Can the Arctic's icy waters solve aquaculture's sustainability problems?

By Cheryl Katz (https://thefern.org/author/cheryl-katz/), February 4, 2018

In April, at a smelting factory in Arctic Norway, the world's largest photobioreactor will begin churning out fish feed grown on pollution. The feed, or microalgae, will provide a critical source of omega oils for prized Norwegian farmed salmon, while digesting carbon dioxide from industrial smoke piped through the bioreactor, says Hans-Christian Eilertsen, a marine biologist with the Arctic University of Norway.

Fast-growing and lipid-rich, these cold-loving microalgae can provide an environmentally friendly, low-cost alternative to current aquaculture feeds, said Eilertsen, one of dozens of scientists at the Arctic Frontiers Conference in Tromsø, Norway, in late January. The conference was focused on ideas for boosting sustainable food production from the ocean in this rapidly changing region.

The world's appetite for seafood is climbing, and the oceans will become increasingly vital to the global food supply as the human population rises. Wild fish stocks, however, are declining, and won't be able to meet the increased demand. Aquaculture, a growing industry

(http://www.fao.org.libproxy.berkeley.edu/in-action/globefish/market-reports/resource-detail/en/c/338597/) worldwide, is an obvious solution. But sustainability has been problematic, especially on the issue of what to feed farmed fish. The main sources of aquafeed today — fishmeal and oil from small, wild fish; soy and other plant materials — risk depleting wild fish stocks, and also exacerbate competition for limited arable land.

Instead, scientists say, we should be looking much further down the food chain for nutrient sources in aquaculture. “Business as usual is not sustainable,” said Michaela Aschan, a professor at The Norwegian College of Fishery Science and the Arctic University of Norway. “We really need to change our production … mainly by focusing on lower trophic levels.”

The “algae factory” about to start up at the Finnfjord (http://www.finnfjord.no/en/the_worlds_most_energy_efficient_ferrosilicon_producer) metal fabricator in Lenvik, Norway, well north of the Arctic Circle, shows how the high north can help lead this effort. The frigid waters are home to hundreds of species of cold-loving algae that feed on dissolved carbon dioxide and could be used to produce omega-3 oil, a key ingredient in fish feed. Cultivating fast-growing microalgae is the quickest way to produce large quantities of lipids and nutrients essential for fish growth, Eilertsen said.

While some oil derived from microalgae is already being used in aquaculture, Eilertsen said his process, utilizing smoke and cooling water from the factory, can provide a much-needed increase in yield. On top of that, he said, the algae actually thrive on the factory smoke, which appears to clean the cells and spur their growth. The output — up to 250 kilograms a day in its pilot phase — will be used by a commercial aquaculture operation in the area.

Insects are another promising new aquafeed from the lower end of the food web. This ubiquitous protein source was recently approved for fish feed in Europe (http://www.fefac.eu/news.aspx?CategoryID=2094&EntryID=23632) and Canada (https://www.feednavigator.com/Article/2017/02/16/Enterra-Canada-approves-dried-larvae-from-insects-for-fish-feed). Approved species in Europe include the common housefly, mealworms and crickets, among others, while Canada is limited to black soldier fly larvae. In

Norway, the world's top producer of farmed salmon, the first fish raised on mealworms are now maturing in a fjord. Later this month, they'll be served at a dinner in Bergen, hosted by the Norwegian Institute of Marine Research and its industry partner, Cargill.

Other alternatives being investigated include feed derived from biofuel and timber industry waste products, trimmings from poultry processors, bacterial proteins, seaweed, blue mussels, and more. Researchers are working on cold-adapted algae that could be grown in sea ice, glaciers or snow.

The technology, however, needs further development. Cost, too, is a big hurdle. Prices for sustainable aquafeeds are coming down — for example, insect meal now costs around $2 per kilogram. But that's still higher than the price of conventional fishmeal feeds, which average closer to $1.50 per kilogram or less. Algae-based oil today costs twice as much (https://www.ft.com/content/651ad428-2511-11e7-a34a-538b4cb30025) as fish oil. And the scalability of these new feeds remains an issue.

"The high north has potential in terms of space and pristine conditions for farming," said Erik-Jan Lock, research leader on fish nutrition and welfare at the Norwegian Institute of Marine Research. "Those waters are also very productive, so if we are able to harvest at lower trophic levels from those areas it could provide a lot of biomass."

But Lock is quick to add: "Rough seas and cold, dark winters—the weather and the distance from the market, will provide many challenges."

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