



FEED THE FUTURE INNOVATION LAB FOR FISH RESILIENCE BRIEF HIGHLIGHTS OF PROGRAM ACHIEVEMENTS AND RECOMMENDATIONS

Introduction and Background

Resilience is a critical component of the U.S. Agency for International Development's work to improve food security and reduce poverty. By resilience, we are referring to the ability of vulnerable groups reliant on income, food, and nutrition from aquaculture and fisheries to mitigate, adapt to, and recover from shocks and stresses. Many practitioners increasingly recognize the fish value chain as a driver of food security and income despite being affected by shocks and stresses.

Aquaculture and fishery systems are particularly vulnerable to extreme storm events, unusual fluctuations in temperature and rain, and anthropogenic stresses and shocks. In aquaculture systems, fish are susceptible to disease outbreak shocks that can cause rapid, high mortalities and move swiftly from farm to farm. As a highly traded commodity, fish are susceptible to price fluctuations and are greatly impacted by feed prices. Contamination of fish from foodborne pathogens can also suddenly close trade markets. These are just some examples of how low ecological, environmental, and economic resilience in aquaculture and fishery systems may have devastating effects for the households and communities that depend on them.

The Fish Innovation Lab has strengthened the resilience of key aspects of aquaculture and fishery systems in countries spanning Bangladesh, Kenya, and Nigeria, to name a few. In the process, researchers, implementers, and communities have contributed specialized knowledge on what is needed to further strengthen resilience for the most vulnerable in varied contexts. This brief shares insights through cases and context-specific recommendations for the scaling and adoption of USAID-funded innovations in aquaculture and fisheries.



Deploying the trap, Mpunguti Reserve, Kenya. Picture by: Ines Gomez.

Climate Resilience

The Fish Innovation Lab has contributed to climate mitigation of vulnerable rice farmers in Nigeria by introducing aquaculture to diversify crops. By diversifying rice fields with aquaculture either concurrently or on a rotational basis, rice farmers generate more income from the same amount of land. They also use water more efficiently, while the aquaculture systems increase the biological diversity of the agro-ecological landscape. Aquaculture production also supports climate mitigation by offsetting the greenhouse gases emitted by rice farming.



The Fish Innovation Lab also supported climate adaptation for fishers affected by climate-related pressures in coastal Kenya and aquaculture producers affected by severe weather events in Bangladesh. Regarding fishers in Kenya, researchers worked with fishers facing catch reductions due to rising sea temperatures that have bleached coral reefs and harmed the species that depend on them. The team introduced traps that are effective for catching rabbitfish, a climate-resilient species that does not depend on the coral reefs and is likely to thrive despite climate pressures. The Fish Innovation Lab also improved the livelihoods of fishers in climate refugia, which are safe from adverse climate events, due to natural land features. These special protected areas enable fishers to harvest sustainably and profitably, providing a long-term climate-smart and sustainable approach.

In Bangladesh, a research team contributed to climate impact reporting and responsiveness by setting up a system for farm-level data to be collected and analyzed by local institutional actors, who in turn use the information to provide training on climate adaptation through digital platforms and in-person. The activity team trained local extension agents on conducting action research, thereby building skills and processes that link climate risk and exposure monitoring to service provision for climate adaptation.

More information is available in this brief: <https://agrilinks.org/post/innovations-aquaculture-production-and-fisheries-management-build-climate-resilience>



Woman displays her dried fish in Cambodia. Picture by: Sandra Correa

Mitigating Risks to Production and Retail Systems

Production systems are vulnerable to numerous risks and threats, some of which can reach the level of a shock that affects household income, food security, and well-being on a large scale. The Fish Innovation Lab has developed strategies and approaches to help manage and mitigate those risks in various contexts, ranging from threats to aquaculture production in Cambodia due to the sector's reliance on imported feed (vulnerable to rapid price increases, trade stoppages and shortfalls), to improved vaccines for tilapia in Zambia, to managing food safety risks in wet markets in Bangladesh. In addition, the Fish Innovation Lab has made key contributions to aquaculture biosecurity in Nigeria.

