. The unified actions of countries in the region have advanced and maintained FMD-free status, as recognized by WOA, with the exception of the Bolivarian Republic of Venezuela. Currently, 99 percent of the region's cattle herds are located in areas recognized as FMD-free, of which 36 percent are without vaccination and 64 percent with vaccination.

The pivotal role of regional governance mechanisms must be emphasized, particularly the South American Commission for the Fight Against Foot-and-Mouth Disease (COSALFA) and the Hemispheric Program for the Eradication of Foot-and-Mouth Disease (PHEFA), supported technically by the Pan American Center for Foot-and-Mouth Disease and Veterinary Public Health (PANAFTOSA). These structures foster political commitment and guide regional and national strategies, including public-private partnerships. Strengthening veterinary services has also been crucial, with improvements in professional training, surveillance systems and laboratory capacity through updated equipment and training. In addition, the upgrading of livestock registration systems has enhanced the ability to monitor and control susceptible populations. These efforts also include bolstering emergency preparedness and cross-border collaboration strategies.

Vaccination strategies are based on risk and include two annual rounds and additional campaigns targeting younger animals. Key components of vaccination implementation include cold chain management, comprehensive training for vaccinators and meticulous record-keeping. Regional vaccine production laboratories play a vital role in ensuring the availability of high-quality vaccines and compliance with established standards. The PANAFTOSA WOAHA Reference Laboratory is instrumental in maintaining vaccine quality through testing and evaluation.

Post-vaccination monitoring strategies are essential for assessing vaccine effectiveness and understanding the factors that influence it. These strategies help refine vaccination practices by identifying specific issues on farms, within vaccination teams, in the cold chain and through the analysis of variables such as animal age, farm type and geographical distribution to address immunity gaps.

Key conclusions underscore the value of a regional approach to FMD eradication, highlighting the role of PANAFTOSA, COSALFA and PHEFA in aligning strategies and facilitating information sharing. Political commitment remains vital to achieving and maintaining a disease-free status, along with strong public–private partnerships. Reinforcing veterinary services – particularly in surveillance, laboratory capacity and emergency response – is also essential. In South America, successful eradication has relied on effective vaccination strategies using high-quality vaccines and robust post-vaccination monitoring.

8.3 AFRICAN SWINE FEVER VACCINE DEVELOPMENT AND APPLICATION

Manuel Borca, Research Microbiologist, Agriculture Research Service, United States Department of Agriculture, United States of America

African swine fever remains one of the most frequent causes of mortality among domestic pigs. The disease is currently present across a vast geographical area of the Eastern Hemisphere, from Central Europe to East and Southeast Asia, Africa, and more recently, the Americas – including the Dominican Republic and Haiti. The causative agent, African swine fever virus, is a structurally complex virus with a large DNA genome encoding approximately 160 proteins. It infects both domestic and wild swine, producing a range of clinical manifestations depending on the virus strain and the genetic background of the infected animals.

Historically, the only effective experimental vaccines were based on live attenuated virus strains developed through various methodologies. Until recently, no commercial vaccines had been made available. This presentation detailed the development of recombinant attenuated virus strains, initially used in experimental vaccines and subsequently transferred to pharmaceutical companies. These attenuated strains are

created through targeted genetic manipulation, involving the deletion of specific virus genes previously identified as contributing to ASFV virulence.

The presentation also reviewed the development of several such vaccine strains and the processes involved in transferring them to commercial partners. Finally, field data on the use of these vaccines were presented, providing insight into their performance in real-world conditions.

8.4 VACCINATION AGAINST HIGHLY PATHOGENIC AVIAN INFLUENZA – THE DECISION AND THE IMPACT

Hualan Chen, Professor, Harbin Veterinary Research Institute, China

Avian influenza viruses bearing the hemagglutinin (HA) gene of the H5 and H7 subtypes have caused 2 634 human cases globally, resulting in more than 1 000 deaths. Highly pathogenic avian influenza viruses have triggered numerous outbreaks in wild birds and domestic poultry and are responsible for the loss of at least 367 million domestic birds worldwide since 2005. Many countries in Europe and North America control highly pathogenic avian influenza by culling infected and suspected birds, whereas others, including China, have adopted a “cull plus vaccination” strategy.

As influenza viruses mutate readily, especially in the HA gene, antigenic variation presents a challenge to vaccination efforts. To ensure vaccine-virus match, China established a platform to generate vaccine seed viruses using reverse genetics. This approach enables the rapid creation within one week of an ideal vaccine seed virus, incorporating the modified HA gene and native neuraminidase (NA) gene of a prevalent H5 or H7 virus, along with internal genes from the high-growth A/Puerto Rico/8/1934 (H1N1) virus.

Active surveillance in wild birds and domestic poultry is essential to detect newly invasive strains. If a significant antigenic difference is observed between the new strain and the vaccine seed virus, the seed virus is updated. Since 2004, ten different H5 seed viruses produced via reverse genetics have been used for inactivated vaccine production. These vaccines have played a key role in controlling and eliminating H5 avian influenza viruses in China.

An H7N9 low-pathogenic avian influenza virus emerged in China in 2013 and caused over 1 560 human infections across five waves from February 2013 to September 2017, with a mortality rate of nearly 40 percent. Before September 2017, culling infected birds at virus-positive poultry markets was the main strategy. However, H7N9 continued to circulate in live markets and, in early 2017, acquired multiple basic amino acids in its HA cleavage site, rendering it highly pathogenic in chickens in Guangdong. These waves

of human infection and the emergence of the highly pathogenic H7N9 virus indicated that stamping-out measures alone were insufficient, prompting the introduction of a vaccination strategy in September 2017.

Vaccinating poultry with a bivalent H5/H7 inactivated vaccine significantly reduced H7N9 prevalence in poultry and successfully eliminated human infections.

In summary, vaccines have been used effectively in poultry to prevent highly pathogenic avian influenza in China. Given the continued global circulation of H5 viruses carrying the clade 2.3.4.4b HA gene – affecting wild birds and causing significant outbreaks in poultry – any unnecessary barriers to vaccination should be removed immediately and permanently.

8.5 SUMMARY OF THE PANEL DISCUSSION

Aldo Dekker, Project leader, Vesicular Diseases, Wageningen University and Research, the Kingdom of the Netherlands

Shi Jishu, Professor of Vaccine Immunology, Director, Center on Biologics Development and Evaluation, Wayne and Hilda Appleton Endowed Professor, United States of America

Gabriel Varga, Regional Director, sub-Saharan Africa at Zoetis, African Livestock Productivity and Health Advancement (A.L.P.H.A.), Slovakia

Hualan Chen, Professor, Harbin Veterinary Research Institute, China



The first question addressed by the panel was the role of regional organizations in supporting national vaccination campaigns and preventing the spread of infectious animal diseases through coordinated efforts. The Kingdom of the Netherlands was cited as an example, where FMD control began in the 1950s with a national vaccination campaign targeting cattle. However, in subsequent years, strains circulating in pigs were introduced from neighbouring countries. This example underscores the importance of coordinated actions among neighbouring countries to address transboundary animal diseases. Another successful case was presented from South America, where coordinated vaccination efforts led to highly effective FMD control.

The panellists discussed key indicators for assessing the impact and effectiveness of national vaccination programmes, including mortality rates associated with specific diseases. This was highlighted as a reliable parameter for evaluating whether the scale of vaccination is appropriate for a country or region. They also stressed the importance of governments and donors understanding the economic impact of animal disease outbreaks in terms of production losses and decreased exports of live animals and derived products. Additionally, ensuring that farmers have access to appropriate financial resources is critical for implementing adequate vaccination programmes and safeguarding animal health. These programmes are also effective in reducing the use of antibiotics for vaccine-preventable diseases, addressing two major challenges simultaneously. Spillover benefits to neighbouring farms were also noted. Furthermore, implementing effective biosecurity measures requires a dedicated allocation of funds.

The success of vaccination strategies and eradication programmes depends on several factors, including:

- availability of a sufficient number of veterinarians and para-veterinarians to provide adequate coverage across geographical areas;
- administration and logistics of vaccine delivery, including safe transportation and cold chain management;
- training and certification of animal health workers, which are critical to the success of vaccination programmes.

For the implementation process to be effective, it must be tailored to local solutions, including localized vaccine production for distribution in domestic markets and the promotion of local public–private partnerships.

Finally, the panellists emphasized that achieving adequate vaccine coverage requires up-to-date data on animal populations. Carefully planned vaccination strategies, followed by control and surveillance programmes, are essential, along with sound procurement policies.

