

Red Tape Slows Bloom of Seaweed Farming's Green Revolution



SOUTHOLD, New York – Seaweed cultivation in the U.S. is growing quickly, cresting on its promise as a sustainable, low-impact form of aquaculture that could help feed millions. But tough state rules surrounding commercial use of coastal resources are preventing many would-be entrepreneurs from diving into the market.

Fifteen farms currently have permits to commercially grow kelp in the Northeast, up from zero prior to 2008, according to [Dr. Charles Yarish](#), an internationally recognized seaweed expert and professor in the Department of Ecology and Evolutionary Biology at the University of Connecticut in Stamford. Some of the new farms are using a technique known as vertical or 3-D farming – using the water column to grow a mix of seaweed and shellfish – to get the most out of their relatively small operations.



University of Connecticut researchers pull seaweed out of Long Island Sound. Drs. Charles Yarish, J.K. Kim/UConn

Most would-be kelp farmers on the West Coast, however, are in limbo as states work to establish regulations. Thus far only Washington has regulations in place, and just one research project under way. One farmer who has leased a former kelp research plot in Southern California hopes to begin farming there as soon as the state approves the transfer.

Even in states where regulations are in place, however, the permitting process is “very onerous,” Yarish said, with approval required from both

state and federal authorities.

Yarish says the approval process is deliberate because regulators are determined to avoid environmental damage – including excessive nutrient discharge, escapes of farmed animals and spread of disease – inflicted by some big aquaculture operations of decades past.

Many states also are moving slowly because “coastal managers are invariably very skittish about doing something new without statutory authority,” he said.

Interest in seaweed has been peaking in recent years, both because of its nutritional value -- it is packed with vitamins A, B and C, as well as iron and protein -- and its minimal environmental footprint: It requires no fertilizers and in fact helps clean seawater by absorbing [nutrient pollution](#) from wastewater treatment facilities and runoff from farms and urban areas.

The Northeast coastal states – Connecticut, Maine, Massachusetts, New Hampshire, New York and Rhode Island – all have regulatory frameworks in place for kelp farming. Connecticut, Maine, Massachusetts and Rhode Island all have commercial operations in production, with farms in New York and New Hampshire expected to raise their first crops later this year.

On the West Coast, Alaska, California and Oregon all are working on creating regulatory frameworks. (Kelp – a large, brown edible form of seaweed -- thrives in colder water, hence the interest from northern states; other types of seaweed might eventually be able to be raised in warmer southern waters, according to Yarish.)

In addition to obtaining a lease and getting state approval, kelp farms need federal aquaculture permits issued by the U.S. Army Corps of Engineers. Yarish said the agency “gets it” as far as the economic and environmental benefits of kelp and has not been a bottleneck in the permitting process.

“All the states have

Despite being a champion of kelp farming, Yarish doesn’t take issue

really come around and they are all working to try to facilitate the permitting operations. It takes time.”

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“All the states have really come around and they are all working to try to facilitate the permitting operations. It takes time,” said Yarish. “Just let everyone work at a speed which ultimately protects the environment, protects the entrepreneur and also protects public interest.”

Among those eager to join the kelp revolution is 57-year-old Karen Rivara, who has more than 30 years of experience spawning oysters, clams and bay scallops in the Long

Island community of Southold. She plans to add kelp if she gets a permit to grow it in the Peconic Bay in time for the coming growing season this fall.

Rivara says adding the crop will diversify her business and also help the environment in Long Island Sound by helping reduce the high levels of nitrogen in the water, primarily attributable to coastal septic systems.



Karen Rivera of Southold, New York, hopes to add seaweed cultivation next year to her shellfish hatching operations on Long Island's Peconic Bay. Petra Cahill / for NBC News

“Because you can’t mitigate all the human impacts that put excess nitrogen into the estuary, the kelp will at least absorb some of that,” Rivara said.

