Fish production in Bangladesh has transformed over the past 20 years. Fish is the biggest protein source in Bangladeshi diets. Through the 1980s and 1990s, high prices for fish contributed to poor nutrition in the country but as fish farming—known as aquaculture—more than doubled between 2000 and 2010, prices fell, per capita annual fish consumption rose countrywide, and the expansion of pond fisheries generated more employment. While Bangladesh has not reached the productivity levels of East Asian countries, recent aquaculture growth has defied many earlier predictions and deserves to be called a “Blue Revolution.”

The Making of a Blue Revolution in Bangladesh: Enablers, Impacts, and the Path Ahead for Aquaculture examines three broad aspects of the transformation of Bangladeshi fish (non-shrimp) aquaculture: (1) the determinants of value-chain transformation, (2) the impacts of the transformation on poverty and food security, and (3) the medium-term prospects for aquaculture in Bangladesh. The authors ask crucial questions, including:

- What has enabled the aquaculture value-chain’s transformation?
- What explains the specialization and formation of fish production “clusters” around the country, and what are their impacts?
- What are the transformation’s implications for income distribution, poverty reduction, and food security?
- What is the potential for aquaculture’s further growth, given the structural and technological changes on the horizon?

The Blue Revolution and Its Drivers and Implications

Aquaculture in Bangladesh relies primarily on “pond culture,” that is, cultivation of fish in ponds, both on a small scale by households for their own consumption and on a larger, commercial scale, with greater use of inputs and labor, for domestic markets.

From 2000 to 2015, aquaculture’s share in fish production increased, rising from 30 percent to 47 percent of production; the sector’s annual growth rate has been estimated at 8.6 percent for this period. Production rose from 498,000 metric tons in 2000 to 1.7 million metric tons in 2015.
Fish consumption followed a similar pattern in both urban and rural areas: total per capita fish consumption increased from 13.4 kg in 2000 to 18.1 kg in 2010, with aquaculture contributing more than half of the overall growth. The expansion of aquaculture also led to a 12 percent drop in farmed fish prices between 2000 and 2010, even as Bangladesh’s population and demand for fish grew.

Aquaculture’s transformation has been driven by improved technology, reduced transaction costs, and value-chain innovation. The improved technology includes modern fish varieties, improved farming practices (such as use of modern inputs), and post-production marketing. Commercial pond fisheries became a major source of fish production in the early 1990s, benefiting from new highly productive and profitable aquaculture fish varieties. The yields (measured by weight) of some fish varieties are 13 times the yield of rice that could be grown on the same land, and revenues are several times higher.

Improved infrastructure and information access lead to lower transaction costs. Roads, rural electrification, and telecommunications access have all dramatically improved in Bangladesh. Between 2000 and 2010, total road length increased; the percentage of households with electricity rose from 20 to 50 percent, and cellphone ownership skyrocketed from 0.2 percent to about 75 percent. Fish trade and marketing costs have declined accordingly.

Fish value chains now involve fewer actors per unit of output. While the number of traders has increased, the increase in fish production has been much greater. Geographic “clustering” means that markets are now closer to farmers, with wholesalers and agents of processors competing to buy fish in rural markets. These improvements in value-chain efficiency lower marketing costs and consumer prices. The drawback of greater market efficiency, however, is that it eliminates small-scale traders, once important members of the value chain.

Bangladesh’s fisheries policy has not kept up with these changes. The current national fisheries policy was adopted in 1998 and, despite some subsequent modifications, could benefit from revision. This analysis of the transformation of aquaculture could help the government to reform fisheries policies.

**Enablers of the Blue Revolution**

The transformation of aquaculture is due in part to availability of new technology and improved infrastructure. But the crucial factor in transforming the fish aquaculture value chain has been domestic demand, fueled by years of sustained economic growth. The farmed-fish market increased 25-fold in three decades, with over 90 percent of farmed fish (shrimp excluded) consumed domestically. Rising demand and falling transportation costs contributed to growth in the domestic fish market, which in turn encouraged specialization and formation of fish production clusters. Together, growth, intensification, and clustering define the value chain’s transformation.

