Antimicrobial Resistance: Preventing the silent pandemic in aquatic food systems

World Antimicrobial Awareness Week – 18th November 2021

WorldFish and Partners: AMR research and development activities

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Our Vision
An inclusive world of healthy, well-nourished people and a sustainable blue planet, now and in the future.

Our Mission
To end hunger and advance sustainable development by 2030 through science and innovation to transform food, land and water systems with aquatic foods for healthier people and planet.
WorldFish has a global presence in 20 countries in 3 continents with 446 staff representing 30 nationalities.
Aquatic foods are essential for *Nourishing Nations and Transforming Food Systems*.

Fisheries and aquaculture can play a greater role in delivering healthy diets and more sustainable, equitable and resilient food systems around the world (Blue foods assessment).

Our challenge is to transform aquatic food systems to do better for humans (safe/healthy food), animals (no/less disease) and the environment (clean)
Aquaculture growth and future challenges

- Currently, aquaculture is one of the fastest growing food producing sector in the world.
- Global demand for aquatic foods will roughly double by 2050 with aquaculture predicted to meet most of this demand complementing capture fisheries.
- With intensification, disease losses are also increasing, impacting the development and sustainability of the aquaculture sector.
- With the highest risk located in LMIC where people rely the most on aquatic food systems and where they are least equipped to respond and adapt to disease risks.
Diseases as drivers of AMU and AMR

For farmers **etiology makes little sense** compared to mortalities. Mitigation through overstocking and treatments including use of antimicrobial agents (e.g. antibiotics).

**67 different antibiotics** used in 11 major aquaculture producing countries, contributing to the global pool of antimicrobial resistance (AMR)

**Antimicrobial use (AMU) in aquaculture differs** from livestock farming due to greater diversity of farmed species and farming systems.

**Antibiotic resistance mechanisms** identical in fish, livestock and human pathogens
AMU in commercial aquaculture farms is common; various types of antimicrobials are available to purchase over-the-counter.

The decision of farmers to resort to AMU is influenced by several actors (e.g. peers, input suppliers, extension service providers, consultants, regulators).

Understanding of behaviour and practice of farmers and value chain actors is vital to design interventions to tackle AMR problems in aquatic food systems.
WorldFish Collaboration with Partners through projects

- AM use and value chains, behavior
- Transmission dynamics and residues
- Interventions and their impact on public health outcomes
- Support enabling policy
- Capacity development, scale solutions

Partnerships facilitated through the AMR hub
AMR Resilience Project Global
Jan 2019-Dec 2020

Joint Programming Initiative on Antimicrobial Resistance (JPIAMR)

Partners:
• Stockholm Resilience Center (SRC)
• University of Waterloo, Canada

Key messages: The project helped to better understand how interventions against antimicrobial resistance shape resilience and transformability. The project produced a learning platform to document which interventions work to limit antibiotic resistance across animal and human health.

The Lancet Infectious Diseases; https://dx.doi.org/20.500.12348/4339
Production without medicalization Project Bangladesh
Jan 2018-Dec 2020

Partners:
- University of Exeter UK
- Centre for Environment, Fisheries and Aquaculture Science (Cefas) UK
- Veterinary Medicines Directorate (VMD)
- Animal and Plant Health Agency (APHA)
- Food and Agriculture Organization (FAO) in Dhaka

Key messages: Research and advocacy on the prudent and responsible use of AB and the need to change behaviour and practice of aquatic food value chain actors including small scale producers

https://hdl.handle.net/20.500.12348/3135
AMFORA Project Vietnam, Egypt and Global
Jan 2018-Dec 2020

Partners:
• Royal Veterinary College (RVC) of London
• International Livestock Research Institute (ILRI)
• University of Stirling

Key messages: Applying a systems-thinking approach to aquaculture systems for identifying hotspots for antibiotic resistance emergence and spread in aquatic systems, elucidating pathways to human exposure and to identify and assess feasibility of potential interventions

https://doi.org/10.1016/j.aquaculture.2021.736735

https://doi.org/10.1016/j.scitotenv.2019.06.134
Fleming Fund Bangladesh
June 2020-Dec 2021

Partners: ILRI for Fleming Fund (FF) Fellowships & DAI (USA) for FF Country Grant, DOF, BFRI, DOL, DLRI, ICDDRb, Cefas UK

Key messages: embedding aquatic food systems in Bangladesh AMR surveillance and One health works. Build capacity for veterinary AMR and AMU surveillance

Key outcomes:
• Mentoring of 2 FF Fellows from the Fish Inspection and Quality Control (FIQC) of the Department of Fisheries (DOF) Bangladesh: (1) AMR Laboratory Aquaculture and (2) AMR surveillance Aquaculture
• Collaborating with FF Country Grant in undertaking point prevalence surveys (PPS) on antibiotics use in public health, poultry and aquaculture. AMU data collected from 480 fish farms covering 6 districts in Bangladesh
**One Health Aquaculture Cefas project** Bangladesh
Dec 2020-April 2021

**Partners:** Cefas UK; Exeter University, DOF, BFRI, DOL, DLRI, ICDDRb (Bangladesh)

**Key messages:** Formally introduce the concept of One Health approach for aquaculture to the authorities and stakeholders responsible for policies associated with environmental, human and animal health in national aquatic food production in Bangladesh.