Yarish, 68, who has spent decades researching the benefits of “nutrient bio-extraction” from an aquatic ecosystem by seaweed and shellfish, says kelp is incredibly efficient at removing inorganic nutrients – like nitrates and ammonium – while shellfish indirectly extract organically bound nutrients from the seawater.

According to data gathered by Yarish’s research program at UConn, sugar kelp removes roughly 180 kilograms of nitrogen per hectare (about 2.47 acres).

“That’s a lot,” he said.

The National Oceanic and Atmospheric Administration also [is researching](#) whether seaweed farms may have the ability to reduce ocean acidification.

To learn the ins and outs of kelp farming, Rivara is working with Yarish’s researchers at the University of Connecticut and Bren Smith, the so-called

“Kelp King” who has helped popularize kelp and so-called vertical or 3-D farming.

“He’s really gotten people in Connecticut – people who are old-time oyster farmers and new farmers –all trying kelp,” she said of Smith. “And because of the water quality over there and the fact that the state permits it on a commercial level, they are doing really well.”

‘Kelp King’

Smith, 43, is a leading advocate of using the water column to grow a mix of seaweeds and shellfish. This is done by laying horizontal lines across the surface of the water and then having seaweed grow vertically down next to scallops and mussels in nets, with oysters in cages below and clams buried in the sea floor.

He also created a nonprofit outreach organization, [GreenWave](#), to extol the virtues of what Smith calls “restorative 3-D ocean farming” and help create stable new markets for kelp.



Bren Smith, GreenWave executive director and owner of Thimble Island Oyster Co., pioneered the development of restorative 3-D ocean farming. GreenWave

Smith, who developed his method of farming in collaboration with Yarish, was motivated by practical reasons.

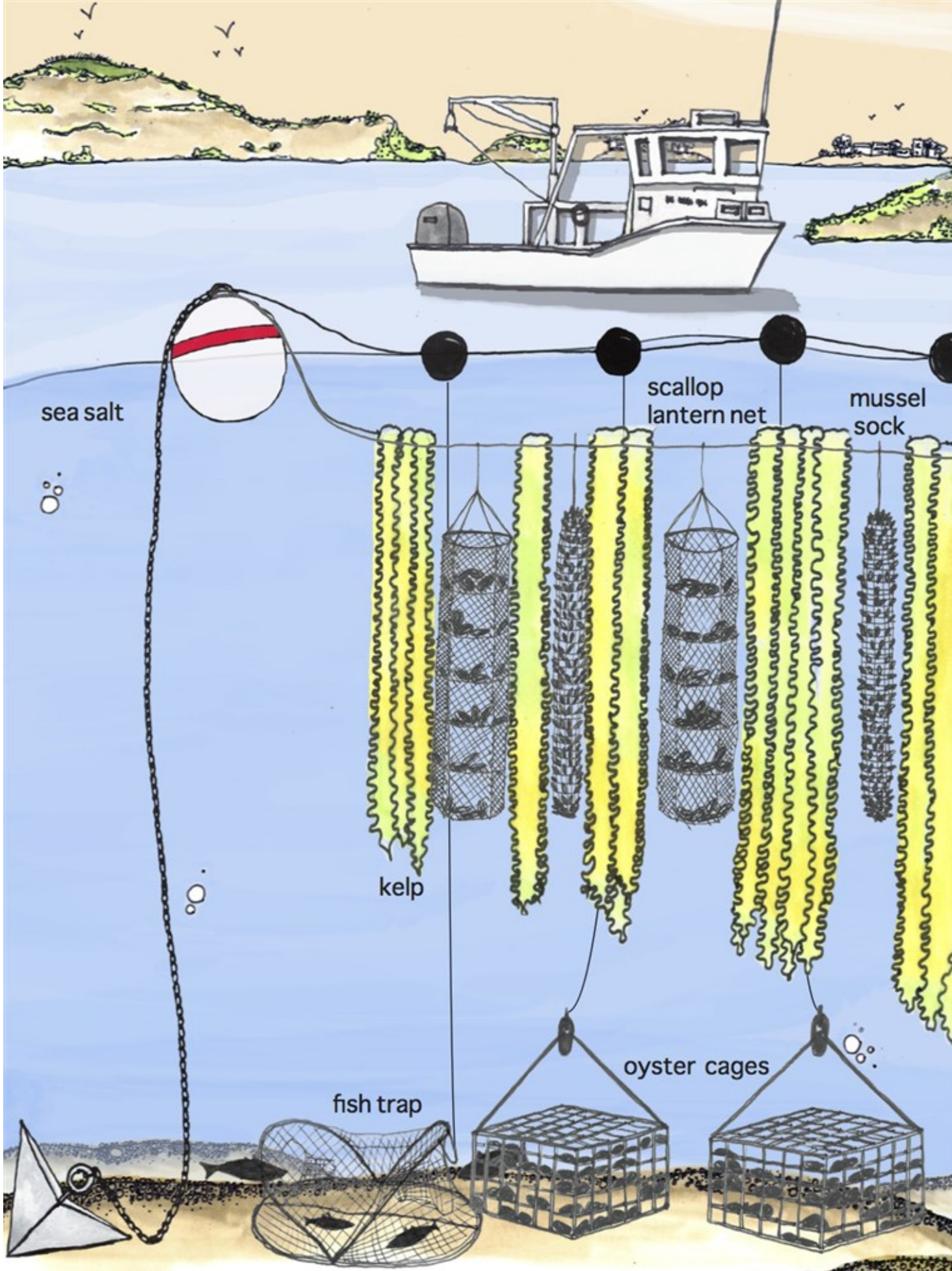
A lifetime fisherman, Smith was born in Petty Harbour, Newfoundland, and began fishing at 14. “You name it, I fished it,” he says.

