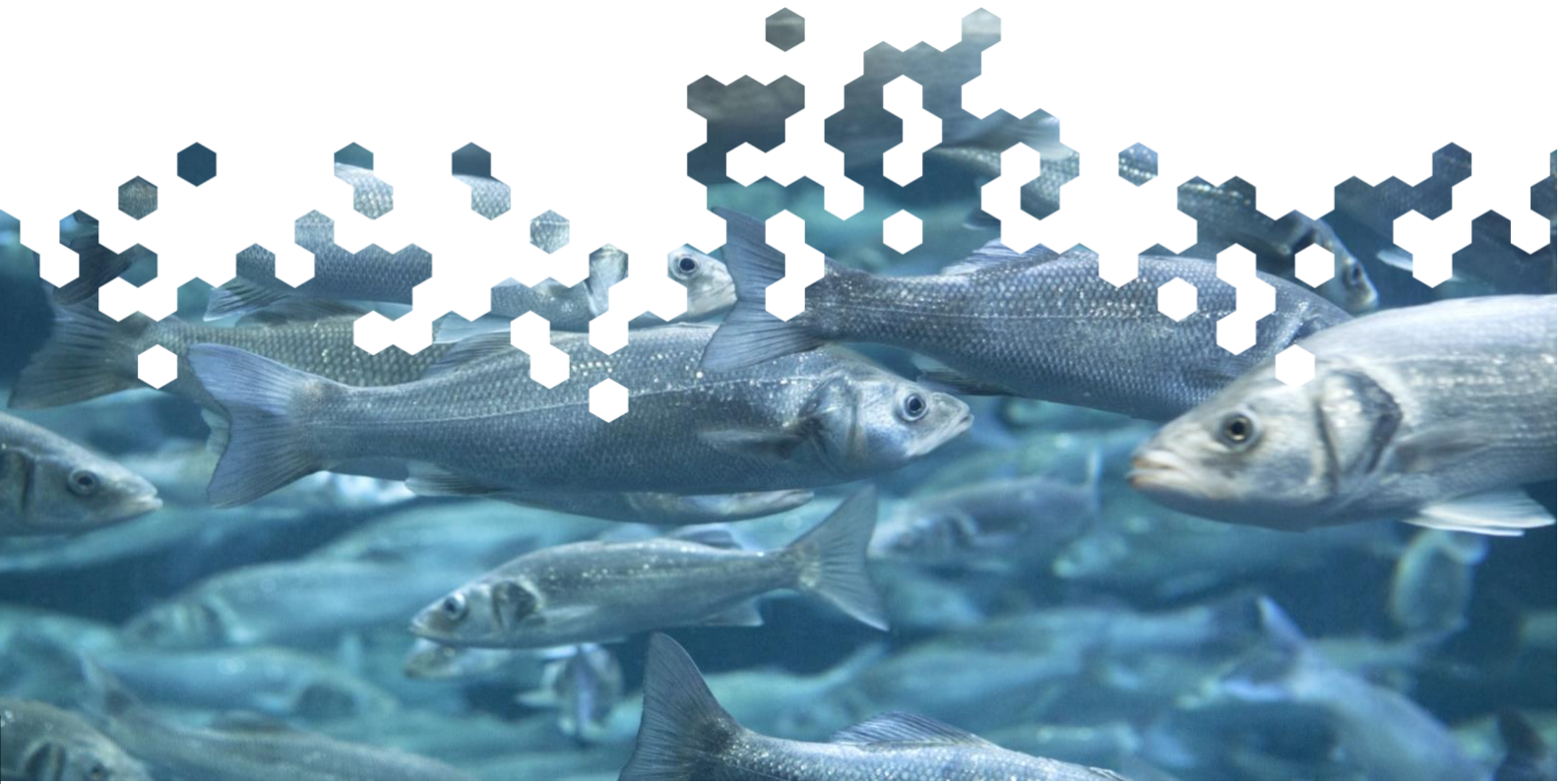
Advancing Aquaculture Health Research

Workshop Report
20-21 February 2025

Report of the workshop to identify the highest-priority research areas for finfish diseases

20-21 February 2025
WOAH HQ, Paris



World Organisation for Animal Health

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The findings and conclusions in this report are those of the contributors, who are responsible for the contents, and do not necessarily represent the views of WOAH or STAR IDAZ IRC or any of the sponsors.

Organised by:

World Organisation for Animal Health

In collaboration with:

STAR IDAZ International Research Consortium on Animal Health

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IDRC · CRDI International Development Research Centre Centre de recherches pour le développement international
Canada

Australian Government Department of Agriculture, Fisheries and Forestry

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GAMRIF Global AMR Innovation Fund

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Advancing Aquaculture Health Research:

Background

Aquatic animal production is rapidly evolving, yet much remains unknown about aquatic animal disease. Research is key to the advancement of knowledge that will benefit aquatic animal health and progress aquatic animal disease prevention and control.

The Advancing Aquaculture Health Research: Workshop to Identify the Highest Priority Research Areas for Finfish Health workshop addressed Activity 4.5 of the WOAH Aquatic Animal Health Strategy, bringing together researchers and funders to identify priority areas for research that will enhance global aquatic animal disease management, especially in ways that influence international standards. It was held 20-21 February 2025 at WOAH Headquarters, back-to-back with the Aquatic Animal Health Standards Commission meeting (12-19 February 2025) to enhance cost-effectiveness and ensure Commission members could participate.

Co-organized by WOAH and STAR-IDAZ IRC, the workshop aimed to engage researchers, funders and industry representatives to help translate identified research priorities into actionable results. This will foster partnerships, an interdisciplinary approach, and long-term planning in the aquatic animal health sector, while aligning research gaps with funding opportunities.

The World Organization for Animal Health (WOAH) has been working on aquatic animal health for over 50 years to address diseases of fish, amphibians, crustaceans and molluscs, and welfare of farmed fish.

The Aquatic Animal Health Code and Manual provide standards for the improvement of aquatic animal health and welfare of farmed fish worldwide, including the prevention of disease spread through safe international trade of aquatic animals and aquatic animal products.

The STAR IDAZ International Research Consortium (IRC) is a global initiative to address the coordination of research programmes at an international level in the area of animal health and in particular infectious animal diseases including zoonoses.

STAR IDAZ is a network of funders and programme owners for research, with partners capable of moving +$2.5B research investment. Aquaculture is a new research priority area for STAR IDAZ IRC.

Report of the workshop

The workshop on Advancing Aquaculture Health Research was held at the WOAH Headquarters in Paris, France, on 20-21 February 2025. The event aimed to identify the highest priority research areas for finfish health that will enhance global aquatic disease management, especially in ways that influence international standards. It brought together experts from various fields to discuss challenges, opportunities, and strategies for advancing research in critical areas for finfish.