In conclusion, major challenges remain in implementing vaccination programmes in many regions of the world. These include vaccine availability, transportation constraints, short shelf life and difficulty in reaching remote areas. The panellists agreed that overcoming these challenges will require coordinated global efforts.

CHAPTER 9

Sustainable solutions for animal health and climate resilience

9.1 ADVANCING CLIMATE-SMART LIVESTOCK NUTRITION TO ENHANCE ANIMAL HEALTH AND RESILIENCE, FARMER PROSPERITY AND FOOD SECURITY ACROSS THE INDIAN SUBCONTINENT

Miel Hostens, Associate Professor, Cornell University, United States of America



India has the largest bovine population in the world, with more than 300 million cattle and buffaloes managed by 80 million dairy-producing households, contributing 24 percent of global milk production. India accounts for 13 percent of the global cattle population and 58 percent of the global buffalo population. In comparison to the second leading dairy producer, the United States of America, India produces 35 percent more milk but has 97 percent more dairy animals. The Indian dairy sector relies on low- and medium-productive cattle and buffaloes, fed on locally available crop residues. Poor animal genetics, inadequate nutrition and suboptimal management contribute to low milk production efficiency, resulting in high methane emissions per unit of milk produced. Globally, FAO estimates that dairy production in India emits twice the methane per litre of milk as in Europe; in Africa, the figure is five times higher than in Europe.

In the face of climate change, India's livestock sector is challenged to meet growing demand for dairy, enhance the livelihoods of millions of farmers, and pursue sustainable intensification without increasing emissions of methane, a potent greenhouse gas and climate pollutant. Cornell University (McFadden Lab) leads an active research programme to improve milk production efficiency, enhance animal health and farmer income, and reduce methane

emissions from livestock in India. Current and planned activities include:

- Enhancing the adoption of advanced feeding practices, including diet formulation, to improve milk yield per animal, strengthen animal health, lower feed costs, increase farmer income and reduce methane emissions from livestock on smallholder farms.
- Developing a comprehensive database to define the chemical composition of livestock feed ingredients used across India. This effort will involve collecting approximately 10 000 feed samples for analysis in the United States of America. Initial partnerships include the Bharatiya Agro-Industries Foundation (BAIF), Hindustan Feeds and the National Dairy Research Institute in Karnal, focusing on Haryana and Maharashtra.
- Supporting the development of regional laboratories in India capable of performing nutrient analysis of local feeds. Initial work will focus on the National Dairy Development Board (NDDB) – Centre of Analysis and Learning in Livestock and Food (CALF) analytical laboratory.
- Advancing the development of the Cornell Net Carbohydrate and Protein System and/or the NDDB Ration Balancing Programme (RBP) model through controlled trials to define nutrient requirements for selected indigenous cattle, crossbreeds and buffaloes. Initial trials will be conducted with the National Dairy Research Institute at Karnal.
- Collaborating with UC Davis and Digital Green to develop a multilingual mobile application for diet formulation, and leading field studies in Maharashtra to demonstrate both the benefits of and barriers to the adoption of advanced feeding practices.
- Identifying methane-reducing feed additives suitable for smallholder dairy systems, including through controlled trials. This includes exploring Indian-sourced seaweeds in partnership with the National Institute of Oceanography, and collaboration with the International Maize and Wheat Improvement Center to develop a carbon credit model that quantifies on-farm methane reductions and provides financial incentives.

- Identifying locally adapted, low-methane-emitting, heat-tolerant and feed-efficient dairy cattle and buffaloes to inform national breeding and management strategies. Planned in collaboration with the Maharashtra Livestock Development Board and BAIF, these efforts will include characterizing the genetic population structure and diversity of 4 000 indigenous, exotic purebred and hybrid cross dairy cattle and water buffaloes across India's diverse ecosystems.

9.2 LIVESTOCK PRODUCTION IN A CHANGING CLIMATE: AN ILLUSTRATION OF CARIBBEAN RESILIENCE

Nneka Hull James, Animal Health Specialist, Caribbean Agricultural Health and Food Safety Agency, Suriname

The Caribbean is a geographically and sociopolitically unique region. Low-lying coastal areas, extensive coastlines, rising sea levels and increasing sea temperatures contribute to the region's vulnerability to climate change. These geographic challenges are compounded by isolated economies, limited resources and climate-sensitive industries. The region also displays great cultural diversity and varying levels of economic development among Caribbean Community Member Nations. Agriculture accounts for 10–25 percent of employment in the region.

The Caribbean is consistently exposed to climatic threats that impact the agricultural sector, including frequent and severe hurricanes, earthquakes, volcanic eruptions, extreme heat, drought, loss of biodiversity and habitat, and the emergence of new diseases and pests. Despite these vulnerabilities, the region has demonstrated resilience through adaptive responses to climatic shocks. Several climate-smart agricultural practices are employed across the Caribbean, such as intercropping pastures with legumes, slatted-floor housing for small ruminants, the use of sugarcane silage as tropical forage and vermicomposting to convert waste into growing media. Adaptation through breeding and genetics has also been prioritized to reduce the impacts of heat stress. For example, the Jamaica Hope cattle breed possesses desirable traits such as high heat and tick tolerance, enhanced fertility, strong conformation, efficient forage conversion and extended longevity (over five lactations in most herds). Similarly, the Barbados Black Belly sheep is well adapted to the tropical climate, with characteristics such as heat tolerance, high prolificacy, parasite and disease resistance, low maintenance and year-round production.

The eruption of La Soufrière volcano in Saint Vincent and the Grenadines from 2020–2021 marked a significant multicountry, multihazard event. Its effects extended beyond the borders of Saint Vincent and the Grenadines to neighbouring islands such as Barbados. The eruption

catalysed an impressive display of regional cooperation and resilience within the Caribbean veterinary community. Approximately three months of local planning preceded the event, including disaster plan reviews, staff training, increased animal identification, animal displacement planning, destocking and priority identification. This was followed by another three months of resource mobilization, the formation of a regional planning group focused on volcanic relief and multisectoral engagement. As a result, more than 70 national and regional organizations from various sectors mobilized rapidly to deliver targeted, large-scale support to the livestock sector in Saint Vincent and the Grenadines, addressing the most urgent needs of livestock and companion animals alike.

Since the eruption, the success of disaster response and recovery efforts in the region has been consistently underpinned by multisectoral and multidisciplinary collaboration, One Health leadership and strong public–private partnerships. These approaches have led to increased cross-sectoral conferences and the transition of government departments throughout the Caribbean towards the adoption of the One Health approach.

9.3 SUMMARY OF THE PANEL DISCUSSION

Nneka Hull James, Animal Health Specialist, Caribbean Agricultural Health and Food Safety Agency (CAHFSA), Suriname

Alka Upadhaya, Secretary, Department of Animal Husbandry and Dairying, India

Miel Hostens, Associate Professor, Cornell University, United States of America

Seyda Ozkan, Senior Scientist, Environment Defence Fund, United States of America



The panel explored the impact of animal health on GHG emissions with regard to current policy frameworks and the accounting of animal health interventions. FAO's 2022 report titled *The role of animal health in national climate commitments*, was referenced as laying the groundwork for a framework and outlining the challenges in integrating animal health into GHG emissions policies. Reportedly,

only a few countries refer to animal health in the context of mitigation or adaptation with mitigation co-benefits, and none quantify the impact of animal health on GHG emissions. To address the absence of a standardized methodology for calculating this impact, the Intergovernmental Panel on Climate Change (IPCC) guidelines are used. However, gaps in capacity, research and available data persist. The panel recommended adapting data management approaches using country-specific models that are tailored to the livestock sector. Indeed, many nationally determined contributions (NDCs) use generic models, such as those for energy systems, that are not suitable for assessing animal health impacts.

There was also a call to raise awareness among decision-makers and to establish clearer responsibilities for data collection and maintenance. National ministries of livestock should appoint climate change focal points and work closely with ministries of environment to better understand the influence of animal health interventions on GHG emissions.

The panel noted that while attention has been given to the link between animal health and climate change mitigation, less has been paid to the connection between animal health and adaptation or resilience. This is a sensitive issue, particularly in developing countries, where the livestock sector provides livelihoods for millions. Adaptation strategies, alongside mitigation, can play a significant role. Animal health is a proxy for better productivity. An example was shared from India, where policy changes favouring indigenous cattle with improved genetics are already yielding positive results.

