AN OCEAN OF CRITICAL PROTEIN

AQUACULTURE OFFERS A PROMISING PATH TO SOLVING THE WORLD’S IMPENDING PROTEIN SHORTAGE

Amid the many complex environmental challenges we face — climate change, habitat loss, pollution, and energy and water needs among them — is another less-obvious challenge that could exacerbate all the others: a looming shortage of protein in a rapidly growing world.

Between now and 2050, global population is expected to increase by approximately 2 billion, with the bulk of the expansion in Africa. That alone will create tremendous new demand for animal protein. In addition, the world, and especially Asia, is becoming wealthier. And while it is unquestionably desirable for hundreds of millions of people to escape poverty, that economic shift comes with an environmental price. As the poor move onto even the lowest rungs of the middle class, their demand for animal protein increases exponentially. In the past fifty years of China’s modernization, per capita meat consumption there has grown to 14 times over 1961 levels, an increase of 1,442 percent.

Combining the trends in population and wealth, experts estimate that by 2050, the world will need to produce 80 percent more animal protein than it does today. But where will it come from, and what will be the impacts in terms of such environmental factors as greenhouse gas emissions, and already-stretched land and freshwater resources?

In one recent large-scale assessment of those impacts, researchers examined every conceivable way to bridge the protein gap on land. Even under best-case scenarios, they found, the environmental costs would be...
enormous. Producing the additional protein from meat alone would require an additional 1 billion hectares of land, an area three-quarters the size of South America. It would add 3 gigatons of greenhouse gas (GHG) emissions; that’s 72 percent of China’s current emissions and 132 percent of current U.S. emissions. And it would require a Lake Huron’s worth of water.

Given that land-based production clearly will not work, a couple of years ago, Bren School dean, Steve Gaines, who co-founded the Sustainable Fisheries Group, began thinking of the challenge in terms of using seafood to bridge the protein gap. But most of the world’s wild fisheries are depleted. So, Gaines thought, what if you could rapidly return every wild fishery in the world to optimum sustainable production?

That led Gaines, and Bren professors David Tilman, a terrestrial ecologist who was involved in the initial land-based protein study, and Hunter Lenihan and Ben Halpern, Bren School marine ecologists, to look at aquaculture. Mariculture has received a great deal of attention from the environmental community, mostly focused on impacts such as land conversion, entanglement of marine mammals in equipment, disease, and escape of exotic species. Since environmental impacts are part of every type of food production, the researchers decided to compare impacts across various types of animal protein.

They quantified the impacts of the most common types — beef, pork, chicken, mutton, goat, and fish/shellfish — in terms of several environmental impacts. They then compared the impacts of using just one type of land-based protein and one type of aquaculture to meet the projected protein demand. The results are remarkable. Even using average current aquaculture practices, which are improving rapidly, aquaculture far outperformed every type of land-based animal protein and, in some cases, even land-based vegetable protein. The contrast is particularly stark when beef, the most common form of meat, is compared to mussels.

As mentioned above, bridging the animal-protein gap with beef alone would require nearly another South America of land. By contrast, meeting the need with only one kind of farmed seafood — mussels — could be done in a space equivalent to the length of New Zealand’s coastline. In terms of GHGs, using mussels to meet the entire world’s projected growth in protein demand would add a paltry amount of new emissions, about 125 percent of what the state of Texas emits now, not 70 percent of China’s current emissions. Finally, when it comes to fresh water, mussel production does not require a Lake Huron of fresh water, nor even a Walden Pond. It requires no new fresh water at all.

This Bren-led collaboration has shown that a challenge clearly unsolvable on land is eminently solvable with aquaculture. And any mix of fish, shellfish, and other marine animal protein is far superior to any mix of land-based meat production. Supported by policies that incentivize the shift to a seafood diet, the world can top out its population and still have enough protein to feed upward mobility.