The workshop commenced with a welcome and introduction by Gregorio Torres, Head of the Science Department at WOAH. Emmanuelle Soubeyran, WOAH Director General, provided the opening speech, highlighting the importance of international collaboration in aquatic animal health research. Next, Montserrat Arroyo, WOAH Deputy Director General, introduced the WOAH Aquatic Animal Health Strategy and Valeria Mariano, research coordinator for the STAR IDAZ Secretariat, provided an overview on STAR IDAZ, the International Research Consortium (IRC) on Animal Health.

Session 1: Challenges in aquatic animal health

Chaired by Larry Hammell, this session focused on key challenges in finfish health. Key experts from WOAH Reference Laboratories and beyond provided their perspectives on data challenges in aquaculture, environmental drivers of disease emergence, fish welfare, antimicrobial resistance (AMR), One Health (the interconnectedness of human, animal and environmental health) and biosecurity (see Annex I: Agenda and Annex II: Abstract of presentations). In addition, an overview of the pre-workshop global consultation on research priorities for the overall aquaculture sector was presented (see **Annex IV: Analysis of pre-workshop survey**).

Session 2: Overview of regional and global research networks

Nelly Isyagi chaired session 2, which showcased existing global and regional research efforts. WorldFish, International Development Research Centre (IDRC), European Partnership on Animal Health and Welfare and the Gates Foundation showcased their aquaculture research programmes and how those research programmes were developed.

Session 3,4 & 5: Challenges, opportunities and identification of research priorities

The subsequent three sessions were dedicated to World Café workshops to identify the research priority areas, both short-term and long-term, for the main finfish production species. Before the workshop, an introduction was provided by the chairs including presentations of the survey results for each session, and in-depth presentations on some challenges and opportunities were provided by Saraya Tavornpanich, Hong Liu and Carlos Leal for each of the following sessions:

- **Session 3: Epidemiology and control strategies research needs**- Chair Edgar Brun
- **Session 4: Diagnostic research needs** - Chair Nick Moody
- **Session 5: Vaccines and therapeutics research needs-** Chair Ha Thanh Dong

Session 6: Panel discussion on the way forward

The final session, chaired by Montserrat Arroyo, engaged the World Aquatic Veterinary Medical Association (WAVMA) and several research funders and aquaculture research programme owners in a discussion on advancing finfish health research. The panel explored pathways for enhanced collaboration and investment in

sustainable aquatic health solutions. Zoetis emphasized their work on vaccine development, while IDRC found the workshop instrumental in refining their funding strategies. GALVmed reported an interest for future programme planning. Participants discussed the need for public-private partnerships (PPPs) focused on research, addressing policy blockages, such as the Nagoya Protocol and intellectual property rights. The session underscored the challenges in translating academic research into marketable products due to high costs and lack of standardization on proof of concept and product target profiles among academia and industry. The elaboration of capacity-building tools to align definitions and streamline public-private research activities might help address these issues. In addition, the session highlighted the importance of networks for disseminating information and standardizing practices. The session concluded with a call for new funding models to support long-term research for product development.

Method for the identification of research priorities

Using three World Café sessions, participants engaged in interactive exchanges to refine the key research areas where advancements are most needed. The discussions built upon insights gathered from a global survey, ensuring that the priorities reflected a broad and representative consultation with experts worldwide. The pre-workshop online global consultation was launched in January 2025 inviting 440 experts from 187 countries (response rate 43%) to share ideas on research priorities for the sectors: finfish, molluscs, crustaceans and amphibians. The consultation achieved good representation from different regions, ensuring a diverse and globally balanced set of perspectives.

The results on finfish of the survey (see Annex IV: Analysis of pre-workshop survey) provided an input for discussion among more than 40 international experts (see List of Participants) selected by a Scientific Committee to participate in the workshop. Experts looked collaboratively at the challenges of the sector and integrated their knowledge to identify transformative solutions needed to overcome the obstacles ahead.

Identified research priorities

Epidemiology and control strategy research priorities

The session on epidemiology and control strategies mapped out the most impactful diseases affecting salmonids, tilapia, carp, catfish, and other species in both freshwater and saltwater environments. Among the disease-causing agents highlighted were viruses such as: tilapia lake virus (TiLV), infectious salmon anaemia virus (ISAV), viral haemorrhagic septicemia virus (VHSV), infectious haematopoietic necrosis virus (IHNV), koi herpesvirus (KHV), betanodaviruses, megalocytivirus; bacteria including *Lactococcus garvieae*, *Edwardisella* spp., *Aereomonas* spp., *Streptococcus* spp., and intracellular bacteria *Piscirickettsia salmonis*; and parasites like salmon sea lice. The discussions reinforced the necessity for holistic approaches to disease prevention and management in aquaculture, exemplified by increasing occurrence of multifactorial production diseases/syndromes (e.g. skin and gill disease syndromes).

The key priority areas for research identified include the validation of diagnostic tools and standards for conventional tests and for new non-invasive cost-effective tests like rapid test kits, biomarkers and environmental nucleic acid (eNA) applicable for different production systems. Enhancing tools for improving early disease detection and surveillance, particularly for border inspection/control and transboundary diseases threatening global trade remain essential. Artificial Intelligence (AI) has great potential for innovation in product development. The effect of sample pooling is an area that needs more investigation.

Understanding host-pathogen-environment interactions is critical to advancing disease control strategies, sustainability and the One Health aspects of aquaculture. Necessary research includes epidemiological studies on disease transmission dynamics and spread, environmental pathobiome dynamics, pathogen survival, and disinfectant efficacy. Moreover, susceptibility studies in farmed and wild species are lacking across pathogens and production systems. This knowledge is essential to support general biological and cost-effective biosecurity measures including zoning, or decontamination/ fallowing strategies following outbreaks.

Biosecurity also includes the use of vaccines, and strengthening the availability of locally produced vaccines at low cost is important. This will positively affect disease control and the reduction of antimicrobial use (AMU)/risk of AMR. Biosecurity optimization and region-specific interventions emerged as a cross-cutting priority, particularly for low-value species, young not yet immunocompetent fish, local production, water contamination, and water management systems where resources for disease control are often limited.

Additional discussions centered on improving disease resistance through genetic breeding programmes.

Sharing of data, compliance with the FAIR principles (findability, accessibility, interoperability, and reusability), accessible phylogenetic data, biobanks and AI were underscored as ways to enhance collaboration, improve data quality and management, strengthen risk assessments and decision-making on trade of fish and their products. For policy, participants stressed the importance of socio-economic studies and increased public-private partnerships (PPPs) for sustainable disease control including use of technical tools like remote sensing and geographic information systems (GIS). Prioritizing research needs to support decision making in the face of a climate-driven changing environment.

Diagnostic research priorities

The session on diagnostic research needs discussed and refined the key priorities for improving disease detection and surveillance for disease management in aquaculture. Building on input from the global consultation, participants identified key shortcomings in diagnostic capabilities and stressed the need for improved clinical history records, sampling methods, technology development, validation frameworks, and meaningful interpretation of diagnostic results. A key focus was placed on the main diseases requiring better diagnostics, ensuring that future research efforts align with the most pressing challenges in the field.