**Objectives:**
- Assess the Bangladeshi aquatic foods system through the One Health lens
- Engage with policymakers
- Develop tools, methods and capabilities to test for COVID-19 in seafood and wastewater

[link to workshop poster](https://www.nature.com/articles/s43016-020-0127-5)
AMR Cefas project Bangladesh
Dec 2020-March 2022

Partners: Cefas UK, DoF, DAI, BLRI, BFRI, Khulna University, ICDDRb

Key messages: Facilitating future collaboration on COVID-19 responses through capacity building on AMR livelihoods

Objectives:
- Establish a pilot system and training for AMR surveillance focusing on fish and crustacean species
- Assessment of AMR at point of consumption via technical assistance and diagnostic services to strengthen and establish AMR surveillance
- Systems modelling undertake data gathering for AMU and AMR pathways and feedback
Quick protocol for antimicrobial susceptibility testing (AST) in aquatic animal species from aquaculture and fisheries

https://hdl.handle.net/20.500.12348/4862

Disk diffusion method (based on CLSI guideline Vet03^1)

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<tr>
<td>Z</td>
<td>10 µg</td>
<td>≥ 18</td>
<td>≤ 17</td>
</tr>
</tbody>
</table>

Sampling materials for fish disease diagnostics

https://hdl.handle.net/20.500.12348/4836

Bacteriology sampling guide

https://hdl.handle.net/20.500.12348/4840
Antimicrobial resistance: Raising awareness

YouTube videos: AMR animation for reducing antibiotic use in Bangladesh fish farming – through better practices developed by SAF at the University of Exeter in collaboration with WorldFish and the FAO. Bangla version (link) and English version (link)

Why Antimicrobial Resistance (AMR) in aquaculture matters for the One Health approach (YouTube link) and poster (link)
Inspire challenge project: Rapid genomic detection of aquaculture pathogens (Jan 2020-June 2021)

Partners: The University of Queensland, Wilderlab, Centex Shrimp (BIOTEC/Mahidol University), GeneSEQ

Key messages:

• “Lab-in-a-backpack” uses nanopore sequencing technology and low cost, low waste sample preparation to generate whole pathogen genome sequence data from diagnostic samples without laboratory support

• Genome-based diagnosis of pathogens enables evidence-based treatment, epidemiological tracing, AMR surveillance and the production of simple low-cost, locally produced “autogenous” vaccines to protect the next crop

• Development of cloud-based identification tools that returns near real-time information on pathogen species ID, MLST (epidemiology) and molecular serotyping (vaccine formulation) (note: current classifiers covering most sequence types and serotypes of Group-B *streptococcus*).

• The source code is readily adaptable to create new classifiers for additional pathogens and a variety of other applications (e.g. acquired AMR genes to inform better treatment).

Links: [poster](#) | [video abstract](#) | [TiLV amplicon paper](#) | [training.pptx](#) | [cloud-based tool](#)
Actions and changes needed to address the key driver

**Improved diagnostics**
(e.g. pond site multiple pathogen detection systems, lab-in-a-backpack)

**Implementation of farm level biosecurity and better management practices**
(e.g. better extension services, practical field manuals, digital tools, learning tools)

**Improving access to alternatives veterinary solutions**
(e.g. autogenous vaccines)

**Access to disease resistant fish strains**
(e.g. WorldFish work on tilapia-GIFT and TiLV)
• AMR is a **product of actions of various actors and elements** involved in the food systems and beyond. **Collective action under a One Health framework** is necessary to tackle AMR in aquatic food systems.

• **Under the One CGIAR**, WorldFish is part of the **One Health IDT** and **AMR and food Safety** are **two key work packages** that WorldFish will support from the aquatic food systems perspective.
WorldFish works with partners and donors
Other WorldFish and partners AMR related outputs

- 2018: The role of infectious disease impact in informing decision-making for animal health management in aquaculture systems in Bangladesh. Preventive Veterinary Medicine. https://doi.org/10.1016/j.prevetmed.2018.03.004
- 2021: Reducing disease risks in fish through better detection, management and prevention. WorldFish FISH CRP Program Brief. https://hdl.handle.net/20.500.12348/4833
Thank You

WorldFish

CGIAR

ANTIMICROBIAL RESISTANCE Hub

CGIAR