FISH2.0
INVESTMENT INSIGHTS

Aquaculture: Disease Management

Disease outbreak is currently the single-greatest challenge and limit to growth in the aquaculture industry. According to a 2014 report by the World Bank, disease outbreaks cause an estimated $6 billion in losses for the industry each year.[1] For the most-afflicted sectors, such as tropical shrimp, disease can (and has) wiped out up to 40% of total stocks.[2] Moreover, disease outbreaks and chemical treatment methods trigger public concerns and have driven governments to cap operating licenses, further limiting aquaculture industry growth.

Diseases pose great operational risk and financial volatility for fish farmers. Because farmed fish spend most of their time out of sight, an initial outbreak can go undetected, then spread rapidly through the pens and kill a farm's entire stock. Months and years of investment disappear—sometimes along with hard-won supply-chain relationships. More-effective disease control enables greater planning, efficiency, and profitability. It also can lower investment risks and generate higher returns across the industry.

Disease types are manifold and vary by species and location—most are still poorly understood and managed. However, the diseases affecting the most commercially important and most expensive species are clearly receiving more focus and investment, namely: sea lice or infectious anaemia afflicting salmon, white spot syndrome and early mortality syndrome in shrimp, and oyster herpes. The prevention and treatment of sea lice in salmon is already a $1B industry and poised for continued growth.

The aquaculture disease management industry boasts a flurry of exciting innovation, with a breadth of different approaches. Notably, there is increasing focus on prevention and early detection, rather than on ex-post facto treatment. But treatments are also increasingly selective, effective, and friendlier to the broader ecosystem. The budding aquaculture animal health industry is producing investable new ventures with huge waiting markets, viable paths to scale, and exit options. In venture-capital speak: These animal health solutions are not "candy" or "vitamins" (fun or nice to have)—they are "painkillers," "vaccines" (literally), or, better yet, "contraceptives" (daily must-haves).

Fish diseases result from interaction among a pathogen, a fish (host), and a stressful environment (Fig 1). Reducing stress will limit disease, even if the pathogen is present (Fig 2).

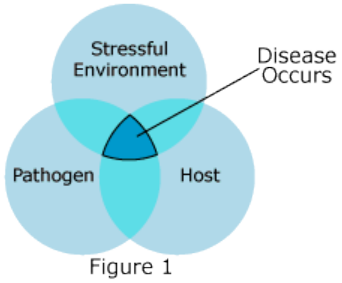

Figure 1

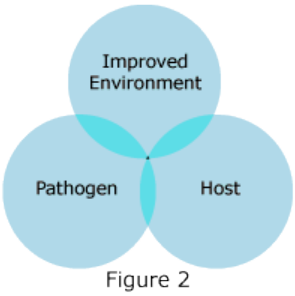

Figure 2

Opportunities and Innovation Areas

Prevention: Still the best cure

A primary disease prevention strategy is to relocate marine aquaculture farms either to land-based recirculating systems that have no contact with potential disease transmitters, or off-shore and at greater depths where the infection risk is lower (e.g., sea lice occur primarily in the top 10m of the water column). Either relocation strategy is capital intensive for farm operators and requires technological innovation to become a profitable model (see our **Marine Aquaculture Technology** paper). A less-capital-intensive method for reducing disease risk is multi-trophic farming that co-sites filter feeders (e.g., oysters, mussels) and photo-synthesizers (e.g., seaweed) with finfish.

Building resistance: Using nutrition and genetics

Effective vaccines that are easy and cost-effective to administer to animals is still the holy grail—and they have proven just as elusive in most cases. Sea lice and other diseases, for example, regularly grow resistant to vaccines and treatments over time. Therefore, researchers have tried to cultivate genetic disease resistance, either through selective cultivation or, more recently, through genetic manipulation, giving rise to new premium hatchlings. Finally, the innovative use of eubiotics, immunostimulants, and nutraceuticals as feed additives promises greater disease resistance in fish and will create opportunities for premium products in the feed sector.

Early detection: Treat before it spreads

Earlier detection and the ability to identify, isolate, and remove infected individual fish is key to preventing large-scale disease outbreaks in aquaculture operations. A wide spectrum of new, sophisticated diagnostic methods is being developed. These include a number of new underwater drones (ROVs), equipped with cameras and sensors that integrate with powerful artificial intelligence software, which are being used to monitor fish health and to identify new infections. There is also an obvious need for cheap, fast, and nonlethal diagnostic tools that can be used at commercial scales. Promising innovations include paper-based tests, akin to pregnancy or pH tests, and scanners that map the mucus layer of fish to identify infections early on.

Remedies: Chemical-free fish homeopathy

For the aquaculture industry to improve its environmental impacts, disease treatment options that are free of potentially harmful chemicals or antibiotics are needed. A range of solutions has emerged: At one end of the spectrum, we find technological solutions that use the bacteria-fighting functionality of UV light or apply ultrasound that has lethal impact on sea lice and no effect on salmon. At the other end of the spectrum, the industry is looking to harness natural solutions, such as introducing symbiotic cleaner fish species to treat salmon for sea lice.

Sources:
1. World Bank, Reducing disease risks in aquaculture, 2014.
2. Stentiford et al. Disease will limit future food supply from global crustacean fishery and aquaculture sectors. *J Invertebr Pathol.* 2012;110:141-147. doi:10.1016/j.jip.2012.03.13.

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