Echoing and expanding the list of priority diseases covered under Epidemiology and control, the following specific pathogens requiring improved confirmatory molecular diagnostic methods, and improved culture techniques were listed:

- Viral pathogens: Tilapia lake virus (TiLV), rhabdoviruses (VHSV/IHNV), megalocytiviruses and betanodaviruses (VNNV) with a focus on the testing of non-invasive sampling methods
- Bacterial diseases: *Streptococcus* spp. and *Lactococcus* spp., *Piscirickettsia salmonis* (SRS), *Renibacterium salmoninarum* (BKD), *Francisella* spp., *Flavobacterium* spp., and *Tenacibaculum maritimum, Moritella viscosa* with a focus on the development, validation and implementation of schemes for surveillance and screening tests
- Fungal diseases: Focus on the growing need for diagnostics tools for fungal and parasitic diseases was also emphasized.

A major priority emerging from the discussion was the standardization of environmental nucleic acids (eNA) protocols, ensuring that molecular diagnostic tools can reliably link environmental data with actual infections. Participants also called for advancing AI-powered tools for diagnostics, including the development of mobile applications for field disease recognition and AI-assisted histopathology analysis, which could revolutionize how diseases are identified and managed.

Another crucial area of focus was optimizing sampling protocols, ensuring that non-lethal and non-invasive techniques can be used, particularly for valuable broodstock populations and schemes for surveillance of apparently healthy populations. The workshop stressed the importance of improving sample transportation from the field to laboratories and the challenges posed by international frameworks such as the Nagoya Protocol for genetic resource sharing.

The development of point-of-care tests was also highlighted as an urgent need, particularly for low-cost, field-deployable diagnostics that could empower farmers and veterinarians to conduct rapid disease detection. Participants also stressed the need to validate highly specific and sensitive screening tests, including those for AMR, ensuring their reliability across different testing environments.

In addition to test development, participants recognized the importance of biobanks to facilitate access to reference isolates, antibody sequences, and positive diagnostic samples, which are essential for validating new diagnostic tools.
Further discussions underscored the need for multiplex diagnostic tests, capable of detecting multiple pathogens in a single assay, which would enhance high-throughput disease surveillance. AI-assisted histopathology, next-generation sequencing (NGS) and MALDI-TOF mass spectrometry were identified as promising technologies that could significantly improve diagnostic accuracy, particularly in cases of unexplained mortality events.

The session concluded with an emphasis on technology transfer, reagent sharing, and strengthening diagnostic networks to ensure that new diagnostic tools are widely accessible.

Vaccine research priorities

The workshop on vaccine research needs, again drawing on insights from the pre-workshop global consultation, facilitated a dynamic discussion on pressing gaps and future directions for vaccine development in aquaculture. Participants mapped vaccine needs across different aquatic production systems, identifying key pathogens affecting salmonids, tilapia, carp, catfish, and other species in both freshwater and saltwater environments. The diseases highlighted intracellular bacterial infections such as *P. salmonis* (SRS), *R. salmoninarum* (BKD) and *Francisella* spp., as well as other bacteria: *Streptococcus* spp., *Lactococcus* spp., *Aeromonas* spp., *Edwardsiella* spp., and *Vibrio* spp., further expanding the list of pathogens of interest as drawn up in the workshops on epidemiology and control and diagnostics. Amongst viral threats the most important were: TiLV, *megolocytivirus Pagrus* 1 virus, VHSV/IHN, and betanodaviruses.

One of the most urgent research priorities identified was the optimization of vaccine delivery systems, particularly for enhancing mucosal immune responses. Methods, such as oral administration, immersion strategies, and slow-release adjuvants, were considered essential to improving vaccine uptake. There was also consensus on the need to accelerate vaccine development through platform technologies, enabling faster production and licensing for emerging threats.
Beyond technical advancements, participants emphasized social and cost-benefit studies to improve vaccine adoption among end-users, recognizing it depends on efficacy, economic feasibility, and farmer perceptions. Additionally, there was a call for standardized frameworks for testing, production, and use of autologous vaccines, ensuring their quality and effectiveness. Complementing these efforts, researchers highlighted the need for alternative methods to assess vaccine efficacy and effectiveness, such as mathematical models (e.g. infectious disease transmission modelling like the susceptible-infectious-recovered (SIR) model) and serological tests, which could provide valuable insights beyond traditional challenge trials.

Further discussions focused on improving knowledge of fish immune responses, which is essential for designing effective interventions. The workshop also underscored the importance of challenge models, cost-benefit analyses, particularly in the development of multivalent vaccines and strategies to reduce vaccine production costs, ensuring broader accessibility, especially in low- and middle-income countries (LMICs).

A major point raised was the necessity of global/regional approaches to vaccine research, linking with public-private partnerships (PPPs) to drive innovation in vaccine development and production. Financial and market hurdles to engage in vaccine development and application in species different from Atlantic salmon were evidenced by many participants. Finally, participants stressed the need to optimize field trials to provide strong, evidence-based validation of vaccine efficacy under real-world aquaculture conditions, where diseases are often multifactorial.

The discussions reaffirmed that developing effective and accessible vaccines for aquaculture requires a multifaceted approach, combining technological innovation, regulatory frameworks, economic considerations, and social engagement.

Therapeutics research priorities

Like the other workshops, the workshop on therapeutic research needs provided a platform for in-depth discussions building on insights of the pre-workshop survey. One of the most pressing research needs in aquatic animal health was the development of alternatives to antimicrobials and innovative methods to identify new compounds for treatment, including through mathematical modeling, AI, and other innovative approaches.

Participants also emphasized the importance of treatments to standardize water environmental conditions to mitigate the impact of the pathobiome, recognizing that disease management must go beyond animal treatment and consider broader ecological factors. The need for research into antimicrobial compounds not used in human medicine — including those already applied in other food animal sectors — was also highlighted as a possible avenue to address AMR concerns while maintaining treatment efficacy.

The workshop further underscored the need for greater research into alternative disease management strategies, such as heat treatments, feed supplements, and phytomedicines, which could reduce reliance on antimicrobials. Another crucial aspect was the development of preventive products, particularly probiotics and immunostimulants, as a means of enhancing fish immunity and resilience against disease.

Beyond these top priorities, participants recognized the potential of phage therapy, and the need for targeted biosecurity plans adapted to different aquaculture industries. There was also a strong call for research into farmer knowledge, attitudes, and practices to ensure that interventions are effectively tailored to the realities of diverse production environments.

The workshop's findings reinforced the need for multidisciplinary collaboration to drive progress in aquatic animal health. By identifying these research priorities, the discussions laid a strong foundation for future innovations in therapeutic development, ultimately supporting the long-term sustainability of global aquaculture.