**Growth.** All segments of the fish value chain have grown rapidly in response to expanding opportunities. According to a recent fish value-chain survey, the number of hatcheries, feed mills, feed dealers, and fish traders more than doubled between 2004 and 2014, and the number of fish farmers grew by 63 percent. Moreover, efficiency increased, as production per farmer and output handled per trader grew in recent decades.

**Intensification.** Fish farmers are using more hatchery-produced seed (fertilized fish eggs), purchasing more floating feed (which, while more expensive, is also less expensive, is also
wasteful and more efficient), applying more chemicals, hiring more labor, and investing more in equipment. Intensification has led to the diversification of upstream value-chain segments, specifically feed and seed, and these segments are now tailoring their products to specific fish species and even different characteristics within species.

**Clustering.** The geographic clustering of fish production and marketing activities is characterized by an increase in fish pond area, together with an increase in the number of fish traders, fish farmers, and feed dealers. Clustering has effectively brought markets closer to the farmers. Numerous traders compete for market shares, and feed dealers bring feed from large- and medium-sized feed mills, some located far from the fish-farming areas. The demand for feed has induced hatcheries to expand beyond northern Bangladesh, the traditional location of intensive aquaculture.

Because fish farmers in highly clustered regions enjoy better access to input and output markets, they use more modern inputs, face fewer marketing difficulties, and cooperate more with other actors in the value chain. For example, fish traders act more frequently as commission agents, brokering deals between buyers and sellers. Actors in the same segment of fish value chains are also more likely to collaborate in highly clustered regions than less clustered areas, often sharing market information, tools, and labor. These advantages of clustering offset the disadvantages of intense competition.

**Poverty and Welfare Implications**

The potential for aquaculture to increase inequality has been a concern for development specialists. Because aquaculture requires land and capital, and over half of Bangladeshi households are effectively landless, it was feared that the poor would not be able to afford to produce or consume farmed fish. But the evidence shows that aquaculture has had a positive effect on the welfare of all income groups. Why is this?

Growth in the fish supply has outpaced fish demand, while value-chain improvements lowered transaction costs. Both of these trends lowered fish prices. As a result, increases in fish consumption have been more equitable than expected. Fish consumption grew across the lines of gender, region, and income, with poorer households experiencing higher growth than other groups. Considering only the impact of the decline in fish prices, all household categories, with the exception of fish-farming households, have benefited. Moreover, the magnitude of losses for fish-farming households is very small. When the impact of increased fish production is also considered, fish farmers benefit the most through rising income, although all households see some benefits.

The results of this study suggest that the impacts of aquaculture growth on income distribution and poverty reduction in Bangladesh have been substantial, even though the impacts on households in the bottom income quintile have been modest. We estimate that aquaculture’s contribution to income growth between 2000 and 2010 was 2.11 percent, including both price and quantity effects. This income growth has translated into an estimated poverty reduction of 1.7 percentage points nationwide. Although these estimates seem small, they represent a large share of overall poverty reduction between 2000 and 2010. National headcount poverty rates declined from 48.9 percent in 2000 to 31.5 percent in 2010. This implies that the growth in aquaculture has been responsible for almost 10 percent of the overall poverty reduction in Bangladesh during the first decade of the 21st century. Put differently, of the 18 million Bangladeshis who escaped poverty during 2000–2010, more than 2 million of them managed to do so because of aquaculture.

**Demand and Supply Projections to 2030**

Bangladesh’s “Blue Revolution” has improved incomes and diets. But with per capita consumption at a historic high, can domestic demand continue to fuel aquaculture growth?

Using a multimarket model, the authors project that, given increased aquaculture investment and productivity, fish production will continue to grow through 2030 and will probably outpace demand. This projected production increase will lead to a moderate decrease in prices. If production increases by 120 percent by 2030, even if demand also rapidly increases, farmed-fish prices could fall by 0.73 percent. Greater aquaculture investment, leading to a productivity gain of 2 percent, could push the production increase to 152 percent, reaching a total production of almost 7 million metric tons. Poor households will benefit from the increases in production and lower prices. Achieving this improvement in productivity will require targeted investments.

**Policy and Research Recommendations**

These findings have policy and research implications for enhancing productivity, developing markets, and building institutional capacity.

