

The Solution In The Sea:  
New York recently legalized commercial kelp farming. Will it help solve the state's environmental and economic woes?

by

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### ABSTRACT

In 1985, an algae bloom, fueled by nitrogen pollution, transformed the Long Island Sound into a dead zone. Though the area has somewhat recovered, the people and marine life that rely on these waters still feel the impact decades later. Many are hoping that kelp farms can help. Kelp farming is a nature-based mitigation strategy that removes pollutants from ocean water while also providing a commercial crop that can be eaten and used in products ranging from pharmaceuticals to fertilizers.

With support from an ocean farming nonprofit called GreenWave, kelp farms have popped up across the country, but it's only recently that New York has embraced this form of aquaculture. Last December, the New York State Senate passed a bill that legalizes farming certain kelp species during winter months on 110,000 acres of underwater land in Peconic Bay and in Gardiners Bay nearby. The bill has broad support from farmers and environmental groups, but problems with permitting and lack of infrastructure raise questions about how much economic or environmental impact the crop will have statewide.

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As a child growing up in Sag Harbor, Long Island, Fred Thiele, Jr., would go down to the water with friends, fishing poles and buckets in tow, to catch fish and dig up clams in the Peconic Bay. For him, fishing was part of life in the 1950s and 60s, “kind of a second nature thing,” he says, and the Bay was always stocked full of fresh catches. “As a little kid, you could just drop a line in the water and pull out blowfish,” he says. “Our water was productive.”

The Peconic Bay, dubbed one of the “last great places in the Western Hemisphere” by historian Marilyn E. Weigold, is located in Suffolk County, about 80 miles east of New York City. Situated between the northern and southern forks of Long Island, the Bay boasts rocky and sandy shores, majestic views of Connecticut, and a habitat for hundreds of marine species. It was also once home to one of the biggest scallop industries in the country, but that changed starting around the 1970s.

At that time, Thiele was in high school. The population of Long Island’s East End nearly doubled, from 70,000 to 150,000 full-time residents in a few short years, and with that growth came more seasonal residents who bought second homes in the area. Housing development skyrocketed. Fields and forests quickly turned into subdivisions and single-family homes. Nitrogen and phosphorous-rich pollution generated from those projects ran straight into the Peconic Bay, and so did runoff from fertilizers on manicured lawns and sewage that leaked from septic systems that couldn't properly contain and filter the effluent. Then, something came to eat all that pollution up.

Residents called it the Brown Tide. In 1985, microscopic marine algae called phytoplankton — *Aureococcus anophagefferens* in scientific parlance—took over the water. Thriving off of the accumulated nutrients, the phytoplankton quickly spread. It formed dense, muddy-brown curtains along the water’s surface, blocking sunlight from reaching plants below. Phytoplankton produce oxygen while they’re alive, but trouble starts when they die a few days after arriving on the scene. As the Peconic phytoplankton decomposed, bacteria and fungi fed on the remains, depleting enormous amounts of dissolved oxygen in the process and transforming the Bay's teeming waters into a dead zone. Damage was massive, especially for seafood harvesters. Between 1985 and 1986, the Bay’s scallop fishery lost an estimated \$4.5 million. The following year, average fishery landings plummeted from 300,000 pounds to just 300. “We all realized that you couldn't take water quality for granted anymore,” says Thiele, later adding, “There was this realization that this resource was not infinite.”

Since then, there have been tremendous efforts to reverse declining water quality in the Peconic Bay, including multi-million-dollar programs to improve septic infrastructure and to upgrade wastewater treatment plants. But, it hasn't been enough. A water quality report from Stony Brook University showed

that between June and October of 2021, record-setting algae blooms and dead zones hit every major estuary and bay around Long Island. “We have a plan to address the problem,” says Thiele. “Kelp is part of that plan.”

Thiele is an assemblyman who represents New York’s first congressional district, which includes the Peconic Bay and parts of the surrounding Suffolk County. To clean up the area and restore the shellfish economy, Thiele has spent the last seven years pushing for legislation that would legalize commercial kelp farming in New York state. Kelp farming is a nature-based mitigation strategy that removes pollutants from ocean water while also providing a quickly-regenerating commercial crop that can be eaten and used in products ranging from pharmaceuticals to fertilizers.

With backing from Thiele, state Senator Todd Kaminsky sponsored Senate Bill 6532A, better known as the Kelp Bill. Passed on December 7th, 2021, the bill legalizes farming certain kelp species during winter months on 110,000 acres of underwater land in the Peconic Bay and in Gardiners Bay nearby.