Cross-cutting issues to enhance research and innovation

Investing in research is investing in the future capacity of the sector to manage aquatic animal health, and the food security and livelihoods that are underpinned by it. For research to be effective and transformative, innovations need to arrive in the field. For this reason additional cross-cutting issues need to be tackled such as: capacity building, infrastructure development to facilitate equal accessibility in the world to veterinary tools and services, regulations to facilitate harmonization of research for vaccines, facilitating their registration, scalability of products and availability on-farm, guidelines for vaccination and therapeutics strategies, and social science to increase acceptance and uptake by farmers. Additionally, sustainable management practices should be promoted to ensure environmentally responsible production. Economic incentives are needed to encourage the adoption of innovative technologies and sustainable practices, fostering long-term sector growth. Strong PPPs between governmental agencies, research institutions, and industry stakeholders will help accelerate innovation and address sector challenges.

Conclusion

The workshop successfully identified key research priorities for finfish health and fostered collaboration among participants. An executive summary for research priorities (research policy brief) will be made publicly available on WOAH and STAR-IDAZ websites to guide future research funding strategies for animal aquaculture towards impactful research results improving finfish health globally.

Acknowledgments

The STAR-IDAZ IRC workshop on Advancing Aquaculture Research was made possible through the invaluable contributions of our dedicated scientific committee & sponsors, chairs, presenters, workshop table leaders, and engaged participants. We extend our deepest appreciation to the following experts for their valuable contribution and leadership:

Scientific Committee and Sponsors: Kimberly Churchwell, Ingo Ernst, Larry Hammell, Armando Heriazon, Hong Liu, Saraya Tavornpanich, Steve Wilson, Ruth Zadoks, International Development Research Centre (IDRC), Australian Department of Agriculture, Fisheries and Forestry (DAFF), European Commission, Gates Foundation, DISCONTOOLS, Global Alliance for Livestock Veterinary Medicines (GALVmed), Norwegian Veterinary Institute (NVI), UK Department of Health and Social Care (DHSC) and Global AMR Innovation Fund (GAMRIF).

Chairs: Gregorio Torres, Larry Hammel, Nelly Isyagi, Edgar Brun, Nick Moody, Ha Thanh Dong, Montserrat Arroyo.

Speakers and panellists: Emmanuelle Soubeyran, Montserrat Arroyo, Valeria Mariano, Larry Hammell, Edgar Brun, David Bass, Francesc Padros Bover, Alicia Gallardo, Mohamed E. Abou El Atta, Jérôme Delamare-Debouttéville, Armando Heriazon, Nathalie Vanderheijden, Kimberly Churchwell, Saraya Tavornpanich, Nick Moody, Hong Liu, Latifa Elhachimi, Ha Thanh Dong, Carlos Leal, Ben North, Steve Wilson

Workshop Table Leaders: Francesc Padrós Bover, Larry Hammell, Edgar Brun, Krishna Thakur, Sophie St. Hilaire, Saraya Tavornpanich, Siow Foong Chang, Mario Latini, Nick Moody, Hong Liu, Niccolo Vendramin, Alicia Gallardo, Francisca Samsing Pedrals, Jérôme Delamare-Debouttéville, Ha Thanh Dong, Anna Toffan, Kim Thompson, Armando Heriazon, Nelly Isyagi, Carlos Leal.

We are also grateful to the 184 experts who participated in the pre-workshop global consultation and the numerous experts from diverse institutions and background (see List of Participants), whose active engagement and contributions enriched our discussions during the workshop.

Together, our efforts are helping to advance aquaculture health research by fostering collaboration, identifying key research priorities and driving innovative solution to enhance aquatic animal health worldwide.

World Organisation for Animal Health

STAR IDAZ International Research Consortium on Animal Health

Advancing Aquaculture Health Research: Workshop to Identify the Highest Priority Research Areas for Finfish Health

WOAH HQ, Paris, 20-21 February 2025

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Annex I: Agenda

Agenda
Advancing Aquaculture Health Research

Workshop to Identify the Highest Priority Research Areas for Finfish Health

20-21 February 2025
WOAH HQ, Paris, France

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GALVmed
Protecting Livestock – Improving Human Lives

Gates Foundation

Day 1

20 February, WOAH HQ, Paris 9.00-18.00

9.00 Welcome and Introduction
Chair: Gregorio Torres, Head Science Department, WOAH

Objective: Welcome participants and set the stage for the workshop by introducing the background that led to its organization, and its key objectives, acknowledging the importance of international collaboration for research in aquatic animal health
Desired Outcome: Participants are aligned on the purpose

Opening speech from WOAH DG
Emmanuelle Soubeyran, WOAH - Director General

WOAH Aquatic Animal Health Strategy
Montserrat Arroyo, WOAH Deputy Director General - International Standards and Science

STAR-IDAZ International Research Consortium for Animal Health
Valeria Mariano, WOAH - STAR-IDAZ Secretariat

9.40 Session 1: Challenges in aquatic animal health
Chair: Larry Hammell, WOAH CC Epidemiology and Risk Assessment of Aquatic Animal Diseases (Americas), Atlantic Veterinary College

Objective: Identify key challenges facing finfish health, including emerging diseases, AMR in aquaculture, diagnostics, and vaccine advancements
Desired outcome: Participants understand the current landscape, challenges, and research gaps in finfish health, setting the context for subsequent sessions

Global consultation on research needs for aquaculture: overview of survey results
Larry Hammell, WOAH CC Epidemiology and Risk Assessment of Aquatic Animal Diseases (Americas), Atlantic Veterinary College

Data challenges in aquaculture
Edgar Brun, Dept. Aquatic Animal Health and Welfare, Norwegian Veterinary Institute

Environmental drivers of disease emergence
David Bass, WOAH CC Emerging Aquatic Diseases, CEFAS

Enhancing fish welfare & health management
Francesc Padros Bover, UAB

Tackling AMR in aquaculture: a One health approach
Alicia Gallardo, AAHSC, WOAH CC Antimicrobial Stewardship in Aquaculture, University of Chile

Strengthening aquaculture biosecurity: A One Health perspective
Mohamed E. Abou El Atta,WOAH CC Aquatic Animal Health Management in the Middle East, Central Laboratory for Aquaculture Research (CLAR)

Q&A

11.30	***Coffee break***
12.00	**Session 2: Overview of regional and global research network on aquatic animal health** ***Chair: Nelly Isyagi, Fisheries and Aquaculture Trade and Investment Expert, AU-IBAR***

Objective: Showcase existing global and regional research efforts, fostering awareness and potential synergies among participants
Desired outcome: Increased awareness of global research networks and research priorities identified, leading to strengthened collaboration and identification of complementary research activities

WorldFish: Projects on aquatic animal health
Jérôme Delamare-Deboutteville, WorldFish

Perspectives on how aquatic animal health research priorities are funded by international agencies
Armando Heriazon, Senior Programme Manager Specialist, IDRC