**Productivity Enhancement.** Despite the progress of the last 15 years, Bangladesh’s full potential for growth in aquaculture productivity has yet to be realized. Aquaculture productivity was only 4.26 metric tons per hectare in 2014, with a total production of 1.61 million metric tons on 377,968 hectares of pond land. If intensive fish farming, with productivity of 100 metric tons per hectare, were expanded from its current limited scope to even half of Bangladesh’s pond area, there would be a more than 12-fold increase in aquaculture production.

To realize Bangladesh’s potential, policymakers and researchers need to identify and address productivity constraints, particularly problems with fish feed. A 2017 survey on problems and challenges faced by aquaculture farmers found that three of the top problems are related to feed: the high price of fish feed, difficulty in getting fish feed on time, and poor quality of fish feed. However, more research is needed to establish the link between low productivity and feed supply.

**Market Development.** If Bangladesh realizes its aquaculture production potential, the next step is to sell fish in international markets. Unlike shrimp production, which is dominated by large entrepreneurs and largely exported, fish
farming is dominated by smallholders. Meeting international safety and certification standards will be difficult for these fish farmers, especially since non-shrimp pond culture has developed to serve domestic markets, which do not enforce food safety standards. Export promotion will require new institutional and regulatory frameworks. This is another important area for future research.

**Institutional Capacity.** Bangladesh lacks adequate regulations and data on aquaculture. An integrated National Fisheries Policy was adopted only in 1998, and a separate strategy document, the National Fisheries Strategy, was released in 2006. Neither pays enough attention to aquaculture. Some crucial regulations related to seed, feed, and other inputs were formulated in 2010-2011, and both fish feed and hatchery regulations were passed in 2011—more than a decade after aquaculture expansion began.

Improved data management and analytics for aquaculture is also needed. For example, Bangladesh’s Department of Fisheries has recognized that it lacks human capacity and acknowledged the need for a comprehensive framework for inland fisheries resources. Moreover, for the authors of The Making of a Blue Revolution, reconciling even basic data, such as production and consumption data, proved difficult.

Without a clear picture of aquaculture development, it is hard for policymakers to make sound policy decisions.

Various aquaculture-related topics not addressed in The Making of a Blue Revolution should be considered by future research. Nutrition is one: identifying the bottlenecks to improving households’ nutritional outcomes can shed light on broader food security implications. Another topic to study will be the impact of clustering on aquaculture productivity and quality. Researchers should also examine the barriers that smallholders face in switching to more intensive fish-farming practices to increase production. Such barriers include access to finance and the risks of adopting new technology. Last, researchers should study the environmental implications of aquaculture growth.

Bangladesh has two great endowments—labor and water. Just as the availability of cheap labor fueled the garment export boom, serving as an important impetus for structural transformation, so the effective use of the country’s water resources can trigger multiplier effects. The Making of a Blue Revolution provides the evidence needed to improve aquaculture policies in Bangladesh and ensure that the country’s two most important resources—its people and water—can contribute to a sustainable future.

“A compelling set of analyses on aquaculture in Bangladesh that is rigorous, relevant, and timely. Bangladesh is committed to developing the fisheries sector in a sustainable manner, and significant investments are being made to achieve that objective. I believe that the analytical frameworks and findings of the book will prove useful in policymaking.”

**Md. Raisul Alam Mondal**
Secretary, Ministry of Fisheries and Livestock, Government of Bangladesh

“A robust and insightful analysis of aquaculture in Bangladesh. This book makes an invaluable contribution to future research and policymaking and to ensuring access to a sustainable supply of safe, affordable, and nutritious fish and aquatic foods for all.”

**Gareth Johnstone**
Director General, WorldFish

“This book is very timely. Fish, shellfish, and mollusks are important sources of protein, vitamins, and minerals for the human diet, but the world’s oceans are mostly overfished and so we need to look at environmentally sustainable aquaculture for answers. This book documents how this sector has grown in Bangladesh and what it needs to do to meet future demand. As usual from IFPRI it combines pragmatism, policy, and first-rate evidence to create a commercially viable and environmentally sustainable roadmap for policymakers and investors on how they can make these nutritious foods accessible to all, especially the most vulnerable.”

**Lawrence Haddad**
Executive Director, Global Alliance for Improved Nutrition (GAIN) & 2018 World Food Prize Laureate

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