Improved vaccination was cited as another contributor to productivity gains. To this end, tailor-made vaccination programmes are needed to address climate-induced vector-borne and zoonotic diseases.

Feeding practices must also adapt, incorporating zone-specific resilient crops. Studies show that improved feeding practices enhance immunity, reduce antimicrobial resistance, improve cow health and help address infertility.

The panel also emphasized the importance of hygiene in production systems. Clean milking practices, for instance, improve the quality of food products available for human consumption.

These strategies require continuous capacity building at the local level.

Scientific research is also advancing the use of ethno-veterinary medicines at the local level.

Circular economy principles were discussed as key to resilience. Well-designed policies could reduce enteric methane emissions by approximately 10 to 15 percent and improve nitrogen use efficiency. Additional elements of resilience include improving livestock housing, which has often been neglected, and introducing index-based insurance schemes to protect farmers' incomes in the face of production shocks.

Several innovative strategies to reduce GHG emissions while improving resilience in vulnerable food systems were explored. These included enteric fermentation mitigation, dietary modifications, feed additives such as essential oils, optimizing fibre ratios, precision nutrient management and methane capture. The use of high-quality forages also improves outcomes. Another strategy discussed was the use of biogas fermenters. In India, for example, the dairy sector is shifting from small biogas units to larger biofuel plants, converting manure into energy. A further benefit is the use of biofuel to power vehicles serving remote areas, creating new opportunities in rural transport systems.

The support of international organizations such as the World Bank and FAO was recognized as critical for achieving these goals.

The panel also considered whether improved animal health consistently results in both mitigation and adaptation benefits, and what trade-offs might arise. They stressed the importance of analysis at multiple levels, from the individual animal to the broader value chain.

The capacity to anticipate and prepare for emerging pathogens or shifts in disease seasonality linked to climate change can be strengthened through new technologies and improved data integration across laboratories. However, this will require significant investment. The DECIDE project, funded by the European Commission, was highlighted as an effort to consolidate data from multiple laboratories to forecast disease outbreaks. The need for more rapid global knowledge-sharing was emphasized, to enhance preparedness and response to outbreaks. Strengthened commitment from the agricultural sector is also necessary, as resistance to new technologies remains an obstacle in some communities. Even though these tools can be transformative, adoption may lag without strong engagement efforts.

Digital tools and mobile apps were presented as potential game-changers, particularly in low- and middle-income countries, provided they are user-friendly and offer guidance in local languages.

CHAPTER 10

Strengthening multistakeholder collaboration/public–private partnerships

10.1 STRENGTHENING MULTISTAKEHOLDER COLLABORATION. PUBLIC AND PRIVATE PARTNERSHIPS

Dustin Oedekoven, Chief Veterinarian, National Pork Board, United States of America



Innovation in animal health is a catalyst for improving sustainable global livestock production. With a growing human population, the demand for animal protein is rising rapidly, projected to increase by 20 percent by 2050. At the same time, urbanization is encroaching on wildlife habitats, reducing biodiversity and creating opportunities for novel pathogens to spread. Other global factors impacting animal health include international conflicts, expanding international travel and global trade. Addressing these challenges will require broad and sustained commitment from all stakeholders in livestock production to learn, improve and challenge the status quo.

Public–private partnerships provide opportunities to gain knowledge and enhance technology that can be shared, advanced or implemented where it is most needed. They also serve as platforms where voices from multiple sectors can collaborate without competition, creating opportunities for innovation to reach geographies and audiences that may otherwise be excluded. Such partnerships can catalyze future collaborations that might not emerge without cross-sector engagement.

The Swine Health Information Center (SHIC) is an example of this type of collaboration. Launched in 2015 with Pork Checkoff funding, SHIC works to protect and

enhance the health of the United States swine herd by minimizing the impact of emerging disease threats. It does so through preparedness, coordinated communications, global disease monitoring, analysis of swine health data and targeted research investments. SHIC operates through multistakeholder working groups, including the monitoring and analysis working group and the preparedness and response working group, which bring together government agencies, the private sector, on-farm veterinarians, the supply chain and academia. These actors collaborate to monitor risks, identify gaps, fund research to address those gaps and ensure the resulting knowledge is widely disseminated.

Each year, SHIC develops an action plan based on five strategic priorities: (1) improving swine health information; (2) monitoring and mitigating risks to swine health; (3) responding to emerging diseases; (4) enhancing surveillance and discovery of emerging diseases; and (5) refining swine disease matrices to prioritize research. For instance, SHIC issues regular disease fact sheets and monthly reports on diagnostic laboratory data to keep farmers and veterinarians informed of disease trends and emerging swine health concerns. In terms of preparedness, SHIC supports biosecurity and vaccine research, collects data through standardized outbreak investigations, and ensures rapid deployment of resources to address emerging challenges. This enables the SHIC to respond swiftly to high-morbidity events or unusual disease outbreaks, bolstering the sector's resilience.

While SHIC focuses primarily on the United States swine industry, the information it generates is relevant to a broader global audience and is available at the Swine Health Information Center website (SHIC, n.d).

In conclusion, the SHIC model illustrates how public–private partnerships can foster knowledge-sharing and innovation that reaches those most in need. It also provides a scalable framework that encourages and sustains future collaboration. Such partnerships are essential for addressing the growing risks in global livestock production, ensuring that progress in animal health management is inclusive, adaptable and responsive to the complex dynamics of an interconnected world.

10.2 PUBLIC–PRIVATE PARTNERSHIPS IN ANIMAL HEALTH AND ONE HEALTH FOR SUSTAINABLE LIVESTOCK TRANSFORMATION

María Sánchez Mainar, *Scientific Programme Manager, International Dairy Federation*

Public–private partnerships are essential in driving sustainable livestock transformation, particularly in the dairy sector. The International Dairy Federation plays a central role in advancing dairy animal health, quality and sustainability through collaboration with international organizations, including FAO, WHO, the World Organisation for Animal Health, Codex Alimentarius and others. The Federation represents stakeholders across the entire dairy value chain, including farmers, processors, government agencies, academia and unions. This inclusive platform promotes knowledge-sharing and the implementation of best practices, addressing the evolving needs of the sector through scientific innovation and collaboration. By working with over 1 200 experts across nine areas of expertise, the federation ensures that its scientific standards promote high-quality, safe and sustainable dairy production globally.

Research indicates that improved mastitis management enhances milk productivity while reducing environmental impacts. Furthermore, as outlined in the federation's *Guidelines for the Use and Interpretation of Bovine Milk somatic cell counts (SCC)*, SCC is not only a marker of milk quality but also a key factor in regulatory and economic decisions regarding milk pricing and herd management. Effective mastitis control, therefore, contributes to improvements in both milk quality and economic sustainability.

Udder health is a critical factor in promoting sustainability in dairy production systems. According to the federation, mastitis is “an inflammatory condition of the mammary gland, usually caused by infection, that leads to a reduction in milk production and alters its composition.” This disease, common in dairy cattle, has significant economic and environmental implications due to its effects on milk quality, yield and food waste. Somatic cell count in milk, a key indicator of udder health, is directly correlated with milk yield and quality. At the population level, milk production losses accumulate, affecting economic efficiency and increasing the carbon footprint of dairy farming.

Effective mastitis prevention is essential to improve animal welfare, reduce food waste and enhance the efficiency of dairy production. Lower SCC levels lead to better milk quality, extended shelf life and reduced food loss throughout the value chain. For example, milk with a low SCC can have a shelf life of up to 21 days, compared with only 14 days for milk with a higher SCC, which is more susceptible to spoilage and rancidity. Reducing mastitis-related problems significantly lowers the need for therapeutic antimicrobials, which in turn reduces the risk of antimicrobial

resistance. This aligns with global efforts to combat antimicrobial resistance and supports the long-term sustainability of dairy systems.

The federation collaborates extensively with key international organizations to improve udder health standards and practices. Through its work with Codex Alimentarius and the World Organisation for Animal Health, it has contributed to the development of global food safety standards that ensure high milk quality and consumer protection. In addition, the federation's joint work with ISO has led to more than 180 international standards for dairy-related analytical methods. These standards ensure consistency and quality in dairy products, including methodologies related to udder health, such as those for measuring SCC. Through its ongoing collaborations, the federation continues to promote a unified global approach to improving milk quality and addressing udder health challenges.

