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Farming Fish Saves Land

To satisfy the protein demands of an anticipated nearly 10 billion people by 2050, the United Nations' Food and Agriculture Organization (FAO) and researchers around the world estimate current animal production will need to grow by an average of 52 percent. Meeting this need without pushing the environment to the brink will be critical.

New evidence shows seafood from aquatic farming — aquaculture — can help feed the future global population while substantially reducing one of the biggest environmental impacts of meat production — land use — without requiring people to entirely abandon meat as a food source.

A new study from UC Santa Barbara's National Center for Ecological Analysis and Synthesis (NCEAS) found that the amount of cropland required to support future protein needs with more farmed aquatic animals would be significantly smaller than if terrestrial livestock production met those needs. This research is the first land-use analysis of future food systems to focus on aquaculture — the world's fastest-growing food sector — and helps reveal its potential role in conservation and food security. The findings appear in the Proceedings of the National Academy of Sciences.

"While aquaculture can add some pressure because — ultimately — it is a food production system, our study demonstrates the relative amount is minuscule compared to terrestrially farmed animals," said lead author Halley Froehlich, a postdoctoral researcher at NCEAS. "Aquaculture is not going to be the main strain

on future crop feed and land use. It is — and will likely continue to be — terrestrial livestock.”

Aquaculture production depends on a number of land-based crops for feed, positioning it uniquely at the interface of aquatic and terrestrial food systems. To understand its land-use implications, the researchers examined how much land would be required to grow the seven most common crops used to feed both terrestrial livestock and farmed fish under three scenarios for the year 2050, synthesizing food production data from the FAO and other scientific sources.

The investigators compared a business-as-usual scenario in which terrestrial meat consumption continues to dominate seafood to two scenarios in which aquaculture meets the additional protein demands of the global population in 2050. They found that replacing the added terrestrial production with aquaculture instead could spare between 729 and 747 million land hectares globally; that’s an area twice the size of India, the world’s seventh biggest country.

These savings, which also consider the substitution of land required for livestock grazing, would occur whether future aquaculture growth is completely marine-based or a mix of marine and freshwater — the two aquaculture scenarios the investigators assessed to understand a range of possible futures.

Land savings would be achieved because fish and other aquatic animals are extremely efficient at converting feed to biomass for human consumption. For example, a cow requires anywhere from six to 30-plus pounds of feed to gain one pound of biomass, while most farmed fish need just one to two pounds of feed to do the same. This efficiency translates into much less cropland required to grow feed for the fish that people eat.

These results highlight the role that food choices play in the future of biodiversity, the biggest threat to which is habitat lost to human land use. “The expansion of agriculture across the world is driving most species extinctions and the dramatic loss of ecosystems,” said co-author Claire Runge, a research scientist at University of Tromsø - The Arctic University of Norway, who was a postdoctoral researcher at NCEAS at the time the research was conducted. “This is only going to increase into the future. Aquaculture offers one way to reduce some of this pressure on our natural landscapes, wild places and wildlife.”

According to Froehlich, the study does not advocate aquaculture as a panacea for sustainable food production. As with any food system, tradeoffs exist. Still, these results build on mounting evidence for the potential of sustainable aquaculture production.

“Aquaculture does not have to be this massive burden on land or in the water, especially if farms are sited strategically and there are incentives for management that move it toward sustainable siting and feed practices,” Froehlich said. “The potential is ripe to really do it right.”

Co-author Ben Halpern, director of NCEAS and a professor at UCSB’s Bren School of Environmental Science & Management, noted that the study also provides a clear reason for people to shift their diets away from meat and increase fish consumption to reduce the environmental impacts of their food choices.

“What you eat has impact, but we understand shifting diets can be difficult,” Halpern said. “We hope that awareness of how much land can be spared with a fish-rich diet helps individuals make the change. Similarly, we hope our results put more ‘fish on the bones’ of policy arguments to make more systematic changes.”

Support for this study came from the Science for Nature and People Partnership, a collaboration of NCEAS, The Nature Conservancy and Wildlife Conservation Society.

About UC Santa Barbara

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