Strategic Research Agendas on aquaculture (CWG AHW) and new funding options (EUP AH&W)
Nathalie Vanderheijden, Coordinator of the European Partnership on Animal Health and Welfare

An introduction to the Gates Foundation Aquaculture Programme
Kimberly Churchwell, Aquaculture Programme Manager, Gates Foundation

Q&A

13.00	***Lunch break***
14.00	**Session 3: Workshop 1 - Epidemiology & control strategies research needs** ***Chair: Edgar Brun, Dept. Aquatic Animal Health and Welfare, Norwegian Veterinary Institute***

Objective: Facilitate in-depth discussions on research needs for control strategies in aquatic animal health, using a World Café format for interactive engagement
Desired outcome: List of priority research areas for control strategies (e.g. priority diseases to focus on, short- and long-term research needs, particular research needed for standard setting) for major finfish production species (salmonids, carp, catfish, tilapia)

Control strategies research needs: overview of survey results
Edgar Brun, Dept. Aquatic Animal Health and Welfare, Norwegian Veterinary Institute

Redefining boundaries: The role of epidemiological units in advancing aquatic disease Surveillance and Control
Saraya Tavornpanich, AAHSC, WOAH CC Epidemiology and Risk Assessment of Aquatic Animal Diseases (Europe), Norwegian Veterinary Institute

Instruction for the World Café session
Valeria Mariano, WOAH - STAR-IDAZ Secretariat

Q&A

15.00-17.00	**Working groups activities**
17.00-17.30	***Break*** *(Time for leaders to rearrange ideas for the plenary presentation)*
Plenary discussion	
Closing remarks ***Edgar Brun, Dept. Aquatic Animal Health and Welfare, Norwegian Veterinary Institute***	
18.00	**Close of the workshop**

Day 2

21 February, WOAH HQ, Paris 9.00-18.00

9.00	**Session 4: Workshop 2 - Diagnostic research needs** ***Chair: Nick Moody, Group Leader for ACDP Fish Diseases Laboratory, CSIRO Australian Centre for Disease Preparedness***
Objective: Facilitate in-depth discussions on research needs for diagnostics in aquatic animal health, using a World Café format for interactive engagement ***Desired outcome: List of diagnostic priority research areas (e.g. priority diseases for which diagnostic is needed, short- and long-term research needs, particular research needed for standard setting) for each main finfish production species (salmonids, carp, catfish, tilapia)***	
Welcome and day introduction	
Diagnostic research needs: Overview of survey results ***Nick Moody, Group Leader for ACDP Fish Diseases Laboratory, CSIRO Australian Centre for Disease Preparedness***	
Diagnostic advances on aquatic diseases ***Hong Liu, AAHSC, WOAH Reference Centre SVCV & IHNV, Animal and Plant Inspection and Quarantine Technical Center***	
Instruction for the World Café session ***Latifa Elhachimi, Kreavet, STAR-IDAZ Secretariat***	
Q&A	
9.30-11.30	**Working groups activities**
11.30-12.00	***Break*** *(Time for leaders to rearrange ideas for the plenary presentation)*
Plenary discussion	
Closing ***Nick Moody, Group Leader for ACDP Fish Diseases Laboratory, CSIRO Australian Centre for Disease Preparedness***	
12.30	***Lunch break***

13.30	**Session 5: Workshop 3 - Vaccines & Therapeutics research needs** ***Chair: Ha Thanh Dong, Aquaculture and Aquatic Resources Management, Asian Institute of Technology***

Objective: Facilitate in-depth discussions on research needs for vaccines and therapeutics in aquatic animal health, using a World Café format for interactive engagement
Desired outcome: List of vaccine and therapeutics priority research areas (e.g. priority diseases for which vaccine and therapeutics are needed, short- and long-term research needs, particular research needed for standard setting) for each main finfish production species (salmonids, carp, catfish, tilapia)

Vaccines and Therapeutics research needs: Overview of survey results
Ha Thanh Dong, Aquaculture and Aquatic Resources Management, Asian Institute of Technology

Vaccine advances on aquatic animal diseases
Carlos Leal, Federal University of Minas Gerais

Instruction for the World Café session
Latifa Elhachimi, Kreavet, STAR IDAZ Secretariat

Q&A

14.00-16.00	**Working groups activities**
16.00-16.30	***Break*** *(Time for leaders to rearrange ideas for the plenary presentation)*

Plenary discussion

Closing
Ha Thanh Dong, Aquaculture and Aquatic Resources Management, Asian Institute of Technology

17.00	**Session 6: Panel discussion on way forward** ***Chair: Montserrat Arroyo, WOAH Deputy Director General – International Standards and Science***

Objective: Engage industry leaders and research program owners in a discussion on advancing finfish health research, examining pathways for enhanced collaboration for impactful outcomes
Desired outcome: Establish actionable strategies for industry-research collaboration, fostering investment and support for sustainable aquatic health solutions

Panel discussion: Perspectives for Advancing Finfish Health Research
Kimberly Churchwell, Aquaculture Programme Manager, Gates Foundation
Armando Heriazon, Senior Programme Manager Specialist, IDRC
Nelly Isyagi, President, World Aquatic Veterinary Medical Association
Ben North, Director, Global Commercial Development, Aquaculture Health, Zoetis
Steve Wilson, Director Vital programme Research & Development, GALVmed

Closing remarks
Montserrat Arroyo, WOAH Deputy Director General – International Standards and Science

18.00 Close of the workshop

World Organisation for Animal Health

STAR IDAZ International Research Consortium on Animal Health

Annex II: Abstract of presentations

Data challenges in aquaculture

Edgar Brun, Dept Aquatic Animal Health and Welfare, Norwegian Veterinary Institute, Norway

Data collected from aquaculture companies have two main purposes; to serve authority and public requirements for regulatory compliance, disease control, reports and research (anonymized and on request), and to serve companies monitoring input variables to control and optimize production. Data collection at small-scale farms may be sparse compared to bigger multinational companies. Together the data generated related to health issues; laboratory investigation; health management; mortality and welfare, slaughter quality, environment etc. are substantial. The industry generally owns these data and invests a lot to collect and report them.

Access to data to produce information serving the needs of Authorities and the Industry as such, may face many challenges. Collection and reporting of data is very diverse. Some data may be irrelevant, conveniently collected, and sampling and analytical routines vary. Vital data may not be collected, collected but not used, or alternatively, "lost" on their path to the main recipients due to unclear reporting routines and responsibilities. Inconsistent or "chaotic" data may not be useful at all for analytical purposes. Confidentiality routines and discrepancies in data collection between companies may lessen the usefulness of the data.

Having lots of data does not necessarily mean that these data include lots of useful information.

Decision-making and research require high data quality, reliable and timely reporting, data sharing, transparency and encouraging feedback. To achieve this, it is important in data collection to comply and clearly define the essential data needs, have an understanding of the reasoning behind the data collection and reporting, and establish easily accessible technical collection routines (sensors, vision tech., automation) and storing. Active use of data that have been collected and proper feedback are key tools to improve collection of essential data of high quality.