In conclusion, improving animal health, particularly udder health, through enhanced management practices is vital for achieving sustainable dairy production. Innovation and disease prevention, especially of mastitis, improve milk quality, reduce environmental impacts and strengthen economic outcomes for dairy producers.

10.3 SUMMARY OF THE PANEL DISCUSSION

Anne Mottet, *Lead Global Technical Specialist, Livestock, International Fund for Agricultural Development (IFAD), Italy*

Mathioro Fall, *Head of the Animal Health Protection Division of the Services Department, Ministry of Livestock and Animal Production, Senegal*

Nicolo Cinotti, *Secretary General, International Poultry Council (IPC), United States of America*

Dustin Oedekoven, *Chief Veterinarian, National Pork Board, United States of America*

María Sánchez Mainar, *Scientific Programme Manager, International Dairy Federation*



The panel focused on ways to strengthen multistakeholder collaboration and public–private partnerships by examining successful examples, alongside the associated risks and benefits.

Attention was given to the United Nations financing institution, IFAD, which works directly through PPPs and multistakeholder partnerships in the field of animal health. These efforts are mainly directed toward delivering investments to rural and smallholder farmers and pastoralists, with hundreds of projects explicitly targeting these groups. IFAD investments in animal health represent approximately 8 percent of the total project portfolio. These funds are primarily used to strengthen national veterinary services, support disease surveillance and control, and provide direct animal care.

This work translates into collaboration with both government and private veterinarians to build their capacity in two main areas:

- i. training and knowledge generation, such as delivering training directly to farmers and building capacity for private sector collection centres, also by mobilizing technical expertise from partners;
- ii. Provision of equipment, including vehicles, to reach smallholder farmers in remote areas.
- iii. Additional funds support ecosystem restoration and preservation, particularly in pastoralist systems, contributing to habitat protection from disease vectors and promoting the health of both humans and animals, following the One Health approach.

A question was raised regarding how PPPs operate from a governmental perspective. It was noted that a successful PPP example in Senegal dates back to 1997, when seven private veterinary companies were mandated by decree to conduct national vaccination campaigns. This initiative has been highly successful, with the number of companies involved increasing since its inception. Strong collaboration with the government has played a vital role in improving vaccination coverage.

Several barriers to PPP implementation were identified. One is the importance of establishing a shared multistakeholder approach from the outset, as a common starting point is essential to bring stakeholders together and make the partnership work. Language barriers also emerged as a significant challenge. For instance, a project in Kenya reported that there is no single term in the local language for “antimicrobial resistance,” posing a real obstacle to translating antimicrobial stewardship policies.

Other barriers include a lack of leadership within stakeholder groups, the need for clearly defined roles that align science across central and local levels, and issues with data comparability due to different metrics.

The topic of risk-sharing in PPPs was addressed from IFAD’s perspective. IFAD bears both the financial responsibility and the risk of investments. The organization supports improvements in the animal health sector through a combination of grants, including funding for proximity veterinary laboratories, and “matching” grants. These matching grants provide partial funding to private entities, such as private

veterinarians, who invest and risk their own resources. Challenges faced include limited data availability for vaccine tracing and disease surveillance, unclear responsibilities, and conflicting objectives among stakeholders, such as between epidemiologists and finance or trade sector actors.

Audience members raised further challenges facing PPPs in Africa. One key issue is the need to establish enabling environments with legal frameworks and investment responsibilities clearly assigned to the relevant ministries. Another concern is the limited presence of representative bodies for producers, farmers and pastoralists. The WOAHA is currently working to establish an African Forum for PPPs in the veterinary services domain. Additional collaboration with international organizations is encouraged to address environmental concerns, support the implementation of legal and regulatory frameworks, and build capacity across the private sector.

The organization of regional events to convene stakeholders was emphasized as a key mechanism in many countries for addressing challenges, establishing trust and promoting transparency, which are all essential for successful collaboration.

CHAPTER 11

Closing session

11.1 HIGHLIGHTS AND OUTCOMES OF THE CONFERENCE

Badi Besbes, Chief, Sustainable Animal Production, Feed and Genetics Group, Animal Production and Health Division, FAO



FAO's Chief Scientist inaugurated the conference, followed by a high-level panel that shared views on how improving animal health is essential for sustainable livestock transformation and for advancing One Health. To ensure all voices were heard, a questionnaire gathered the perspectives of Member Nations on key challenges and opportunities in animal health.

Over the course of the two and a half days of the conference, the following key messages were shared under the main themes:

1. Importance of improving animal health

- Animal health is crucial for livestock productivity, supporting livelihoods, ensuring food security and safeguarding public health, although awareness of its significance among the general public is often low.
- Strengthened veterinary services and national animal health systems are essential for building sustainable livestock systems. Better use of data is needed to optimize disease control interventions and demonstrate that the cost of inaction exceeds that of prevention.

2. Animal health innovation

- Multidisciplinary coordination among research institutes, academia and private companies is critical to bringing the latest technologies to end users. However, in low- and middle-income countries, funding often remains a major barrier.

- Innovation is key to advancing animal health, particularly through improved diagnostics and vaccine development.
- Digital tools to enhance data collection and application will be pivotal for surveillance and early warning.
- A shift in mindset is often required before new technologies and approaches are adopted.

3. Reference centres

- Reference centres play a vital role in global surveillance, capacity building and knowledge sharing.
- Networking among centres strengthens global surveillance, trust, transparency and data sharing are essential.
- Resource constraints, lack of political backing and legal implications under the Nagoya Protocol threaten this global public good.
- Regional support laboratories are a valuable resource and may serve as a pathway to establishing reference centres in underserved areas.

4. Vaccines

- New and improved vaccines, including multivalent formulations, are needed to combat animal diseases.
- The success of the FMD eradication programme in South America illustrates the value of vaccination with quality-assured vaccines and coordinated disease control.
- Vaccine quality, availability and affordability are critical.
- Ensuring vaccine supply requires addressing economic and regulatory conditions affecting production and distribution, as well as confronting social and behavioural barriers to vaccine uptake.
- Surveillance should be integrated with vaccination for informed vaccine selection, monitoring of effectiveness and demonstrating impact.
- "Last-mile services" are essential to vaccination campaigns and require sustainable resourcing. While vaccines are a critical prevention and control tool, they must be complemented by other measures, such as biosecurity.

5. Climate resilience

- Livestock contribute to and are affected by climate change.

- Improving animal health reduces GHG emissions per unit of product and strengthens system resilience.
- Safe, effective technologies are needed to reduce enteric methane emissions and improve smallholder dairy efficiency.
- More attention is required for the nexus between animal health and climate adaptation and resilience.

6. Multistakeholder collaboration and public–private partnerships

- Collaboration across producers, service providers, academia and policymakers is essential.
- Public–private partnerships are vital for addressing regulatory and investment barriers, bringing together diverse perspectives and accelerating progress.
- Challenges include communication gaps, building trust, defining leadership roles and ensuring science-based decision-making.
- International organizations such as FAO and WOAAH have a key role in supporting countries to initiate PPPs, including legal frameworks.

7. How will this inform the work of FAO on animal health?

- FAO will use its global reach and communication channels to raise awareness of the importance of animal health for sustainable livestock production and One Health. It will advocate for greater support to veterinary and laboratory services and for investment in new diagnostics, vaccines and innovative approaches.
- FAO will continue to produce scientific and technical evidence, including through global surveillance of high-impact animal diseases, to inform policy, investment and decision-making by countries and industry stakeholders. It will support the development of context-specific solutions for regional animal health challenges, including bottom-up co-created biosecurity responses.
- FAO will leverage its training and knowledge-sharing capacity to strengthen veterinary services, build regional laboratory capacity (especially in underserved regions), and support countries in developing systems for data collection, analysis and use. It will assist reference laboratories and others in establishing data-sharing agreements and navigating the legal implications of the Nagoya Protocol.

8. Working in partnership

- FAO will implement these actions through partnerships. Within the organization, staff in the Animal Production and Health Division at headquarters will collaborate with animal health officers in FAO's regional and subregional offices.

- FAO will work with competent authorities in Member Countries and coordinate with WOAAH, as well as with the United Nations Environment Programme (UNEP) and WHO under the One Health Quadripartite.
- FAO will also engage with the private sector, civil society, producer organizations, research bodies and academia.

11.2 INTERVENTIONS BY MEMBERS AND OTHER PARTICIPANTS

Following the conclusions by the Chair, Badi Besbes, Chief, Sustainable Animal Health Production, Feed and Genetics Group, Animal Production and Health Division, FAO, the moderator opened the floor for interventions by Member Nations, international organizations, private sector companies, civil society and academia.