In Nigeria, innovations supported and incentivized producers to adopt better fish health management practices and share disease-related information in a transparent and timely way. Further, one team addressed the systemic threat of antimicrobial resistance by encouraging producers to reduce their use of antibiotics. In order to incentivize behavior changes that benefit the group as a whole— but incur short-term costs for producers— the activity supported locally managed electronic platforms that enable producers in remote locations to access timely and accurate diagnosis and treatment advice from extension workers. As producers receive better and more personalized services, they are more willing to cooperate with reduced antibiotic use guidelines. Finally, government agencies are now able to access a database of real-time and accurate diagnostic information housed by universities, enabling producers and decision-makers to better address new and emerging threats.

To learn more, check out this brief:

<https://www.fishinnovationlab.msstate.edu/newsroom/2022/06/strengthening-system-resilience-aquaculture-biosecurity-nigeria>

Improving Livelihoods for Household Resilience

Sustaining household incomes— and supporting the growth potential of livelihood activities— during shocks is critical for vulnerable smallholder producers, fishers, and processors. Innovations supported by the Fish Innovation Lab make key contributions to the resilience of these vulnerable livelihoods across countries. For example, one team trained local business coaches to advise Nigerian smallholder aquaculture producers to introduce efficiencies in their production process. The coaches learned a process for testing out new practices with a few producers, assessing the results, and then scaling them to a larger number of producers. Skills in iterative development and application of solutions to new and emerging issues are key resilience capacities needed for a dynamic response to threats related to shocks, such as floods. In addition, the practice of peer consultation and greater access to information flows supported by the lean management approach also improve resilience.

A second activity worked with Cambodian fishers to improve their access to information about current catch levels vis-à-vis sustainable fishing levels, due to long-term stresses on fish availability. In addition, the activity supported livelihood diversification by improving processing and preservation techniques to buffer fishers' income despite potential interruptions getting fresh fish to market. These two examples illustrate the diverse interventions needed for improving the resilience of livelihoods and underscore the need for contextualized approaches.

Applying Learning to Design for Resilience

In preparing for adoption and scaling, research teams applied resilience thinking, which involves planning and designing for dynamic response to emerging shocks and stresses. Drawing on their deep knowledge of the contexts where they have been working, researchers analyzed the shocks and stresses that impact vulnerable groups who are using or benefiting from innovations. Through collaborative workshops, teams interacted across technical areas and exchanged ideas and experiences relevant to their countries and sectoral contexts.

As an outcome of these consultations, researchers developed resilience strategies for sustaining well-being outcomes in the face of shocks and pressures related to climate change and other stresses that threaten the positive impacts of their innovations. First, research teams determined the positive responses to shocks and stresses that will be necessary for effective recovery of aquaculture and fisheries systems. They next identified the resilience capacities (i.e., assets, behaviors, and strategies) needed by aquaculture and fisheries systems and system actors to respond pro-actively. Teams proposed interventions to strengthen those resilience capacities and noted the various types of stakeholders who would need to be involved.

Notably, the resilience strategies across areas of inquiry and country contexts involved three key elements: 1) dynamic organizing and response capacity of smallholder aquaculture producers, processors, and fishers; 2) government-sponsored infrastructure and organizational capacity to provide services and strategic investment, in partnership with private sector actors; and 3) timely emergency support to vulnerable actors through insurance schemes, cash transfers, or responsive services, etc. The cases presented in this brief demonstrate the shared resilience capacities across strategies that address the specific gaps, organizing structures, and opportunities of each sector in its particular country context.