Further improvement of disease control will depend on handling multiple data sources (big data), standardization, quality, sharing and transparency at national and company level. The FAIR-principle is important to increase reliability of results and the informative value of the data, and to encourage analytical research and innovations in technical and analytical tools like visualization, digital twins, and AI.

Environmental drivers of disease emergence

David Bass, WOAH CC Emerging Aquatic Diseases, CEFAS, UK

Disease manifestation in animals and plants is a result of the interaction between the host and its symbionts (including but not limited to pathogens; collectively referred to as the holobiont), and the surrounding environment. For aquatic organisms the environment is particularly influential, as it challenges holobionts with a direct and dynamic interaction with a huge diversity of microbes, chemicals, and physical factors. Sessile organisms are at the mercy of what the surrounding water conducts to them, and mobile organisms often travel through diverse sets of environmental conditions to survive and complete their lifecycle. The diversity of disease-causing organisms is very large, and represents a very dynamic system, but both well established and rapidly developing tools exist to characterize and monitor new and emerging disease (although there is much

work to be done in this area). The interaction between aquatic animal health and other environmental factors is a broader challenge, not least because so many factors are involved: e.g. chemicals and pollutants, temperature (including heat waves), pH and other physico-chemical parameters, nutrients, and nutritional and physiological stressors, all in the context of overarching influences such as climate change and anthropogenic activities. A significant challenge is how to measure these environmental factors to effectively inform on health status of aquatic organisms. One Health- and systems thinking are required to address the interacting complexity of contributory factors, and causal analyses (for example adverse outcome pathways) are required at different levels of the aquatic health system to better understand, characterize, and manage environmental drivers of disease emergence. This presentation will highlight a range of research gaps that are currently impeding a more holistic understanding of aquatic animal health and disease.

Enhancing fish welfare & health management

Francesc Padrós Bover, UAB, Spain

Fish welfare is becoming increasingly important as a key element in fish farming systems and, together with fish health management, is one of its most important axes. In addition, the integration and interaction of fish welfare with other elements (husbandry, environment and social perception) describes a system that fits perfectly with the concept of 'One Health'. In farmed fish welfare, special account must be taken of the diversity and complexity involved in the existence of multiple species of farmed fish, specific production phases and different production systems. This means that welfare programmes must be established and adapted to each of the possible combinations. To establish the legal frameworks and procedures for the supervision of these wellbeing programmes, it is necessary to consider all the stakeholders involved: industry, industry-representatives, health and welfare specialists, international and national institutions specialized in welfare, governments, policymakers and representatives of the society. In this holistic vision, maybe one of the aspects that is not always sufficiently considered is the social perception, an element that is also very important to understand the concept of well-being and its contextualization in fish and fish farming. The social perception of well-being in general is fundamentally based on ethical and moral concepts of societies, consequently 'anthropocentric' concepts. These views should be compensated by other visions to have an integrated and balanced vision of the fish well-being concept. In the case of fish farming, it is particularly useful to present well-being from an 'Eco-centric' perspective. This means understanding fish farming as a form of aquatic living resources management in which two drivers are extremely relevant: sustainability and responsibility.

Tackling AMR in aquaculture: A One health approach

Alicia Gallardo, President of Aquatic Animal Health Standard Commission of WOAH (AAHSC), WOAH CC Antimicrobial Stewardship in Aquaculture, University of Chile, Chile

Antimicrobial resistance (AMR) is one of the most pressing global health challenges, and aquaculture plays a significant role in its emergence and spread. The overuse and misuse of antibiotics in fish and shellfish farming have contributed to the development of resistant bacteria, which can impact animal health, food safety, and environmental sustainability.

The One Health approach emphasizes:
1. Improving animal health management: reducing the need for antibiotics through better husbandry practices, biosecurity measures, and vaccination programmes to prevent diseases in aquaculture species. Innovation in rapid diagnostic tools, pathogen genomics, and alternative treatments are needed
2. Promoting alternatives to antibiotics: Encouraging the use of probiotics, prebiotics, phage therapy, and immunostimulants to enhance disease resistance and overall animal health
3. Monitoring and surveillance: Implementing robust systems to track AMR trends in aquaculture settings, enabling early detection and response to resistance issues
4. Environmental protection: Minimizing the release of antibiotics and resistant bacteria into aquatic ecosystems through improved waste management and water treatment practices.

Effective collaboration among veterinarians, farmers, researchers, and policymakers is essential to develop and implement sustainable solutions. By adopting a One Health approach, we can ensure the sustainable growth of aquaculture while protecting animal health, reducing AMR risks, and preserving ecosystems for future generations.

Strengthening aquaculture biosecurity: a One Health perspective

Mohamed E. Abou El Atta,WOAH CC Aquatic Animal Health Management in the Middle East, Central Laboratory for Aquaculture Research (CLAR), Egypt

Aquaculture is a rapidly growing sector, yet its sustainability is increasingly challenged by the emergence of infectious diseases. To ensure long-term resilience, biosecurity measures must be strengthened using a **One Health approach**, integrating human, animal, and environmental health perspectives.

Biosecurity in aquaculture can be categorized into **physical, biological, and operational measures**. Key strategies include the use of **disease-resistant species, probiotics, and immunostimulants** to enhance fish health. Furthermore, **improved feed management, water quality monitoring, and hygiene protocols** are essential for reducing disease risks. Advanced technologies such as **AI-driven disease modeling and real-time water quality sensors** offer new opportunities for proactive health management.

A major concern is the **development of antimicrobial resistance (AMR)** due to the overuse of veterinary drugs. Additionally, disease outbreaks contribute to biodiversity loss, overfishing, and environmental degradation. To mitigate these risks, a **multi-stakeholder approach** is necessary, involving policymakers, researchers, and industry professionals.

This workshop aims to **identify high-priority research areas** for finfish health, including:

1. **Epidemiological studies** to understand emerging pathogens and their transmission dynamics
2. **Development of alternative disease control strategies**, such as vaccines and probiotics
3. **Risk assessment frameworks** to evaluate biosecurity threats and improve disease preparedness
4. **Sustainable farming practices** that minimize environmental impact while ensuring productivity
5. **Strengthening regional and international cooperation** for knowledge-sharing and harmonized biosecurity regulations.

By adopting a **holistic and science-driven approach**, aquaculture stakeholders can enhance disease prevention strategies, ensuring food security and economic stability in the sector.

Perspectives on how aquatic health research priorities are funded by international agencies

Armando Heriazon, Senior Programme Manager Specialist, International Research Development Centre (IDRC), Canada

Innovative Veterinary Solutions for Antimicrobial Resistance (InnoVet-AMR) is a partnership between Canada's International Development Research Centre and the UK government's Global AMR Innovation Fund (GAMRIF) which is part of the Department of Health and Social Care (DHSC). InnoVet-AMR focuses on funding alternatives to antimicrobials, including vaccines, for livestock, poultry, and aquaculture. It is well known that the aquaculture sector is the fastest growing farming market. This has led to an increase in infectious diseases and antimicrobial resistance which is being compounded by climate change.