WOAH

On behalf of the Director General of WOAAH, appreciation was extended to FAO, Director-General Dr QU Dongyu, and Assistant Director-General Thanawat Tiensin for the invitation to participate in the Global Conference on Animal Health Innovation, Reference Centres and Vaccines.

The WOAAH spokesperson congratulated all participants for the tremendous work carried out during the three intense days of discussions on this important topic. It was emphasized that the forum provided an occasion to advocate for and raise the visibility of animal health at a time when its significance is gaining international attention. The gathering of Member Nation representatives – including ministers, reference centres, laboratories, vaccine producers, researchers, international organizations and regional economic communities – created a unique opportunity to exchange perspectives on a wide range of shared concerns.

WOAH reaffirmed its commitment to supporting the dynamic environment created for collective action and collaboration, in line with its mandate and long-standing partnership with FAO. It also pledged to continue strengthening the link between the two organizations in the broader context of One Health and to prioritize the support of veterinary services, together with its partners.

Chng further emphasized the importance of enhancing collaboration by leveraging WOAAH's scientific network to strengthen global frameworks and ensure that scientific expertise is generated in currently underrepresented countries. This, in turn, would enable the development of locally adapted, context-specific solutions. The need for sustained investment in research, vaccine development and innovation – particularly digitalization and public–private partnerships – was also highlighted. Continued advocacy

with decision-makers, supported by joint efforts from international organizations, was deemed critical to progress.

African Union

Salih conveyed the appreciation of the African Union Commission for Agriculture, Rural Development, Blue Economy and Sustainable Environment. The participation of African ministers reflected the vital role that animal health and animal resources play in food security, nutrition and poverty reduction across the continent.

It was noted that the conference had already met one of its key objectives: fostering collaboration and networking at all levels. This platform allowed AU-IBAR and the African Union to engage with partners and communicate Africa's vision for animal health and development.

A specific emphasis was placed on the ambitious goal of eradicating PPR, building on the successful eradication of rinderpest. This effort, undertaken in collaboration with FAO, WOAHA and other partners, calls for full stakeholder engagement, including the private sector.

Zoetis

Stirling noted that the conference demonstrated the need for stronger private sector collaboration with all stakeholders, particularly through partnerships with FAO and the implementation of the 3Rs (replacement, reduction and refinement) in animal health, especially regarding vaccine batch release. Ensuring the consistent production and availability of safe, high-quality and effective vaccines was highlighted as a critical issue.

Zoetis underscored that lessons learned from established markets in Europe and the United States of America could be leveraged to foster greater collaboration with FAO and WOAHA. This would help extend advancements to low- and middle-income markets, supporting long-term sustainability in animal health systems.

JOVAC

Dayem, CEO of JOVAC, expressed gratitude for the opportunity to participate and to engage with such a distinguished panel of experts. While acknowledging the progress made, he emphasized that much work remains to be done. Vaccine producers, he stated, consider themselves core stakeholders and are fully committed to supporting FAO's strategy moving forward.

International Organization for Biological Standards

The academic representative stressed the need to address a broad range of challenges – from access and availability to application – and emphasized that the solutions developed must be both effective and viable in the market, ensuring long-term sustainability and practical use.

Uganda

On behalf of the Chief Veterinary Officers of Africa, Ademun thanked FAO for convening a multisectoral meeting that included the private sector, international organizations and other stakeholders. The conference provided valuable opportunities to engage with diverse representatives and gain new knowledge that participants intend to bring back to their countries. The aim is to implement successful practices and experiences to benefit farmers and improve rural livelihoods. Hope for continued opportunities to participate in similar forums was expressed.

Pakistan

Hussain Sanghi extended thanks to FAO for the invitation and recognized the conference's impact on shaping future strategies for sustainable livestock development. He pointed to countries such as Pakistan as having great potential in livestock farming, not only to meet domestic needs but also to export surplus food and livestock products.

While several issues were raised during the event, Sanghi advocated for pragmatic strategies tailored to the specific needs of individual countries, especially those facing challenges in exporting their surplus production. He emphasized livestock's crucial role as an economic driver, especially for low-income populations and for empowering women, who are instrumental in the sector. He also called on international partners to reallocate research funds toward support for research efforts in developing countries to accelerate progress.

Reference centres

Srinivas congratulated FAO for the success of the conference and underscored the importance of directing efforts toward strengthening regulatory systems in multiple countries. This, it was argued, would help build a solid foundation for animal health systems.

She emphasized FAO's key role in coordinating technical knowledge and enhancing the visibility of regional centres, particularly by facilitating communication through headquarters with regional and national offices. One proposed approach was the use of regular bulletins to inform regional offices and countries about the services and capacities of the various centres.

FAO's AMR Reference Centre initiative was cited as a model for how other centres might disseminate information and strengthen cross-regional awareness and collaboration.

Samia Metwally

Samia Metwally, Senior Animal Health Officer at FAO, thanked all participants, noting the conference had been a valuable opportunity to share insights and develop concrete solutions. She called on participants to maintain the momentum generated and continue working together.

While acknowledging that more progress is needed on vaccine quality, Metwally stressed the importance of reference centres expanding their support to additional countries. She urged that more countries be made aware of the centres' mandates and capabilities, and highlighted FAO's role in connecting countries with the resources they need.

She specifically praised the joint work of WOA and FAO on the FMD network, suggesting it could serve as a model for collaboration across other reference centres. She also recommended including regional support laboratories in such networks. Funding remains a challenge, she noted, but could be addressed through joint efforts to develop proposals that attract sustained donor support.

11.3 CLOSING REMARKS

Thanawat Tiensin, Assistant Director-General, Director of Animal Production and Health Division and Chief Veterinarian, FAO



Excellencies, distinguished colleagues, friends, speakers and partners, ladies and gentlemen,

As we come to the close of this important Global Conference on Animal Health Innovation, Reference Centres and Vaccines at FAO headquarters, I wish to extend my heartfelt gratitude to each of you for your active participation and invaluable contributions over the past three days.

This conference has demonstrated the power of collective action and shared knowledge. Together, we have explored the critical role of innovation, collaboration and global partnerships in advancing animal health systems.

Building on the foundation laid by the 2023 Global Conference on Sustainable Livestock Transformation, we have reaffirmed the vital importance of improving animal health for more efficient, inclusive, sustainable and resilient agrifood and livestock systems that contribute to food security, nutrition and livelihoods worldwide.

The discussions and insights shared have underscored the urgent need to address pressing challenges – including infectious diseases, emerging pathogens, climate change and antimicrobial resistance.

It is clear that to overcome these threats, we must leverage cutting-edge research, innovative tools and global networks – including the invaluable work of FAO's reference centres and other partners.

Your expertise and dedication are pivotal in advancing FAO's One Health in Agrifood Systems for Global Health and Food Security Framework, addressing transboundary animal diseases and zoonoses, tackling antimicrobial resistance, and protecting the health of animals, humans, plants and ecosystems.

Vaccination remains a cornerstone of our efforts. However, as we have seen, significant challenges persist in ensuring that affordable, safe and effective vaccines are accessible to all.

Public procurement of high-quality animal vaccines is essential for farmers and producers. It plays a key role in safeguarding animal health, ensuring food security and promoting sustainable livestock systems.

By facilitating access to affordable, effective and safe vaccines, public procurement helps prevent the spread of infectious diseases, reduces economic losses from livestock mortality, boosts productivity among farming communities and minimizes the need for antimicrobials on farms.

This conference has shed light on these challenges while also highlighting innovative vaccinology solutions that can help us move forward.

Equally important, we have spotlighted the energy and vision of youth. They will be the drivers of future progress in animal health, and it is vital that we continue to support and empower them.

As we look ahead, there are clear pathways for transforming animal health systems: improving access to quality health services, strengthening disease prevention, adopting technological advancements and scaling up One Health approaches.

Together, we can foster capacity development and collaboration across governments, the private sector and international organizations to achieve a sustainable agrifood and livestock transformation.

In closing, let me reaffirm FAO's commitment to working alongside all of you as we strive for better production, better nutrition, a better environment and a better life for all.

Thank you once again. I look forward to the impactful work that will emerge from this conference.

Safe travels, and until we meet again.