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Contextualized Resilience Strategy

for Scaling and Adoption of Innovations for Aquaculture in Nigeria and Zambia

Recommendations for Resilience of fish processors in coastal Nigeria

Fish Processing Technology



Fish Innovation Lab connected women small-scale processors to new technology to preserve nutrients and reduce spoilage

Shocks Affecting Small-Scale Processors



Severe Flooding in wetlands near coastal areas

Recommended Interventions for Resilience of Processors



Link fish processors with finance for purchasing improved storage equipment and business planning training to buffer fish supply during floods; incentivize private sector to supply improved storage equipment at affordable prices

Resilience Capacities Strengthened



Access to finance
Adjust business plans in of market disruption



Local Stakeholders Engaged

Local banks/MFIs issue suitable loan products

Government Fish Management Office provides financial and business management training

Local private sector sells affordable improved storage equipment

Small-Scale Aquaculture Producers' Resilience-Focused Context-Specific Use Cases for Adoption/Scaling

Fish Innovation Lab-supported innovation	Shock/stress affecting vulnerable aquaculture producers	Recommended interventions for resilience of vulnerable producers	Resilience capacities strengthened
Integrated rice-fish production to increase or smooth income	Severe Flooding	In Nigeria, farmer cooperatives can identify problems with current dyke systems and develop new dyke technologies that work in their contexts with locally available materials and labor. Federal ministries can use current programs to support and connect farmer cooperatives that are experiencing and responding to severe flooding.	Access to information flows Participation in joint initiatives/partnerships
Information sharing hub connecting veterinarians and producers	Emerging/ Exotic Disease Outbreak	In Nigeria, the Fish Innovation Lab project developed an information Hub connecting producers and veterinarians. This Hub could be expanded to include other stakeholders, such as biologists, government officials and others that can work to develop an overall aqua health strategy response to disease outbreaks at the national level.	Access to information flows Government programs/strategies
Improved production system for increased efficiency	Sharp Increase in Cost of Inputs	In the face of increased prices for imported fish feed, Nigeria aquaculture producers can turn to local producers and sources of feed, such as cassava meal or groundnuts. Local producers of these inputs and government ministries can work on behavior change campaigns and marketing to consumers who currently prefer fish raised with imported feed.	Adjust business plans in case of market disruptions
New vaccine for farmed tilapias	Rising Temperature Reduces Vaccine Effectiveness	In Zambia, large tilapia producers and the government could jointly fund research into new vaccine variations. These variations would protect not only large producers' fish, but also the stock of small producers that are facing the same shock.	Government programs/strategies

Contextualized Resilience Strategy

Scaling and Adoption of Innovations for Aquaculture in Bangladesh and Cambodia

Case #1 Recommendations for Resilience for Fish Farmers in Bangladesh

Improved Sperm Available to Hatcheries



Fish Innovation Lab developed improved sperm for hatcheries to grow brood stock to sell to small-scale fish farmers

Shocks Affecting Small-Scale Processors



Heavy rains and flooding during cyclone season that wipe out fish farms

Recommended Interventions for Resilience of Fish Farmers



Link fish farmers with hatcheries to replace fish lost during extreme storms at a low price; Create a forecast system to provide more advance warning to fish farmers so they can prepare to weather the storm

Resilience Capacities Strengthened



Buffer supply of critical inputs, savings, inventory
 Technical capacity to adjust business plans in case of market disruptions
 Access to and use of early warning information



Local Stakeholders Engaged

Government stores back-up fish stock and provide financial assistance to affected fish farmers

Hatcheries provide replacement fish stock at low prices

Local government or research entities disseminate advance storm forecasting to fish farmers

Cases #2–5: Recommendations for Improving Resilience for Aquaculture Producers and Consumers in Bangladesh and Cambodia