InnoVet-AMR recognizes the importance of reducing AMR for animal and human welfares. Like other funders, IDRC faces the dilemma of finding a partner which aligns with our current approach. Alignment of objectives to fund gaps could be difficult depending on the strategy of each funder and the availability of funds. A program at IDRC is conceptualized by identifying experts and conducting a literature review. Often, workshops and surveys are conducted to identify gaps and define priorities. Once the program and goals have been developed, a call is initiated, executed, and projects are selected and monitored.

To determine gaps and priorities, IDRC collaborates with various organizations, such as Global Strategic Alliances for the Coordination of Research on the Major Infectious Diseases of Animals and Zoonoses (STAR-IDAZ). One challenge in funding research in animal health are the large number of species, particularly for aquaculture, that need support. Some areas of research on alternatives to reduce the use of antimicrobials and AMR that have been identified can be divided into: 1) Prophylactics (vaccines, probiotics, immunostimulants); 2) Therapeutics (new antimicrobials, bacteriophages, antimicrobial peptides, bacteriocins, and phytochemicals); 3) Growth promoters (probiotics, organic acids, nutraceuticals; and 4) Husbandry (genetics, nutrition, biosecurity). It is also important to recognize that proper surveillance, including diagnostics and artificial intelligence, could help reduce AMR. InnoVet-AMR is currently funding 14 projects to develop 7 different alternatives to AMR technologies targeting livestock, poultry and aquaculture. To help scientists advance their product towards commercialization in a fair and competitive environment, IDRC has developed a support plan that includes gender equity and inclusion, evaluation and protection of intellectual property, private sector engagement, knowledge translation and guidance towards regulatory approval and commercialization of products.

Strategic Research Agendas on aquaculture (CWG AHW) and new funding options (EUP AH&W)

Nathalie Vanderheijden, Coordinator of the European Partnership on Animal Health and Welfare

Key gap-mapping exercises related to fish health in Europe over the past decade were presented. Major earlier initiatives include the FVE (Federation of Veterinarians of Europe) FishMedPlus Coalition, Standing Committee on Agricultural Research (SCAR) Fish of the Collaborative Working Group on Animal Health and Welfare (CWG-AHW), and European Aquaculture Technology and Innovation Platform (EATiP). At the European Union level (EU), more recent initiatives include the EU Aquaculture Assistance Mechanism and EURCAW (European Reference Center for Animal Welfare) aqua, which focus on aquatic animal welfare. The ERA-NETs (EU

Research Area Networks) have been replaced by co-funded partnerships, and today's focus will be on the European Partnership on Animal Health and Welfare (EUPAHW)—a Horizon Europe Cluster 6 collaborative action aimed at fostering research and innovation for food-producing animals, both terrestrial and aquatic, across conventional and organic production systems.

Launched in 2024, the partnership comprises 90 partners from 24 countries, including 19 EU Member States. The total estimated budget over 10 years is €360 million, with 50% funded by the EU and 50% co-funded by partners through national/regional funding agencies and in-kind contributions from Research Performing Organisations (RPOs). Two European Agencies, EFSA (European Food Safety Agency) and EMA (European Medicines Agency), are also partners, and the partnership is coordinated by Ghent University in Belgium. External research calls were/will be launched to attract non-partner RPOs and bring in additional expertise. Meanwhile, the internal program has an integrative function, connecting 56 partner RPOs organized into 17 consortia, which also conduct innovative research.

The EUPAHW is structured around five priority areas, as outlined in the Strategic Research and Innovation Agenda: Surveillance and risk assessment; Procedures, methodologies, and tools; Management and husbandry; Treatment and vaccines; Socio-economics aspects. Aquatic animals (fish, molluscs, and crustaceans) are a major focus of 16 of these first-phase consortia. The EUPAHW website and newsletters will provide updates on funding opportunities, including external calls, short-term missions, and summer schools.

Improving productivity for small-scale producers: the role of the Gates Foundation Aquaculture Programme

Kimberly Churchwell, Aquaculture Programme Manager, Gates Foundation

Aquaculture is the newest area of investment for the Gates Foundation's Agricultural Development team. The presentation introduced the foundation's mission and role in catalysing inclusive agricultural transformation, highlighting Gate's approach to improving productivity in livestock and aquaculture. It also outlined how the foundation is working to catalyse growth in freshwater pond-based aquaculture in Nigeria, East Africa, and selected states in India to unlock sustainable growth for small-scale producers.

Redefining boundaries: The role of epidemiological units in advancing aquatic disease surveillance and control

Saraya Tavornpanich, Member of Aquatic Animal Health Standard Commission of WOAH (AAHSC), Norwegian Veterinary Institute

Epidemiological units serve as the foundation for defining populations at risk, forming a critical component in aquatic disease surveillance, risk assessment, and biosecurity. However, defining epidemiological units with precision remains a significant challenge, as it requires the accurate delineation of spatial, environmental, and biological factors that influence disease transmission. Without well-defined units, surveillance, biosecurity measures, and disease control strategies become less effective.

The use of advanced technologies, particularly real-time monitoring systems, geographic information systems (GIS), remote sensing, and rapid and accurate detection tools, provides dynamic insights into aquatic health status. These innovations support timely decision-making and help reduce the spread of infectious agents. However, integrating such technologies into routine disease surveillance presents logistical and financial barriers, particularly in resource-limited settings. Interpretation of data from such systems necessitates specialized expertise, underscoring the need for interdisciplinary collaboration.

Another major challenge in utilizing epidemiological units effectively lies in achieving a common understanding and interpretation among relevant stakeholders. Effective aquatic animal health management requires close cooperation among farmers, regulators, aquatic animal health professionals, veterinarians, epidemiologists, microbiologist, environmental scientists, and policymakers to establish criteria for applying epidemiological units. Furthermore, the global nature of aquatic disease threats necessitates international cooperation to harmonize surveillance protocols and response strategies. The interconnectedness of aquatic ecosystems, coupled with the transboundary movement of aquatic animals, calls for a unified approach in disease management. Addressing these challenges requires sustained investment in research, capacity building, and the development of technology-driven solutions that enhance disease surveillance while fostering global collaboration among experts.