CHAPTER 12

Side events reports

12.1 CELEBRATING 20 YEARS OF SUPPORT BY THE EMERGENCY CENTRE FOR TRANSBOUNDARY ANIMAL DISEASES OF THE FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS TO TRANSFORM NATIONAL ANIMAL HEALTH SYSTEMS

The side event brought together representatives from Member Nations where FAO ECTAD projects are implemented, as well as those interested in establishing such projects, resource partners, and stakeholders to recognize the work done in emergency response to disease outbreaks, laboratory capacity development, strengthening animal health workforces, and developing relevant national policy and legislation.

The event opened with remarks from Thanawat Tiensin, Assistant Director-General and Director of the Animal Production and Health Division, and Chief Veterinary Officer at FAO. This was followed by a keynote address from Baba Soumare, FAO ECTAD Global Programme Coordinator, who highlighted the global impact of FAO's Animal Health Capacity Development Programme.

Presentations on achievements and success stories from the field were delivered by Mohamed Idriss Doumbouya, Chief Veterinary Officer at the Ministry of Livestock in Guinea; Getnet Mekonnen, Deputy Director at the Animal Health Institute in Ethiopia; Amira Abdelnabi, Risk Management Specialist at FAO ECTAD Egypt; and Imron Suandy, Director of Animal Health at the Ministry of Agriculture of Indonesia. A video showcasing FAO ECTAD's work was also presented.

A panel discussion followed, featuring Ambassador Fatimata Cheffou from the Embassy of the Republic of Niger in Italy, Imron Suandy from the Indonesian Ministry of Agriculture, and Maria Helena Semedo, Former Deputy Director-General of FAO. The discussion was followed by a question and answer session.

The event concluded with closing remarks from Rein Paulsen, Director of the Office of Emergencies and Resilience at FAO.

More than 150 participants attended in person, with an additional 100 joining online.

This year, FAO ECTAD celebrates 20 years of transforming national animal health systems in over 50 countries. A survey of participants showed that 94 percent rated the event as good/brilliant, with 100 percent of respondents indicating they had gained knowledge about FAO ECTAD.

12.2 INNOVATIONS TO REDUCE THE NEED FOR ANTIMICROBIALS: HOW CAN FARM-LEVEL INNOVATION REDUCE THE NEED FOR ANTIMICROBIALS TO ACHIEVE SUSTAINABLE AGRICULTURE TRANSFORMATION

On 25 April 2024, FAO and the Rongchang District co-hosted the International Symposium on RENOFARM in China, aimed at reducing AMU in agriculture. The event brought together 300 leaders from 35 countries and fostered global consensus on transforming agrifood systems to become more sustainable. This side event featured discussions on the "5 Goods" approach and highlighted the role of innovation, vaccines and reference centres in combating AMR and improving livestock management.

Moderated by Vincent Guyonnet, the opening session included remarks from key figures in sustainable agriculture. His Excellency Pathumwadee Imtour, Thailand's Permanent Representative to FAO, IFAD and WFP, reaffirmed Thailand's commitment to reducing AMU. Anna Rose Ademun Okurut of Uganda underscored the importance of veterinary diagnostics and livestock management in AMR control. Sun Zhongchao of the China Animal Health and Food Safety Alliance shared insights into China's veterinary public health efforts. Badi Besbes from FAO emphasized the critical role of sustainable animal production and genetics.

The first panel discussion focused on laboratories and policies shaping AMR solutions, with an emphasis on farm-level interventions. Francesca Martelli of the United Kingdom of Great Britain and Northern Ireland's Animal and Plant Health Agency presented how enhanced biosecurity contributed to a substantial reduction in antibiotic use in her country's poultry sector, including a 79 percent decrease in high-priority critically important antimicrobials (HP-CIA). Ge Liangpeng of the Chongqing Academy of Animal Sciences presented China's "5 G FARMS" initiative, which harnesses technological and genetic innovations in pig farming to minimize antimicrobial reliance.



The second panel, moderated by Junxia Song of FAO, explored corporate responsibility in antimicrobial reduction. Ke Xu of the Yili Group outlined the company's values and how they contribute to reducing antimicrobial use at the farm level. Feng Li of Yebio Bioengineering highlighted the critical role of vaccines in disease prevention and AMR reduction. Kitiya Vongkamajan-Aurand of Kasetsart University discussed bacteriophage therapy as a potential alternative to antimicrobials, while noting challenges related to safety, scalability and regulatory acceptance.



The event concluded with remarks by Thanawat Tiensin, Assistant Director-General of FAO, who emphasized the need for global cooperation in advancing One Health principles and promoting sustainable livestock practices. Discussions throughout the symposium underscored the importance of innovation, corporate accountability and policy-driven solutions in reducing antimicrobial dependence across agrifood systems.

The side event welcomed over 70 participants in person, with additional attendees joining via webcast through the conference webpage.

12.3 ROUNDTABLE OF YOUNG PROFESSIONALS IN THE ANIMAL HEALTH SECTOR – SHARING EXPERIENCES AND CHALLENGES



This roundtable event, held on 23 September 2024 as part of the FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines, provided a platform for young professionals to share their experiences, success stories and challenges in the animal health sector. Organized by the Global Youth Network on Sustainable Livestock Transformation and the World Food Forum (WFF), the event emphasized the critical role of youth in driving innovation.

The session followed a structured agenda, beginning with welcoming remarks by the moderator, Daniel Abreu, Incident Coordination Specialist at the Office of Emergencies and Resilience. He outlined the importance of youth engagement in addressing global animal health challenges.

A keynote address was delivered by Aimable Uwizeye, Livestock Policy Officer at the Animal Production and Health Division, who underscored the need for youth perspectives in shaping global animal health policies. This was followed by a presentation from Javier Garcia Bravo, Head of the World Food Forum Youth Assembly, who introduced the work of the Youth Assembly and its Innovation Lab.

The event featured a series of presentations from young professionals showcasing their innovative projects. George Lugonzo Odongo presented "VetGuard," a project aimed at improving veterinary service delivery. Nida Auliani shared her research on the use of palm waste as prebiotics to prevent avian influenza. Wang Yize discussed the effectiveness of pulse vaccination in controlling PPR, and Maria Luisa de la Puerta Gonzalez presented an ICT-enabled awareness campaign on avian influenza.

The second half of the session focused on challenges faced by young professionals in the field. Nafinatu Abdullahi, via prerecorded video, provided insights on how FAO could enhance support for youth in low-income countries. Nneka Hull James highlighted barriers to accessing decision-making platforms. Kosga Felix Djonwe discussed the resource constraints that limit opportunities for youth in the

sector, while Sabina Pokharel, also via prerecorded video, shed light on gender-related challenges, particularly those affecting young women in animal health.

The event concluded with closing reflections from the moderator, who emphasized the importance of maintaining active youth engagement in the future of animal health innovation.

Approximately 50 participants attended, including young professionals, students, researchers, attendees of the FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines and FAO colleagues. Speakers represented countries from Africa, Asia, Europe and the Caribbean, reflecting the global scope of the discussion.

12.4 ONE HEALTH APPROACH TO STRENGTHEN PANDEMIC PREVENTION AND PREPAREDNESS



The side event gathered participants interested and involved in One Health implementation to support sustainable animal health transformation and pandemic prevention, alongside leading scientists from the One Health research and implementation community. The objective was to provide valuable inputs to FAO's ongoing work on zoonoses management and pandemic prevention, and to integrate collective efforts from various partners and sources under the FAO Sustainable Livestock Transformation Framework and One Health in Agri-food Systems for Global Health and Food Security. This side event was co-organized by FAO (NSA), the IAEA's Zoonotic Disease Integrated Action (ZODIAC) and PREZODE.

The One Health approach is a core element of FAO's Strategic Framework, closely aligned with the four betters and the Sustainable Livestock Transformation Framework. These frameworks emphasize sustainable development and the protection of both animal and human health, underlining FAO's commitment to advancing pandemic prevention through a holistic and integrated approach. Leveraging its technical expertise, FAO actively supports countries in implementing One Health strategies and operationalizing the Pandemic Fund across diverse contexts to strengthen resilience against zoonotic diseases.

To optimize its support for One Health initiatives and harmonize efforts from various stakeholders, including

reference centres, FAO employs a comprehensive corporate framework. This framework guides actions in managing zoonoses and preventing pandemics within agrifood systems. By focusing on priority zoonoses and key operational areas, FAO aims to maximize the impact of its interventions and foster sustainable animal health transformation.

