I'd Like The Guilt-Free Filet, Please

Steven Summerfelt and his colleagues at The Freshwater Institute are on a mission to supply the world a healthy portion of tasty, guilt-free fish. Given the pressures on wild fish populations, the state of the world's oceans, and the challenges facing traditional aquaculture, let's hope they succeed.

Fish have for ages supplied a significant part of the world's protein diet, and pressures on wild fish have steadily increased. Driving this push to harvest the seas is a steady increase in human population, and an even sharper increase in our appetite for fish – up 70 percent annually over the past 50 years. Put another way, if we each ate a pound of fish per month before, we now eat almost two. When you count all the world's hungry mouths, that's a lot of fish.

Demand is so high, that natural stocks can't come close to supplying all the need. The Food and Agriculture Organization (FAO) of the United Nations regularly surveys the state of the world's fisheries and the health of the oceans. It estimated in 2007 that 80 percent of the world's fish stocks were fully exploited or overexploited, meaning there was no room to increase catches, and in many cases a need to reduce them. Only two percent of the fish stocks the FAO monitored clearly had room to allow more catches.

Meanwhile, aquaculture has been growing faster than any other sector of food production and now supplies more than a third of the world's fish and shellfish. At its current rate of growth, aquaculture could supply half of all the fish and shellfish consumed by 2020.

That's good. However, traditional aquaculture practices present their own set of problems, ranging from excessive water use to significant water pollution to concerns about endangering wild populations with diseases and corrupting the gene pools of wild species. This is where Steve Summerfelt and colleagues come in. For the past two decades, Summerfelt and the aquaculture systems research staff of The Conservation Fund's Freshwater Institute have been systematically digging into these problems and creating innovative, long-lasting solutions that make aquaculture a sustainable practice that produces healthy fish for healthy food.

Freshwater Institute isn't near big water. That tells you something right away. It sits in a little valley off a bluestone back road near Shepherdstown, West Virginia. In early morning sunlight the stream valley has a fresh and fragile look; hardly the place to re-invent an industry. And that's the point. If you can do large-scale aquaculture here, you can do it nearly anywhere.

"We are shrinking fish farming's water and waste footprints," Summerfelt says. He's standing on a metal grating surrounding a fish tank that looks ever so much like a backyard above-ground pool on steroids.

The water is clear and bright. It looks inviting, and for a minute you consider slipping yourself over the waist-high wall to swim with the fishes – at this moment several thousand yellow perch.

This big tank – eight feet deep and 30 feet in diameter – holds 40,000 gallons of water. That water needs to be clean and well-oxygenated to support the thousands of fish it holds. If the tank were constantly pumping new water through to maintain these qualities, it would quickly consume millions of gallons, and it would carry the fish manure away, probably to the water body from which it pulled its supply. Called a flow-through system, this is the way many traditional aquaculture facilities work.

Not this tank. Its water is almost 100% reused - meaning it is cleaned and then cycled back into the tank – re-circulated through a system that holds 70,000 gallons. New water -- about 4 percent of its volume -- is added as evaporation and waste removal pull a minimum amount of water from the tank.

"We're trying to make that number smaller," Summerfelt notes.

In the tank the fish all swim counter-clockwise, like a shimmery, giant, synchronized swim team, against a current generated as the water swirls around the rim and down through a central drain sweeping the waste products with it into a network of pipes. The pipes carry the waste and water through screens and biological processes that strip the waste products -- manure and ammonia -- from the water and convert them into fertilizers ready to feed a field. The now clean water flows back toward the tanks through processes that disinfect it, oxygenate it and return it to the fish.

Nearly every tangent on this circle has been closely studied by Freshwater's problem-solving team of engineers, veterinarians, and technicians. What's the best way to clean the waste water? They've got answers. How to best disinfect the water the facility pulls from its well? They've got answers. Can we grow vegetables in the nutrient-rich waters of the waste stream? Sure, we've done that too. What's the best food for the fish? Here's the latest paper.

This last question – the best food – means a lot to the world's oceans. Fish raised in traditional aquaculture facilities are fed pellets made up largely of ground up forage fish netted from the seas. It can take as many as six pounds of fish meal to produce one pound of fish in an aquaculture pond. If forage fish continue to make up the base of the aquaculture food chain, then the pressure on the global stock of forage fishes – fish like menhaden and anchovies that eat plankton and become food for other fishes – will continue to grow. Some of these species already feel the pressure, and as their numbers decline, so does the food supply for the fish that feed on them. Meanwhile, because the supply of fish for fish food is steady or declining while the demand for more food for aquacultured fish is increasing, the price is increasing. Finally, basing fish food on other fish, pyramids the levels of accumulated toxins such as PCB's in the feed.

At Freshwater, the team has investigated the use of grain-based feeds and found that fish fed on them grow well, are healthy, and taste good. They have helped in research that has steadily reduced the

amount of fish in the feed. Research is continuing to push toward a feed that contains no animal proteins at all.

Another concern for traditional aquaculture systems is what the scientists call "bio-security," meaning that there's no secure wall between the fish in the aquaculture facility and those in the wild. This allows fish pathogens to easily travel from one population to another, potentially spreading diseases. It also means that fish that are hatchery bred for aquaculture might escape into the wild, taking their specialized set of genes to the wild population.

The closed-loop nature of re-circulating systems secures a fish farm. The water coming in can be disinfected, no fish can escape, and the limited water going out can be carefully cleaned and monitored.

Contrast this with densely stocked net pen farms, where concentrated fish waste flows directly into the surrounding ocean, or with a freshwater flow-through system where the wastes are swept into the nearby river. The wastes are significant. A European study concluded that the pollution from an average salmon farm is equivalent to discharging raw human sewage from a town of several thousand people.

Re-circulating systems protect the fish raised in them and the waters outside in another way as well. Often the fish raised in traditional systems are fed antibiotics and other chemicals needed to ward off disease. In an open system, these are flushed out directly to the surrounding waters. Because they are protected from pathogens, fish raised in closed systems seldom need antibiotics, and the water is cleaned before it is discharged.

"These systems can be built nearly anywhere," Summerfelt said, noting that some have been built in the center of cities. Given that the U.S. Department of Agriculture reports that the United States is the largest market for seafood in the world, and more than 40 percent and perhaps as much as 80 percent, of the seafood we eat is imported, this ability to locate fish farms in many places is a good thing. It means that a system that demands little freshwater and generates safe and re-usable fertilizer, that is bio-secure and that uses a sustainable source of feed, can produce healthy, tasty, fish in or near most communities.

How much more guilt-free can food be?