He did commercial fishing of cod and crab in the Bering Sea in the 1980s, one of the most dangerous jobs in the world – particularly for a non-swimmer. Then sickened by overfishing, he switched to aquaculture and salmon. But he quickly realized that wasn’t sustainable or environmentally sound. He reinvented himself again in the early 2000s and became an oysterman in Long Island Sound – but then Hurricanes Irene and Sandy buried his crops.

After Sandy, Smith said, “I just realized I had to adapt and shift and restructure the farm.”

Smith’s says his seaweed and shellfish farm in Stony Creek, Connecticut, about 12 miles from New Haven, produces a huge amount of food in a small area.

“Say my farm used to be 100 acres, now it’s down to 20 acres and it grows significantly more food than ever before,” said Smith. “I can grow 10 to 30 tons of seaweed and 250,000 shellfish per acre.”



An illustration of a 3-D or vertical ocean farm from GreenWave shows how underwater agriculture works, with kelp growing adjacent to scallops, mussels and oysters. Stephanie Stroud

‘Superman of foods’

Daniel Marquez, 51, of Goleta, California, also has been working with Smith and Yarish in hopes of pioneering seaweed farming in the Golden State.

Marquez, who was assistant director for facilities management at University of California-Santa Barbara until retiring last year, says he and his wife initially hope to use the kelp they produce in a line of cosmetic products she is developing and sell seaweed extract to pharmaceutical companies.

Marquez was able to cut in line in California – even before the state has developed regulations for farming seaweed – by obtaining a lease on a 25-acre lot just west of the Ellwood Pier in Santa Barbara, which had been previously been used by two marine biologists for kelp research: He has been waiting eight months for the California Department of Fish and Wildlife to approve the name switch on the lease. Since the plot already was permitted for kelp, he believes his request will be approved.

In the meantime, he spent about a week in Connecticut early this summer apprenticing with Smith and Yarish and will be back in August.

“Some people say kale is a superfood, but kelp is the Superman of all foods.”

“I’m really excited. This is my second life,” said Marquez. “The knowledge I’m acquiring and the people I’ve met have been amazing. I’m very much looking forward to being out on the water and helping the environment.”

