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The Future of Food: Fish Not Fowl Best for Planet, Scientists Say

Researchers analyzed the environmental impacts of replacing land-raised meat with farmed seafood to feed a burgeoning population and found aquaculture could preserve nearly 750 million hectares. But there could be nutritional tradeoffs.

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An aquaculture operation in Hualian, China, in 2017. Zhou Hailun/VOX via Getty Images

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Race to the Bottom: Impact of Deep-Sea Fishing Severely Underestimated

A **TEAM OF** scientists last year published findings that a tiny area of the ocean – in total about the size of Lake Michigan – could, if devoted to farming seafood, produce 100 million metric tons (110 million imperial tons) of fish and shellfish annually. That’s almost twice aquaculture’s current yield. It’s also a lot of food from a relatively small spread of water – about 1/70th of a percent of the ocean’s total surface area.

At the time, however, questions remained about whether or not this would be good for the planet. After all, most farmed seafood does not come for free. Fish and shrimp must be fed, and many commercial feed blends rely heavily on farmed grains, seeds and legumes, as well as captured fishes – what many scientists and environmentalists say is an inefficient way of using edible resources.

Now, a follow-up study from the same lead scientists attempts to quantify these impacts, and in doing so they strengthen the case that humans should be eating more farmed seafood and less meat. The new research, published in the journal Proceedings of the National Academy of Sciences, shows that dramatically boosting consumption of farmed seafood while shifting away from meat and poultry over the next three decades could significantly reduce environmental strains on the planet,

especially in terms of how much land is needed to feed farm-raised sea creatures.

“We didn’t want to do one of those studies that proposes replacing meat and dairy entirely with fish, or with vegetarian diets,” said lead author Halley Froehlich, a postdoctoral researcher at the University of California, Santa Barbara. “People have done that a ton, and we wanted to keep it somewhat realistic.”

So she and her colleagues analyzed a scenario in which current meat production remains stable while all projected increases in meat consumption through 2050 are replaced with farmed seafood. The researchers, Froehlich explained, figured that to grow the seafood would require feed that consists on average of 75 percent plant matter and 25 percent fishmeal from captured forage fishes, like anchovies, herring and menhaden. They calculated this scenario would spare about 730 million hectares (1.8 billion acres) of the planet – an area two times the size of India – that, under current trends, would eventually be required for pasture and for growing livestock feed.

Still, the new research hardly ends the debate about how best to feed the planet’s growing human population. The authors themselves wrote, “Shifting diets to more cultured seafood has comparatively lower impact on feed and land use, but does not eliminate such pressures and could result in other environmental and dietary shortcomings.” These effects include pollution, habitat degradation, escapes of captive animals into the wild and the nutritional quality of fish reared mainly on crops.

Another issue – and a factor that complicates the task of measuring efficiencies – is the fishmeal required as a supplement for aquaculture feeds, and it’s an issue that concerns fisheries biologist Daniel Pauly at the University of British Columbia. Pauly is not satisfied with the new study’s assumption that farmed seafood must be fed anything at all. Clams, mussels and oysters, for instance, are grown in open water from which they filter naturally occurring nutrients.



A salmon farm in Norway. (Artur Widak/NurPhoto)

“What makes aquaculture great is that we can produce seafood from nothing,” he said. “Clams, mussels, oysters – these animals don’t need feed, and we can feed the world with them because they create a net addition to the planet’s food supply. We cannot feed the world with salmon, because they consume more fish than they produce.”

Froehlich said that “Pauly raises a very fair point.” However, her research team focused on “direct feed species” because “most people prefer fish,” she said, and because their purpose was to compare the feed demands of farmed seafood and land-based meat.

Jillian Fry, a researcher and the project director of the Johns Hopkins Center for a Livable Future in Baltimore, considers the research a “very valuable exercise that highlights the urgent need to shift to more efficient sources of protein.”

“But we need to keep in mind that an increase in aquaculture can also have its own environmental impacts and that moving to crop-based feeds for aquaculture doesn’t mean we’ve taken care of sustainability issues,” said Fry, who was not involved in the study.

She recently published research showing that fish and crustaceans are more efficient than farmed mammals at converting a given mass of feed into body weight but about equally efficient in terms of how much of the protein they consume becomes nutritionally available for the humans who eat them. That means farmed seafood is hardly a panacea to global food resource concerns.

Pauly noted that it’s unclear how feasible it is to feed fish and crustaceans diets consisting mostly of grains and legumes.

“This is in principle possible but it makes salmon taste like tofu,” he said.

It might also compromise the nutritional value of the final product, said Max Troell, a scientist at the Stockholm Resilience Centre in Sweden who has closely studied the demands of food production on terrestrial and marine resources. He said a plant-based diet for fish and crustaceans would likely reduce the content of omega-3 fatty acids in the fish – often cited as one of the most important reasons to eat fish.

Troell also said he believes the new research doesn’t closely consider the potential environmental benefits of converting more of the population to a vegetarian diet.

“[W]e need to shift our diets radically toward more vegetarian diets to stay within the planetary boundaries,” he said in an email. “So just replacing meat with fish will not be a solution.”

In their paper, Froehlich and her coauthors outline the intense pressures that farming puts on the planet.

“Approximately 40 percent of terrestrial land is already cultivated or grazed, which has contributed to rapid loss of species diversity

and habitats, unsustainable freshwater use, substantial pollution in terrestrial and aquatic ecosystems and large greenhouse gas emissions over the past century,” they wrote.

Those pressures will increase. By 2050, the human population is expected to hit 10 billion, and if current dietary trends persist, the consumption of farmed meat will increase by 46 percent, according to the paper. Because mammals and birds are less efficient than many fishes and invertebrates at converting feed into body mass, 90 percent of what feed crops are grown on land will still be fed to cows, chickens, pigs and other livestock animals, even with a major shift toward aquaculture production.

Moreover, if aquaculture replaces projected increases in meat consumption, the production volume of seven major crop types still doubles under the scenarios studied by the authors. They found that in certain countries, including Chile, Egypt and Norway, this could actually mean more land used for growing feed. But by far the greatest increase in land used for crop production occurs under what they call the “business-as-usual” scenario of rapidly growing consumption of meat.

Froehlich said she has coauthored another paper, recently accepted for publication in the journal *Nature Sustainability*, that analyzes how expected future reliance on fishmeal from wild captured species like menhaden, herring and anchovies will affect marine ecosystems.

Pauly, at the University of British Columbia, is frustrated that society isn’t making more efficient use of these so-called “forage” species.

“I grew up in Europe, and there we don’t call them ‘forage fish’ – we call them ‘excellent fish to eat,’” he said. “The notion of feeding tons of them to bigger fish that can be sold in markets in the name of ‘aquaculture’ is absurd, because it transforms perfectly edible fish into a luxury product. As soon as that fish passes through the stomach of a salmon or a bass in a fish pen, it becomes unaffordable for the people who might have eaten it otherwise.”

He said the cost of not eating these fish is left out of calculations on the benefits of aquaculture.

“Because when someone doesn’t eat a forage fish, they might eat cow instead,” Pauly said.

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