



# FEED THE FUTURE

The U.S. Government's Global Hunger & Food Security Initiative

## IDENTIFYING MAJOR SOURCES OF FOODBORNE PATHOGENS IN BANGLADESHI AQUACULTURE VALUE CHAINS AND THE MOST COST-EFFECTIVE RISK REDUCTION STRATEGIES

### FOOD SAFETY CHALLENGES IN AQUACULTURE SUPPLY CHAIN IN BANGLADESH

Over the past decade, Bangladesh has witnessed remarkable progress in aquaculture production. The cultivation of tilapia (*Oreochromis niloticus*) and pangas (*Pangasius pangasius*) holds significant commercial importance in the country. While the aquaculture industry has experienced substantial growth through intensive farming methods, there has been limited focus on improving fish safety concerning contamination with human pathogens, including multi-drug resistant organisms. In this study, the Feed the Future Innovation Lab for Fish activity assessed contamination of tilapia and pangas with *E. coli* and antibiotic-resistant *E. coli* along with major foodborne pathogens (*Salmonella* spp., *Shigella* spp., *Vibrio cholerae*, *Vibrio parahaemolyticus*, and *Cryptosporidium* spp.) throughout the supply chain, from fish farmers to the cut-up tables in retail markets.



Bangladeshi fish market. Photo by Md Khorshed Alam.

### WHY IS IT IMPORTANT TO REDUCE THE MICROBIAL CONTAMINATION OF RAW FISH ALTHOUGH BANGLADESHIS DO NOT EAT RAW FISH?

The study on estimating the prevalence of foodborne pathogens revealed that fish from retail markets had high levels of contamination with foodborne pathogens. Individuals who handle contaminated fish without taking preventive measures are at risk of exposure to these pathogens. Additionally, raw fish can potentially contaminate cooked food in consumers' households, leading to foodborne infections, particularly diarrhea. These infections are highly prevalent in Bangladesh, especially among children under five years of age, who often experience numerous episodes of diarrhea before their first birthday. Repeated episodes of diarrhea can damage the intestinal epithelial layers, resulting in reduced nutrient absorption, known as environmental enteropathy. This condition puts children at high risk of malnutrition, which, in turn, increases their vulnerability to diarrhea, creating a vicious cycle. Reducing the contamination levels of harmful microbial pathogens in raw fish at the retail market would lower the exposure to these organisms at the household level, resulting in a positive impact on consumers' health.

### CUT FISH IN RETAIL WET MARKETS HAVE HIGH LEVELS OF MICROBIAL CONTAMINATION

The research team found that 92% of cut-fish samples from retail markets in Dhaka city were contaminated with *E. coli*. However, the prevalence of *E. coli* was significantly higher in samples from the wet market (97%) compared to the super shops, or grocery stores (71%). Similarly, a significantly higher proportion of wet market samples (58%) were positive for extended spectrum beta-lactamase producing *E. coli* (ESBL-Ec) compared to the samples from super shops (8%). The prevalence of *Salmonella* spp. was significantly higher in wet market samples (28%) compared to the samples from super shops (8%). The prevalence of contamination was not related to a fish vendor's business hours as no significant difference was observed in the prevalence of *E. coli*, ESBL-Ec, *V. cholerae*, and *Salmonella* spp. between fish samples collected during the morning and evening hours.



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The level and type of foodborne pathogens varied between tilapia and pangas. The concentrations of both *E. coli* and ESBL-Ec were significantly higher in pangas compared to tilapia. In contrast, a significantly higher number of tilapia samples was positive for *Salmonella* spp. compared to pangas.

## FISH PROCESSING IN UNHYGIENIC CONDITIONS IN WET MARKETS CONTRIBUTES TO CONTAMINATION OF FISH

In this study, 66% of fish farmers reported using antibiotics directly in their ponds, and a concerning 92% of these farmers purchased antibiotics without any prescription. The hygiene practices of cut-up table workers in the wet markets were suboptimal. About 44% of these workers reported using only water to wash their hands, cutting board surfaces, knives, and other apparatus. None of the cutting stations had running water, and the cut-up table workers reused the same water repeatedly for handwashing and washing scaled fish, rarely using soap or detergent during cleaning.

In the wet markets, >70% of cutting board swab samples tested positive for *E. coli*, ESBL-Ec, and *Vibrio cholerae*, and 40% of samples were positive for *Salmonella* spp. Comparison of the prevalence of ESBL-Ec between whole fish samples from vendors and cut-fish samples from the cut-up tables in the same wet markets showed that the prevalence of ESBL-Ec in cut-fish samples (58%) was significantly higher than the whole fish samples (20%). These findings suggest that external sources of contamination during fish processing may contribute to increased prevalence and abundance of ESBL-Ec in cut-fish samples in wet markets.

## RISK ASSESSMENT CAN GUIDE IMPLEMENTATION OF INTERVENTION STRATEGIES TO IMPROVE MICROBIOLOGICAL SAFETY OF FISH

Risk modeling with the data collected from the fish supply chain identified that the highest level of microbial contamination occurs in the wet markets, especially at the fish cut-up points. The fish cutting board was most frequently contaminated. The research team believes that an intervention at the cut-up tables in retail markets would reduce pathogen loads in ready-to-deliver fish to consumers.

## RECOMMENDATIONS

In this activity, we identified some critical behavioral practices among actors along the supply chain that can be targeted for future intervention studies, including the following:

- Reduce unnecessary use of antibiotics in the pond at the production level.
- Improve hygienic practices of cut-up table workers in the wet markets and ensure supply of clean water for processing of fish.
- Consumers should use separate bags for purchased fish and process them at home following proper hygiene practices to avoid cross-transmission.

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## ABOUT THE FISH INNOVATION LAB

The Fish Innovation Lab supports the United States Agency for International Development's agricultural research and capacity building work under Feed the Future, the U.S. Government's global hunger and food security initiative. Mississippi State University is the program's management entity. The University of Rhode Island, Texas State University, Washington University in St. Louis, and RTI International serve as management partners.

[www.fishinnovationlab.msstate.edu](http://www.fishinnovationlab.msstate.edu)

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