The side event brought together One Health stakeholders and experts to advance sustainable animal health and pandemic prevention, shaping FAO's work on zoonoses management and integrating efforts under its Sustainable Livestock Transformation Framework. The PREventing Zoonotic Disease Emergence (PREZODE) initiative collaborates with the Quadripartite Alliance and One Health High-Level Expert Panel (OHHLEP) experts to reduce zoonotic risks, enhance prevention, and support FAO's goals of global health security, food safety and resilience through One Health principles.

By bringing together diverse expertise, this event aspired to advance synergistic efforts, promote cross-sectoral collaboration and support the implementation of evidence-based strategies to safeguard human, animal and environmental health for a more secure future.

The agenda began with a welcome speech and an introduction to the objectives of the side event by Badi Besbes, Chief, Sustainable Animal Production, Feed and Genetics Branch (NSAP), FAO. This was followed by an overview of FAO's work on One Health for global health and food security by Zelalem Tadesse, Senior Animal Health Officer, One Health and Disease Control Branch (NSAH), FAO. Viskam Wijewardena from the Joint FAO/IAEA Centre (Nuclear Techniques in Food and Agriculture) (CJN) presented on the activities of ZODIAC related to zoonosis prevention, preparedness and response. Samuel Mills from the World Bank Pandemic Fund Secretariat delivered a presentation on The Pandemic Fund: Building Resilience for Effective Pandemic Prevention, Preparedness and Response. Linda Saif of Ohio State University provided an online presentation on the One Health approach to preparedness and prevention of RNA virus pandemics. The session concluded with closing remarks from Zeev Noga, Strategic Goals Lead at PREZODE.

The side event was attended by over 50 participants in person, with an additional 118 joining online from countries including Bangladesh, Benin, China, Congo, Ethiopia, France, Kenya, Morocco, Nepal, Pakistan, Papua New Guinea, Spain, Thailand, the United Kingdom of Great Britain and Northern Ireland, the United Republic of Tanzania and Tunisia.

Moderated by Julio Pinto (NSAH), from the FAO Geneva Office, the session opened with Badi Besbes emphasizing the One Health approach as integral to FAO's strategic framework for sustainable livestock transformation, addressing zoonotic diseases and antimicrobial resistance. FAO's collaboration on 12 Pandemic Fund projects was highlighted, particularly efforts to enhance surveillance and human resources in partnership with WHO, UNICEF and others.

Zelalem Tadesse discussed the integration of One Health into agrifood systems, focusing on early warning systems, zoonotic disease prevention and capacity building to enhance global health security. Viskam Wijewardena outlined ZODIAC's achievements in zoonotic disease detection using nuclear technologies, emphasizing capacity building, research and international cooperation.

Arnaud Bataille of CIRAD/PREZODE presented on PREZODE's efforts to strengthen pandemic prevention from local to global levels, including data sharing, research coordination and community-based surveillance. PREZODE's operational programme, PRACTS, was described as integrating early warning systems and science–policy dialogue, particularly in Africa and Asia.

Samuel Mills described the Pandemic Fund, launched by the G20 in 2022, as a mechanism to strengthen pandemic prevention, preparedness and response in low- and middle-income countries, with a focus on surveillance, laboratory capacity and workforce development, while supporting the One Health approach.

Alemayehu Mekonnen Anbessie shared Ethiopia's experience implementing a Pandemic Fund project through a One Health lens, emphasizing zoonotic disease management, AMR, and cross-sector capacity building. Umesh Dahal from Nepal highlighted his country's efforts to enhance preparedness through intersectoral coordination, surveillance and laboratory strengthening.

Linda Saif focused on preventing RNA virus pandemics using the One Health approach, calling for targeted surveillance and cooperation among veterinary, medical and environmental sectors to prevent spillover events.

The plenary discussion emphasized the importance of political commitment, strong coordination mechanisms and intersectoral collaboration. Ethiopia's experience addressing zoonotic disease outbreaks and Nepal's success in field epidemiology training for veterinarians were highlighted as strong examples of One Health implementation. PREZODE's role in uniting global efforts on zoonotic prevention was also recognized.

Challenges noted included delays in project implementation and duplication of efforts. Solutions suggested involved streamlining processes, initiating coordination committees early, and improving collaboration during proposal development. Field epidemiology training programmes supported by FAO and partners were also identified as key to strengthening One Health systems.

The side event had over 50 participants in person and 118 online attendees from countries such as Spain, the United Kingdom of Great Britain and Northern Ireland, France, Hong Kong, Bangladesh and multiple African nations.

12.5 ENSURING VACCINE QUALITY AND BOOSTING FARMERS' CONFIDENCE TO MITIGATE THE IMPACT OF ANIMAL DISEASES



Vaccination has proven to be one of the most effective methods for eradicating or eliminating infectious diseases in both humans and animals. In livestock, it serves as a powerful tool for disease control, notably reducing the burden of transboundary animal diseases, minimizing the use of antimicrobials and safeguarding livestock production. This significantly supports the livelihoods of millions of people in low- and middle-income countries. However, in many countries, vaccine production and distribution often fall short of adhering to good manufacturing practices and international quality standards. As a result, vaccine failures and disease outbreaks among vaccinated animals are frequently reported, undermining the confidence of veterinarians, farmers and the public.

The agenda of the side event included opening remarks by Beth Crawford from FAO, followed by a presentation on FAO's support for vaccines in response to emergencies by Bruno Minjauw. Samia Metwally from NSA/FAO then discussed vaccine registration, and Davide Blancato from CSLP/FAO spoke about FAO's vaccine procurement for members. Jacqueline Horsington from EuFMD/FAO presented on vaccine prequalification. A plenary discussion and question and answer session engaged both speakers and the audience, followed by conclusions and recommendations from Samia Metwally.

FAO has been supporting countries by providing vaccines during emergencies and for global control programmes. Over the years, FAO has assisted countries in purchasing vaccines. In the past three years alone, FAO has supplied approximately 132 million doses of emergency vaccines for priority TADs, valued at around USD 30.7 million. Key diseases addressed include FMD, PPR, sheep and goat pox, and lumpy skin disease.

FAO has initiated a process to register vaccines that meet international standards for safety, efficacy and quality and can be readily used in emergencies and routine vaccination programmes in Member Countries. This registration process

begins with an open call for manufacturers to submit complete dossiers through a Request for Expression of Interest (REOI) on the United Nations Global Marketplace (UNGM). The dossiers are evaluated by a panel of international experts, followed by a site visit to the vaccine production facility and quality control testing of the products. Manufacturers who do not meet the required standards are provided with recommendations and, if requested, with support for improvement.

This side event aimed to provide a platform to address the challenges in accessing quality vaccines and to develop solutions to bridge the confidence gap in vaccine use. Strengthening trust in vaccines ultimately enhances animal health, prevents disease outbreaks, and promotes sustainable livestock production and One Health implementation, while safeguarding human health and food security.

The panel discussion engaged the audience on key issues for improving the efficiency of vaccination and boosting farmers' confidence. It emphasized the importance of quality control during and after manufacturing, post-vaccination monitoring, and the proper management of the cold chain, distribution and delivery. Vaccine producers highlighted the need for improved coordination among manufacturers and a more reliable, streamlined process for licensing and registration.

Participants in the event included a diverse group of panellists and representatives from various organizations. Among the panellists was Anna Rose Ademun Okurut, Chief Veterinary Officer of Uganda. FAO partners included Aldo Dekker from Wageningen Bioveterinary Research (WUR), the Kingdom of the Netherlands, a FAO Reference Centre for FMD; Carolin Schumacher from GALVmed; and Michael Karl Schunk from the International Finance Corporation, World Bank Group. Vaccine manufacturers were represented by Panyi Zhou from the China Association of Veterinary Drugs and Farid Amraoui from Biopharma.

12.6 THIRTY YEARS OF EMERGENCY PREVENTION SYSTEM: IMPROVING FOOD SECURITY AND PROTECTING GLOBAL HEALTH

This side event celebrated 30 years of the Emergency Prevention System (EMPRES), highlighting its impact on global food security through the prevention and control of transboundary pests and diseases. Experts emphasized the importance of international collaboration, the One Health approach, and the application of advanced technologies to strengthen early warning systems, biosecurity, and proactive disease prevention in support of a sustainable future.

On 25 September 2024, FAO hosted a commemorative event titled Thirty Years of EMPRES – Towards a Sustainable Future: Leading the Fight Against Transboundary Pests and Diseases, as part of the FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines.