Diagnostic advances on aquatic diseases

Hong Liu, Member of Aquatic Animal Health Standard Commission of WOAH (AAHSC), Reference laboratory of spring viraemia of carp virus (SVCV), Reference laboratory of infectious haematopoietic necrosis virus (IHNV), Animal and Plant Inspection and Quarantine Technical Center, China

WOAH always pays attention to the latest developments in each specific disease detection method, and evaluates the applicability and practicality of the methods uniformly according to the validated standard procedures, ultimately forming Table 4.1 for each specific disease chapter. It recommends appropriate testing methods based on the suspected and confirmed diagnosis of epidemic free and infected populations at different stages of life. Table 4.1 also describes the degree of validation of the detection methods for users to compare and choose from.
Aquatic animals and aquatic animal pathogens have some special characteristics, such as difficulty in collecting blood samples, large target populations, diverse species, and high value of broodstocks and some ornamental fish. These characteristics make it difficult to widely apply detection methods that require high homogeneity of samples and serological detection methods that mainly rely on antibody detection. Therefore, traditional detection methods still mainly rely on collecting tissues, preparing tissue homogenates, isolating pathogens, or directly conducting nucleic acid testing.

The global prevention and control of aquatic animal diseases are facing many new challenges along with aquaculture styles, breeding levels, breeding scales, environmental pressures, climate pressures, etc. And there is a higher demand for detection technology.

Pathogen detection technology has developed rapidly in recent years. The global COVID-19 epidemic has further promoted pathogen detection technology. Molecular biology methods, immunological methods, metagenomics, mass spectrometry techniques, point-of-care testing (POCT), etc. There are the latest developments in every field.

How can new detection technologies better meet the global demand for aquatic disease prevention and control? Here are several suggestions for discussion:
1. eDNA pathogen enrichment technology – disease early warning, pathogen detection in transportation water, non-destructive testing, and assessment of pathogen purification level in the environment
2. CRIPSR – On-site visualization of test results. Can quickly detect specific sequences in the viral genome
3. Microfluidic technology - simultaneous detection of multiple pathogens, micro sample detection, nucleic acid extraction, and integrated nucleic acid detection
4. Metagenomics – potential and emerging pathogen detection, pathogen tracing, molecular evolution analysis
5. MALDI-TOF MS – identification of bacterial and fungal pathogens in a short period of time
6. Metabolomics – Indirectly identifying pathogens and providing personalized diagnosis by analyzing metabolites
7. Liquid phase chip – truly high-throughput
8. Digital PCR – Low concentration sample detection, absolute quantification of pathogens
9. New nano material-enhanced immune detection – improving detection sensitivity. Capable of detecting ultra trace pathogens
10. Next generation sequencing (NGS) technology – identification of unknown pathogens and analysis of drug resistance of known pathogens; Track the transmission path of virus variants
11. Multitechnology integration, automation, and intelligence – POCT, as well as real-time monitoring in application scenarios.

Vaccine advances on aquatic animal diseases

Carlos Leal, Federal University of Minas Gerais, Brazil

The use of vaccines in global fish farming has developed over the last 40 years. Initially focused on salmonids (Atlantic salmon and rainbow trout) and high-value marine fish, it has recently expanded to lower-cost tropical species such as tilapia. While there are no precise data, some specialists estimate that only 5% of the world's tilapia production is currently vaccinated, with 40% of that occurring in Latin America (LATAM). Brazil (BR) alone accounts for 50% of this total.

In Brazil, sales of tilapia vaccines increased from 2.2 million doses in 2015 to approximately 289 million in 2024, representing a 13,031% increase. The effectiveness of tilapia vaccines has been recognized by both producers and companies, and their economic viability has been demonstrated by scientific studies. Research has shown that for every U$1.00 invested by producers (including vaccine, antibiotics, labor, and vaccination costs), they receive a return of U$1.24—more than a 100% return on investment.

Initially, vaccination programmes in Brazil were carried out in a rudimentary manner on farms. Fish were captured in tanks, anesthetized in drums containing a eugenol solution (anesthetic), and then manually vaccinated at designated stations. This scenario has changed drastically in recent years with the introduction of semi-automatic tilapia vaccination machines. These machines, with a capacity of 8,500 tilapia per hour, have significantly increased the vaccination efficiency of large companies.

Despite this robust expansion and adoption, several challenges remain. The sector has identified key needs, including the development of new effective vaccine formulations (e.g. immersion vaccines) and administration methods for fingerlings, higher quality control standards for autogenous vaccines, faster development of commercial vaccines, new flexible vaccine platforms (e.g. nucleic acid vaccines), and low-cost semi-automatic vaccination machines tailored for small-scale farmers. Addressing these needs will be essential for improving tilapia health and vaccination programmes in the future.

Annex III: Summary table

Most impactful pathogens/diseases per species/environment cluster and associated diagnostics and vaccines needs

Disease / pathogen	High impact/specie/environment		Diagnostic	Vaccine
Aeromonas spp.‡				
				
				
				
				
Amoebic gill disease (AGD)				
Aphanomyces invadans; Epizootic ulcerative syndrome (EUS)				
				
				
				
Cardiomyopathy Syndrome (CMS)				
				 ¶
Complex gill disease (CGD)				
				
Edwardisella ictaluri				
Flavobacterium spp.†				
				
				
				
Francisella spp.				
				

Heart and skeletal muscle inflammation (HSMI)				
Infectious haematopoietic necrosis virus (IHNV)				
				
Infectious pancreatic necrosis virus (IPNV)				
Infectious salmon anaemia virus (ISAV)				
Koi herpesvirus (KHV)				
***Lactococcus* spp*.**				
				
				
***Megalocytivirus lates* 1 (SDDV)**				
***Megalocytivirus pagrus* 1 (ISKNV/RSIV/TRBIV)**				
				
				
***Moritella* spp.**				
Nodular gill disease (NGD)				
Piscirickettsia salmonis (SRS)				
***Renibacterium salmoninarum* (BKD)**				
Sealice				
Spring viraemia of carp (SVC)				
***Streptococcus* spp.**				
***Tenacibaculum* spp.**				

Tilapia lake virus (TiLV)				
***Vibrio* spp.[§]**				
Viral haemorrhagic septicaemia virus (VHSV)				
				
Viral nervous necrosis virus (VNNV)				

[‡]**Includes: *A. salmonicida, A. hydrophila, A. veronii, A. dhakensis*.** [†]**Includes: *F. psychrophilum, F. columnare, F. tilapiae*.** ***Includes: *L. garvieae, L. petauri, L. formosensis*** [§]**Includes: *V. harveyi, V. vulnificus, V. parahaemolyticus*, and *V. alginolyticus*.** [¶]**Vaccines to be administered in early stage of life (freshwater).**

Key:			
	Most impactful disease		
	Freshwater		Saltwater
	Salmonids, freshwater		Vaccines (development or improvement)
	Tilapia		Improved isolation and cell culture methods
	Carp		Virulence characterization
	Catfish		Validated diagnostics
	Salmonids, saltwater		Improved molecular methods
	Others, saltwater		Non-lethal sample protocols

Annex IV: Analysis of pre-workshop survey

Report of the pre-workshop global consultation on aquaculture research priorities: Finfish Section* https://www.star-idaz.net/priority-topic/aquatic-diseases/#reports

**Full survey analysis will be soon published on both WOAH and STAR-IDAZ websites*