“Some people say kale is a superfood, but kelp is the Superman of all foods.”

He also is a big believer in the nutritional and health benefits of kelp.

“Some people say kale is a superfood, but kelp is the Superman of all foods.

It has everything we need,” Marquez told NBC News. “Its amazing stuff ... what it does for the inside of your body and the outside.”

Making U.S. inroads

But is there a U.S. market for kelp?

Yes, says Smith, and demand is growing exponentially.

Seaweed is actually a [\\$5.6 billion industry globally](#), according to the Food and Agricultural Organization of the United Nations, with most sales in Asia.

In addition to its uses as food, seaweed is used in a wide range of products, including nutritional supplements, fertilizers, animal feed and cosmetics. It is even used to make ice cream smooth and its extracts in creams and lotions are said to help the skin's moisture levels by increasing blood circulation.

But it also is making inroads in the U.S.

Kelp chips and crackers already have made a dent in the U.S. snack market with retail sales valued at over \$250 million in 2014, according to [New Nutrition Business](#).

And Smith said chefs are embracing it as an ingredient in a variety of dishes.



He and other farmers affiliated with GreenWave currently sell all the kelp they produce to restaurants and partners like Google – where it is

incorporated into the menu in corporate cafeterias that feed about 100,000 employees daily.

Smith and GreenWave hope to eventually sell directly to customers, and expand to other non-food uses like biofuel, skincare and animal feed.

Greenwave also does research and development to help market the kelp and create corporate partnerships, including one with the environmentally conscious outdoor wear company Patagonia.

And it helps new farmers get off the ground by providing apprenticeship training and other assistance, including pro-bono legal support to help with the permitting process, start-up grants, seasonal gear provided by Patagonia and guaranteed purchase of 80 percent of crops at triple the market rate for the first five years.

The buy-back program helps newcomers get their feet wet in the industry, Smith says.

“So while people are being trained, they can actually make a living,” he said. “They know what they grow is going to get bought. The global price of kelp is very low (but) because of our infrastructure, because of our marketing strategy, we are able to sell out the other side and actually make money and then pump that back into GreenWave.”

‘Good’ aquaculture?

Massive fish farms and other corporate forms of aquaculture have been criticized for a host of environmental problems, but seaweed and shellfish aquaculture avoids many of those issues, according to George Leonard, chief scientist at [Ocean Conservancy](#), a nonprofit environmental advocacy group headquartered in Washington, D.C.

Leonard, who lives in Santa Cruz, California, and has a Ph.D. in Marine ecology and evolutionary biology, explains that seaweed and shellfish aquaculture avoid many problems associated with “fin-fish aquaculture” because they are “non-fed aquaculture,” meaning they don’t require any

food or chemicals beyond what nature provides.

“Aquaculture is not a panacea to the world’s problems,” said Leonard.

“But, I think aquaculture done right, in the right places, can be a major contributor to (fixing) what ails the ocean and what society needs from our living and healthy ocean.”

Both Yarish and Smith say they have been getting inquiries about their work from all over the world.

“We’ve had requests to start farms in every coastal state and province in North America,” said Smith. “And now more than 20 countries around the world; the calls keep coming in. We’re absolutely overwhelmed.”

To help spread the word even farther, they have developed open source material through GreenWave that is available to potential farmers around the world. Yarish and his team at [UConn also published](#) a guide to the [cultivation of seaweed](#) and created a [six-part YouTube](#) tutorial with funding from the NOAA and the National Fish and Wildlife Foundation that’s been translated into Spanish.

Smith’s ultimate goal is to create a series of what he calls “GreenWave Reefs” every 200 miles up and down the coast. Each would have 25 to 50 farms, a seafood sales hub for their produce, a hatchery, a ring of institutional buyers and then a ring of social entrepreneurs developing value-added products.

“I call this the ‘nail salon model’ of the sea,” he said. “Anybody with \$30,000, a boat and 20 acres can start their own farm. The low barrier to entry is what we believe is the way to scale.”