The event recognized the critical role of the EMPRES in safeguarding global food security by controlling and preventing the spread of transboundary threats across the animal, plant, aquaculture, forestry and food safety sectors.

The event began with welcome remarks by Yurdi Yasmi, Officer-in-Charge, Director of the Plant Production and Protection Division (NSP), and Paul Welcher, Agricultural Attaché and Alternate Permanent Representative of the United States of America Mission to the United Nations Agencies in Rome. A video presentation followed, commemorating 30 years of EMPRES and highlighting the programme's key achievements through testimonials.

A panel discussion featured contributions from Abhijit Mitra, Chief Veterinary Officer and Animal Husbandry Commissioner, Ministry of Fisheries, Animal Husbandry and Dairying, India; Huyam Salih, Director of the African Union – Inter-African Bureau for Animal Resources; Keith Cressman, Senior Locust Forecasting Consultant, NSP; Mark Rweyemamu, Executive Director, SACIDS Foundation for One Health; and Mona Chaya, Special Adviser, FAO Chief Scientist Office.

Madhur Dhingra, Senior Animal Health Officer, NSA, presented FAO's future vision for EMPRES. A question and answer session followed, during which participants engaged with the panellists. The event concluded with closing remarks by Madhur Dhingra.

The side event was attended in person by more than 75 participants, with additional attendees joining virtually via the FAO webcast. The event was moderated by Juan Lubroth, former FAO Chief Veterinary Officer.

Opening remarks by Yurdi Yasmi emphasized EMPRES's contributions to building early warning systems, strengthening rapid response mechanisms and enhancing capacity development. Paul Welcher underscored the importance of international collaboration to combat pests and diseases that jeopardize food security, public health and economies.

A video segment showcased milestone achievements of EMPRES, including the eradication of rinderpest in 2011, efforts in desert locust control and the development of early warning systems for zoonotic diseases such as H5N1 avian influenza.

During the panel discussion, Abhijit Mitra highlighted India's achievements in managing transboundary animal diseases such as foot-and-mouth disease, peste des petits ruminants and avian influenza through global cooperation and coordinated vaccination campaigns. Huyam Salih addressed the ongoing challenges of disease surveillance in Africa and called for increased investment in monitoring and capacity development.

Mark Rweyemamu stressed the need to integrate animal, human and environmental health to prevent disease outbreaks through a One Health approach. Keith Cressman illustrated how technological innovations, including the use of satellite imagery and drones, have significantly improved

locust early warning systems. Mona Chaya reinforced the importance of continued investment and collaboration to position EMPRES as a pillar of sustainable agrifood systems.

In her closing presentation, Madhur Dhingra outlined the future vision for EMPRES: scaling up One Health implementation, leveraging advanced technologies such as predictive analytics and artificial intelligence to enhance risk forecasting and improve early intervention. She noted that the next phase of EMPRES will focus on bolstering biosecurity measures,

strengthening early warning systems and enhancing global coordination for inclusive and proactive disease prevention.

As EMPRES marks three decades of impact, it continues to serve as a cornerstone in the fight against transboundary pests and diseases. By expanding the reach of One Health, fostering stronger partnerships and embracing cutting-edge technologies, EMPRES is well-positioned to lead the charge toward a more resilient and sustainable future for agricultural health and global food security.

CHAPTER 13

Exhibition report: twelve success stories of sustainable livestock transformation

The exhibition in the FAO atrium (FAO, n.d) featured 24 fixed stations showcasing materials from reference centres, FAO decentralized offices and external institutions. It served as a platform for networking and knowledge exchange among participants.

A large screen alternated between the main conference programme, success stories from FAO decentralized offices, the schedule of side events and thematic videos. These videos highlighted key issues such as animal health, sustainable livestock practices, climate change and One Health approaches.

A total of 20 exhibition booths presented a diverse array of organizations, including international institutions, research centres, private companies and other key stakeholders. These booths offered attendees valuable insights into current initiatives, innovations and collaborations shaping the field.

The Animal Production and Health Laboratory at the Joint FAO/IAEA Centre (APHL-CJN) featured prominently, displaying a wide selection of publications covering diagnostic techniques, vaccine development, animal production and genetics, and novel approaches to disease management in livestock. All materials could be accessed digitally through a QR code displayed at the booth.

FAO was represented through the Joint FAO/IAEA Centre (CJN), the Regional Office for Africa, the Regional Office for Europe and Central Asia, and the Office of Emergencies and Resilience (OER). Three reference centres also participated: Istituto Zooprofilattico Sperimentale dell’Abruzzo e del Molise “G. Caporale” (IZS Teramo), Istituto Zooprofilattico Sperimentale del Lazio e della Toscana (IZSLT), and Kansas State University.

Ten companies took part in the exhibition: MSD, STAR-IDAZ, Health for Animals, MCI SA, GALVmed, Biopharma, Univercells, JOVAC and two CVDA booths.

Additional initiatives featured included the Rabies programme, the International Year of Camelids 2024, and the European Commission for the Control of Foot-and-Mouth Disease (EuFMD).

These booths acted as dynamic hubs for knowledge exchange, fostering networking and collaboration. Attendees had the opportunity to explore the exhibition area and engage with experts on the latest developments and opportunities in animal health and sustainable livestock production.



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FAO ANIMAL PRODUCTION AND HEALTH PROCEEDINGS

1. Protein sources for the animal feed industry, 2004 (En)
2. Expert Consultation on Community-based Veterinary Public Health Systems, 2004 (En)
3. Towards sustainable CBPP control programmes for Africa, 2004 (En)
4. The dynamics of sanitary and technical requirements assisting the poor to cope, 2005 (En)
5. Lait de chamelle pour l'Afrique, 2005 (Fr^e)
6. A farm-to-table approach for emerging and developed dairy countries, 2005 (En)
7. Capacity building, for surveillance and control of zoonotic diseases, 2006 (En)
8. CBPP control: antibiotics to the rescue?, 2007 (En)
9. Poultry in the 21st century – Avian influenza and beyond, 2008 (En)
10. *Brucella melitensis* in Eurasia and the Middle East, 2010 (En^e)
11. Successes and failures with animal nutrition practices and technologies in developing countries, 2011 (En)
12. Rift Valley fever vaccine development, progress and constraints, 2011 (En)
13. Influenza and other emerging zoonotic diseases at the human-animal interface, 2011 (En, Ar)
14. Challenges of animal health information systems and surveillance for animal diseases and zoonoses, 2011 (En, Zh)
15. Lessons learned from the eradication of rinderpest for controlling other transboundary animal diseases, 2012 (En^e)
16. Optimization of feed use efficiency in ruminant production systems, 2013 (En^e)
17. Declaration of global freedom from rinderpest, 2013 (En^e)
18. Developing a stepwise approach for rabies prevention and control, 2013 (En)
19. CBPP Round table: Can CBPP be eradicated?, 2016 (En)
20. Africa Sustainable Livestock 2050, 2019 (En)
21. Proceedings of the FAO Global Conference on Sustainable Livestock Transformation, 2024 (En)
22. FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines, 2025 (En)

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This volume presents the proceedings of the *FAO Global Conference on Animal Health Innovation, Reference Centres and Vaccines*, which was held at FAO headquarters in Rome from 23 to 25 September 2024. The conference was attended by over 400 participants – including delegates from 66 FAO Member Nations, chief veterinary officers, representatives of international organizations, FAO reference centres, vaccine manufacturers, as well as researchers and young professionals – to address urgent challenges in animal health and chart a path toward sustainable animal health transformation.

Structured around nine thematic sessions, the proceedings capture a wide range of technical and policy discussions on topics such as innovations in veterinary vaccinology and diagnostics; the evolving role of FAO reference centres and regional support laboratories; the application of the One Health approach; and strategies for improving preparedness, surveillance and multistakeholder collaboration. It includes summaries of high-level plenary sessions, panel discussions and ministerial segments, as well as dedicated chapters on six side events and a curated exhibition showcasing 12 global success stories in sustainable livestock practices.

The proceedings offer a detailed and accessible record of the conference's content, including keynote speeches, country interventions, technical presentations and expert reflections. Together, these materials provide an essential reference for decision-makers, practitioners, academics, and development partners seeking to strengthen animal health systems in alignment with FAO's vision for *better production, better nutrition, a better environment and a better life*.

As both a technical resource and a strategic roadmap, this publication reflects FAO's commitment to advancing global cooperation in animal health – supporting inclusive, resilient and sustainable livestock systems that contribute to food security, rural development and One Health outcomes worldwide.

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