

## Innovation Brief

# Aquaculture and Global Food Security

### Overview

Feeding a global population of 7.5 billion amid increasing natural resource constraints, pollution, and climate change requires a resilient food system. More than two billion people are food-insecure as measured by calorie and micronutrient deficiencies, and they are vulnerable to shocks in food supplies and prices. In recent decades, aquaculture has emerged as one of the most dynamic and resilient segments of the world food economy. The growth of aquaculture output has outpaced that of staple crops and terrestrial animal products, and aquaculture price variability has been low relative to other food commodities. Despite substantial investments in novel and diverse aquaculture systems worldwide, scaling up the sector in ways that provide affordable, healthy and environmentally sustainable products remains a significant challenge. The U.S. government has introduced a comprehensive policy approach for aquaculture that provides incentives for innovation and regulations for environmental protection and food safety. If this policy is implemented effectively, the U.S. could go from a relatively minor role in sustainable aquaculture production to become a global leader in the coming decades.

### Problem Statement

Aquaculture has the potential to contribute to global food security and a resilient food system only if it progresses in an efficient, equitable and environmentally sound manner. Aquaculture policies will need to focus on innovation in feed technology and rearing practices for a wide diversity of aquatic species, and on adaptive regulations for food safety and environmental quality. Two key indicators of success will be: i) that consumers at all income levels benefit from aquaculture development, and ii) that aquaculture avoids the environmentally detrimental growth path generated by many industrial livestock systems around the world.

### The Facts

Aquaculture accounts for over half of fish and shellfish consumed directly by humans. According to the UN Food and Agriculture Organization, fish accounts for around 17 percent of the world's protein intake. For some coastal countries and islands, the share is closer to 70 percent. A fish-based diet has well documented health benefits for consumers across all income groups, including reduced risk of anemia, heart disease, obesity and micronutrient deficiencies. Fish also represents one of the most widely traded food commodities, with roughly two-thirds of the fish produced in developing countries destined for consumers in industrialized countries. Rising seafood demand in one country can lead to depletion of wild fisheries in another country, but trade also creates a robust global market for aquaculture products. With a growing population and struggling wild fisheries worldwide, aquaculture is expected to supply the majority of global seafood demand in the coming decades.

Over 600 species of finfish, shellfish, algae and other aquatic organisms are farmed in freshwater, brackish water and marine environments throughout the world. Aquaculture thus presents an unusual opportunity for enhancing nutrition and rural incomes in a wide variety of settings. It can also aid in rebuilding depleted wild fish populations, and can provide ecosystem services such as wastewater treatment and habitat structure. Like all animal production systems, however, the aquaculture industry has the potential to generate a wide range of environmental, resource and social problems if not managed carefully.

Forage fish such as anchovies, which account for roughly one-quarter of the global marine fish catch, are often reduced into fishmeal or oil for aquaculture feeds, and are vulnerable to collapse due to overfishing and poor management. For low-income populations that depend on forage fish as a primary source of protein, the rising demand for aquaculture feeds can cause forage fish prices to rise, jeopardizing people's food security. Alternatives to using forage fish as feed include the use of terrestrial meals and oils, mainly from crops and crop byproducts. Fish and livestock processing wastes also substitute for wild fish in feeds. Steady improvements in feed conversion ratios have been made, but certain species, such as shrimp and salmon, still require significant inputs of fishmeal and fish oil. In addition to rising feed requirements, intensive aquaculture systems create pollution from excrement, antibiotics and other chemicals, and can cause exotic species invasions, algae blooms and pathogen outbreaks in aquatic ecosystems. Finally, as the aquaculture industry scales up, it increases the demand for scarce freshwater, land and coastal resources.

With increased environmental and resource constraints in many countries, aquaculture production is moving toward the open ocean. The U.S. has the world's largest Exclusive Economic Zone and therefore has major opportunities for open ocean aquaculture in federal waters. Currently, over 80 percent of U.S. seafood consumption is met by imports, with roughly half supplied from aquaculture and half supplied from capture fisheries. The U.S. aquaculture industry is relatively small—around 2 percent of global production—and accounts for only 5 percent of fish consumed domestically by volume and one-fifth by value. Investments in U.S. aquaculture research and technology have been building for over 30 years, but the industry has been constrained by a wide range of regulations, many of which have successfully protected the marine environment. The National Oceanic and Atmospheric Administration recently released a five-year Marine Aquaculture Strategic Plan, which includes goals to double its sustainable marine aquaculture production by 2020, and to permit a limited volume of commercial aquaculture in U.S. federal waters. The plan contains strong language on sustainable resource, environment and social goals. If these goals are met, the U.S. could become a global leader in environmentally sound marine aquaculture development.

## The Challenges

The broad challenge for the U.S. aquaculture sector is how to expand production in order to reduce fish and shellfish imports and increase the volume of affordable seafood for all consumers—not just for the rich—while maintaining environmental quality and food safety. Although NOAA's current five-year strategy provides a comprehensive framework for sustainable aquaculture production, several issues could limit the plan's success, including:

- Unforeseen impacts of climate change, ocean acidification, and disease and parasite outbreaks;
- Greater dependence on wild fish in aquafeeds resulting from increased farming of high-valued finfish;
- Insufficient monitoring and enforcement of nutrient and chemical pollution, which is difficult to track from nonpoint sources;

- Significant reduction of diversity in aquaculture species and production systems akin to the experience of industrial livestock systems;
- Negative impacts on income distribution, access, and food security;
- Regulatory capture by large aquaculture firms as the industry expands.

## The Recommendations

**The U.S. is at a pivotal time in marine aquaculture development and should be vigilant in following the National Oceanic and Atmospheric Administration plans for efficient, equitable and environmentally sound production practices.**

Policy attention should focus on:

- Incentives for research and development in aquaculture feed technologies, rearing practices, confinement infrastructure, and genetics across a wide diversity of species and ecosystems;
- Nutrition, food safety and food security outcomes;
- Employment in emerging sustainable aquaculture industries;
- Public participation in the decision making process related to aquaculture siting, species introductions, and environmental regulations;
- Liability mechanisms and enforcement for producers operating in federal waters;
- Transparency at all levels of industry development.

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