Fish Innovation Lab-supported innovation	Shock/stress affecting vulnerable actors	Recommended interventions for resilience of vulnerable producers	Resilience capacities strengthened
Case #2: System for monitoring aquaculture performance and related economic impacts	Decrease in demand for seed fish affecting workers in hatcheries	In Bangladesh, government agencies and insurance companies can partner to provide insurance plans in hatchery initiatives. These plans can be emphasized in the development plans by the Department of Fisheries to provide a risk management system for fish hatchery owners. Hatchery owners should also be able to access loans under the central banks' Agricultural and Rural Credit Policy.	Public investment in longer term, inclusive sector growth Availability of suitable finance/insurance options Market actors give input on policies Confidence in ability to find alternate suppliers Protective regulation for political and economic participation
Case #3: Economic and food security analysis of market potential and constraints	Price volatility affecting consumers of small fish	In Bangladesh, the government can reserve land to promote integrated rice/fish farming on crop land in order to stabilize the fish supply. The government's open water management strategy should also regulate the floodplain ecosystem, reducing the volatility in the supply of small fish.	Community or landscape level investment in natural resource management Public investment in longer term, inclusive sector growth Market actors give input on policies Value proposition to customers drives competition
Case #4: Improved feed to reduce catch levels	Volatility in imported feed prices/availability affecting small-scale producers	To address input price volatility, the Cambodian private sector could support the commercialization of domestic production of fish feed to reduce dependence on imported inputs. The government and banks could provide loans on favorable terms for the aquaculture sector to both establish domestic feed production, and to limit the exposure of small-scale producers to volatile feed prices in the shorter term.	Public investment in longer term, inclusive sector growth Market actors give input on policies Availability of suitable finance/insurance options
Case #5: Brood stock for genetically improved carp	Severe flooding leading to loss of brood stock affecting small-scale producers	The Bangladesh government in partnership with the private sector should provide a mechanism to provide and disseminate fish seed in the event of hatcheries being out of production and losing their brood stocks. Additionally, the private sector should continue researching cryopreservation technology that could preserve brood stocks in the face of shocks.	Public investment in longer term, inclusive sector growth Market actors give input on policies Availability of suitable finance/insurance options Confidence in ability to find alternate suppliers

Contextualized Resilience Strategy

Scaling and Adoption of Innovations for Fisheries in Cambodia, Kenya and Zambia

Case #1 Recommendations for Resilience for Kenyan Fishers



Cases #2–5: Recommendations for Improving Resilience for Fishers in Cambodia, Kenya and Zambia.

Fish Innovation Lab-supported innovation or approach	Shock/stress affecting vulnerable actors	Recommended interventions for resilience of vulnerable producers	Resilience capacities strengthened
Case #2: Technologies for aquaculture and livelihood diversification	Decline in fish supply due to climate change and flooding	To reduce reliance on the river for fish and livelihoods in Cambodia, NGOs are working with communities to promote ecotourism and could expand that to a greater level, providing communities the opportunity to bring in outsiders for the experience of fishing, interacting with the village, and purchasing local products	<p>Natural resource management plans effectively implemented</p> <p>Develop managerial capacity to meet business and consumer needs</p> <p>Ability to pilot new technologies, product or practices and make informed choices about scaling</p>
Case #3: Improved fisheries governance for sustainable catch	Government policies around commercialization and abrupt changes in regulations	In Kenya, link Beach Management Units with decision makers to advocate for fishing communities and share evidence on stock and fisheries yield assessments with the government. And expanded BMU network could share monitoring information to build a platform of evidence and be able to present their work and decisions transparently to better engage the government.	<p>Participation in localized groups</p> <p>Accessible platforms for information exchange</p> <p>Strong and inclusive cooperation</p>
Case #4: Assessment of crayfish invasion characteristics and environmental impacts	Invasive species spread due to climate change and flooding	The Zambian government should work with the governments of Namibia and Zimbabwe to coordinate and plan transnationally on watershed conservation and the potential spread of crayfish into a shared river. The Zambian government, in partnership with the private sector, could also invest in and promote local crayfish traps so that local fishers could catch the invasive species in the waterways.	<p>Public investment in longer term, inclusive sector growth</p> <p>Government collect and act on information on harmful climate trends</p> <p>Strong and inclusive cooperation that influences other domains</p>
Case #5: New food product to improve nutrition during lean season	Climate and nutrition related shocks	In Zambia, the government could help connect women processors to suppliers of better drying technology to aid in drying fish to mitigate post-harvest loss and safeguard nutrition.	<p>Value proposition to customers drives competition</p> <p>Ability to pilot new technologies, products or practices and make informed choices about scaling</p> <p>Investment in customer service and satisfaction</p> <p>Basic market integration</p>