The bill comes on the heels of a boom in kelp farming across the coastal US. Though the United States hasn’t traditionally been a big player in the industry—China produces over 17.5 million tons of seaweed annually, which is more than half of the world’s total production—kelp is the fastest-growing aquaculture sector domestically. Close to 1 million pounds currently come from US waters every year, but as legislation and permitting increasingly become streamlined, the market is expected to quadruple by 2035.

With support from an ocean farming nonprofit called GreenWave, kelp farms have popped up across the country in places like Washington state’s Puget Sound and Alaska’s Delta and Sound regions. Northeastern states, including Maine, Massachusetts, and Connecticut, have also embraced kelp’s potential with their own small-scale markets.

New York’s Kelp Bill has broad support from farmers and environmental groups, but as coastal communities struggle with the issues this bill purports to solve, problems with permitting and lack of infrastructure prevent kelp farming from expanding and raise questions about how much economic or environmental impact the crop will have.

### **Betting beneath the sea**

Like Fred Thiele, the Shinnecock Nation has also seen their waters and economies change, and they’re banking on kelp to help. The Shinnecock are a federally-recognized Indigenous Nation whose territory

cascades down the southeastern shore of Suffolk County, sitting south of the Peconic Bay and just below Shinnecock Hills. The Nation survived off of the water in nearby Shinnecock Bay for 13,000 years. As expert fishermen and whalers, the water “provided all of our food, nutrients, vitamins, and has always been a place of abundance,” says Tela Troge, an attorney of Indian Law and member of the Shinnecock Nation. But that era of abundance is long gone.

Shinnecock territory has shrunk. In the 1700s, the Nation occupied close to 5,300 acres of land. Shinnecock territory went as far as Mastic, which is 30 miles east of the Shinnecock Hills, to East Hampton and down to Southampton going toward the Atlantic Ocean. But over the years, numerous land disputes against New York state, the Long Island Railroad, and New York University, among others, have whittled the territory down to just 800 acres. Meanwhile, the area surrounding the Shinnecock has grown considerably.

Shinnecock territory is sandwiched between the Hamptons—a collection of beachside towns where average home prices top \$2 million—and is adjacent to Cooper's Beach, one of the most popular vacation spots in the state. Rapid high-end development throughout the Hamptons has created enormous inequity, both environmentally and economically. On one side of Shinnecock Hills, “you have billionaire’s row where some of the wealthiest people in America have homes,” says Troge. “Then on the other side, you have Shinnecock territory, where 70 percent of us are living in complete poverty.”

The Shinnecock reservation is one of the most underdeveloped areas in the Hamptons. Homes here are modest and built with capital that members pooled together on their own—because Indigenous land is often owned communally, residents can't use it as collateral to secure mortgages or home improvement loans. Making a living is difficult, Troge explains. Some families live on just \$6,000 a year, most of which comes from seasonal work during summers and holidays when billionaire’s row vacationers need home maintenance or entertainment. When the COVID-19 pandemic hit in 2020, many of those income sources almost completely shut down, drastically increasing the need for reliable paychecks.

As the Shinnecock struggle to survive, their neighbors over the hills lead very different lives. On Meadow Lane—a wide, tree-lined street on billionaire’s row just minutes away from Shinnecock territory—tall manicured bushes growing alongside equally tall gates almost hide the mansions entirely. Some of the bushes have just enough space between them to reveal multiple-door garages and neat lawns, many of which are maintained by Shinnecock workers.

What visitors don't see are the marshes that were drained to build these homes or the chemicals that run off of the neighborhood's lawns and development projects straight into Shinnecock Bay waters. They also don't see the problems brewing down below. Many homes throughout the Hamptons don't have

proper septic systems that can adequately contain sewage. Roughly three out of every four homes here rely on older systems that use underground cesspools, often made of concrete or brick, that allow waste to leach into the soil and make its way into the water. Three-quarters of the nitrogen found in these waters come from faulty and older septic systems, and, over the last few years, these waste problems have gotten much worse. During the global pandemic, wealthy New Yorkers fled the city to live in their summer homes year-round, putting even more pressure on crumbling underground infrastructure.

