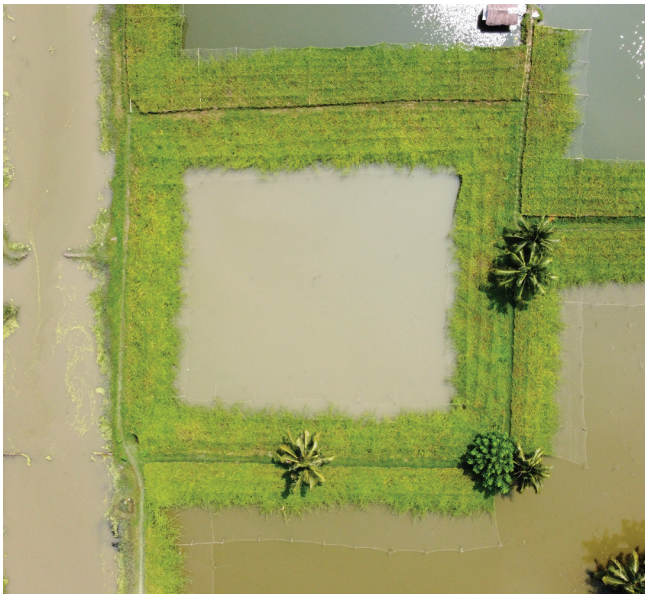
FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

HARNESSING MACHINE LEARNING TO ESTIMATE AQUACULTURE PRODUCTION AND VALUE CHAIN PERFORMANCE IN BANGLADESH

Lack of rigorous data collection means that conventional wisdom about aquaculture often lags far behind conditions on the ground and makes aquaculture production statistics unreliable. Inadequate information makes it difficult to plan and manage aquaculture development or design investments, policies, and interventions effectively. Moreover, new technologies and practices developed by innovative farmers and supply-chain actors often go unrecognized and may diffuse more gradually than they would if promoted actively by formal extension agents. Digital technologies are undergoing a revolution. Artificial intelligence (machine learning), remote sensing, smartphones, mobile internet, social media, and opensource data collection and video production software open up an array of new possibilities for cheaply collecting, analyzing, and communicating information in new forms to multiple audiences. Drawing together these strands, the research team combined survey-based research techniques with remote sensing, machine learning, and video production to generate knowledge products disseminated via digital media to reach and serve the diverse information needs of farmers, enterprises, researchers, and government. The activity had three components:



Aerial view of a patchwork of integrated fish-prawn-vegetable "ghers" in Kulna district, southwest Bangladesh. Photo by Md. Mahfujul Haque

INNOVATIVE DIGITAL EXTENSION APPROACHES

Component 1 identified emerging technologies and innovative practices in aquaculture value chains and piloted digital extension approaches to accelerate their adoption, while reducing transaction costs and time associated with traditional forms of technical research and extension. To do so, the research team followed the stacked survey method developed by Michigan State University (MSU) to survey a total sample of 1,195 value-chain actors in seven districts in the Feed the Future Zone of Influence in southern Bangladesh, comprised of 66 hatcheries, 79 feed suppliers, 721 farmers, 229 fish traders, and 100 fish retailers, around 75% of which were interviewed by MSU in 2013. Additional in-depth interviews were used to gather detailed information on innovative practices and produce short videos, featuring individuals talking and demonstrating their innovative behavior in their own words to provide easily relatable content to be disseminated widely through social media platforms.

USE MACHINE LEARNING TO ANALYZE FISHPONDS

Component 2 focused on automating extraction of data on ponds from satellite images and integrating it with georeferenced survey data to accurately estimate fish production, economic value, and employment (disaggregated by gender and age) to improve the accuracy of official statistics and enhance capacity to effectively target investments and regulation. The team utilized machine learning techniques to extract and analyze data on fishponds from satellite images. In combination with data collected under Component 1, this analysis facilitated development of an interactive online data visualization tool used to estimate aquaculture's multi-dimensional contributions to the economy and nutrition, focusing

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on production, economic value added, and employment, all differentiated by gender. The publicly available web-based tool was designed based on stakeholder consultations to facilitate user interaction with and visualization of the data generated.

BUILD RESEARCH AND ANALYTICAL CAPACITY

Component 3 worked to build organizational and individual capacity in Bangladesh by conducting rigorous research on the socioeconomic and spatial dimensions of aquaculture and contribute to the development of an enabling environment for fostering sustainable aquaculture growth. Capacity building activities included (1) stakeholder consultations on features potential users wished to see incorporated into the interactive GIS interface; (2) data collection and analytics training to build host-country researcher capacity for quantitative survey data analysis, analytical thinking, and written and oral academic presentational skills; (3) dissemination of Bangla-language extension videos via social media; (4) an online six-part remote-sensing capacity-building course for GIS users; and (5) three closing workshops to promote new and emerging technologies to private sector actors and extension agents at the national level and in the surveyed zones.

CONCLUSIONS AND RECOMMENDATIONS

The activity was highly effective in delivering multiple policy and capacity-building-oriented research outputs under extremely difficult circumstances during the COVID-19 pandemic thanks to excellent teamwork. The activity introduced multiple innovative methodologies and approaches that can be adapted for use in other contexts and locations by future projects, and it generated significant interest and proactive support from the Bangladesh Department of Fisheries. Future efforts could work to scale out these approaches to other countries and mainstream them within Bangladesh. Recommendations include the following:

- Integrate remote sensing and machine learning techniques with ground-truthing and statistically representative surveys to dramatically improve the quality and scope of aquaculture production statistics.
- Expand the application of the analytical methods developed by the activity to the national scale in Bangladesh in partnership with the Department of Fisheries, Bureau of Statistics, and internationally with other partners.
- Extension videos featuring innovative farmers and other value-chain actors can be simple and cost effective to produce, but they require professional support to maximize dissemination through social media to reach large numbers of end users.
- Virtual capacity-building activities, such as online workshops, can reach much larger numbers of participants at lower cost than in person workshops.

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

This executive summary was made possible by the generous support of the American people through the U.S. Agency for International Development (USAID) under the Feed the Future initiative. The contents are the responsibility of the Feed the Future Innovation Lab for Fish and do not necessarily reflect the views of USAID or the United States Government.