The Shinnecock don't live in these wealthy communities or have access to their amenities, but they do disproportionately suffer the environmental damage these communities cause. Suffolk County's public drinking water has one of the highest nitrate levels in the country, according to county data. In humans, nitrate overconsumption reduces the blood's ability to carry oxygen and is linked to several types of cancer, including colorectal, ovarian, and kidney. In sea creatures, nitrate overloads and the algae blooms that come after are deadly. "You can talk to anyone doing aquaculture here, they're hurt," says Matt Ballard, a Shinnecock Nation member and Troge's partner. "Fish and everything else out here is all being polluted."

The Shinnecock are turning to kelp for help. Indigenous communities around the world have harvested kelp for centuries, but many were either forced or pushed to drop the practice under colonialist rule. In the United States, tribal sovereignty laws allow Indigenous groups to grow and harvest kelp within their own territories, even in states where the practice is prohibited elsewhere. In the last decade, some Indigenous communities, like the Eyak peoples in Alaska's Copper River Delta, have started kelp operations to both leverage the crop's economic and environmental benefits and to reconnect with lost practices and traditions. That's Troge's hope, too.

In 2019, an ocean farmer in nearby Connecticut named Bren Smith approached the Shinnecock Nation with a proposition. Smith is the founder of GreenWave, a nonprofit that helps launch new kelp hatcheries worldwide using a model called regenerative farming that combines kelp and shellfish production. He had recently seen *Conscience Point*, a documentary film that chronicles the decades-long battle between the State of New York and local Indigenous groups over land and water rights, and wondered if the Shinnecock would be interested in launching a hatchery with financial and training support from GreenWave. Their model "so closely matched our skills, our expertise, our traditional ecological knowledge," Troge says. For the Shinnecock, Smith's offer was a no-brainer. They just needed a place to do it.

The following summer, the Shinnecock Nation held a month-long protest in Hampton Hills to shine a light on living conditions on the reservation and to push federal and state governments to provide more aid. To support the fight, the Sisters of St. Joseph, a Catholic community well-known for their

environmental and social justice work, offered to let the protestors use a cabin located on their seven-acre bayside villa—land that was once part of Shinnecock territory—as a spot to organize and rest. But it quickly became apparent to Becky Geina, a Shinnecock leader who was featured in the documentary, that this place could be more than just a basecamp for protesters. It could be ground zero for the first Indigenous-led kelp farm on the East Coast. The Sisters agreed.

In August of 2020, Troge and five other Shinnecock women launched a cooperative hatchery called Shinnecock Kelp Farm, which is headquartered in the cabin's living room. Across from a makeshift desk where Troge works, two large aquarium tanks, both filled with water, sit on tables side-by-side. Thick, white plastic rings, each seeded with microscopic sugar kelp spores, rest at the bottom of the tanks. Next to the tanks, PVC pipes called “spools” are filled with a mixture of seawater, kelp spores, and other nutrients. A long nylon cord hanging inside offers infrastructure for baby kelp to grow.

Once the spores sprout and grow a couple of millimeters, the nylon cord will be removed and carefully wrapped around long ropes that get planted in the water. Then, there’s a wait. Kelp doesn't require much tending—no fertilizers, pesticides, or pruning necessary—so the Shinnecock team will wait four to six months before pulling the lines up, harvesting the kelp, drying it, and processing it before it's manufactured into fertilizer additives. For now, the Shinnecock are holding off on making kelp products for human consumption or personal use until their first season's harvests can be tested for pollutants. For the coming fall, they hope to process some of their harvest for cosmetics and edible products.

The Shinnecock farmers view this past season as a pilot program, one they hope will prove to potential investors that the farm can produce significant amounts of kelp and that it's worth expanding in the coming years. Danielle Hopson Begun, a co-founder of Shinnecock Kelp Farmers, says that they're well on their way to that goal. Last season went so well, the farm was able to give extra spores back to GreenWave to support their partner farmers. Despite battling outbreaks of slip gut—a type of algae that grows on sugar kelp and suffocates it—the farmers harvested 100 pounds of kelp and plan to beef up production next season. “We going from 20 spools to 200 this year,” Hopson Begun says.

For Troge, success isn't defined by how big the harvests are; it’s how well the farm can bolster the community around it. She is delighted by the prospect of being financially secure enough to bring on additional hands. “I'm just really excited about building up to the point to offer people living wage jobs,” Troge says.

## **Why kelp?**



The Shinnecock Kelp Farmers aren't the only ones betting on kelp. Technically a type of seaweed called brown microalgae, kelp is attractive to seafood harvesters, in part because it's cheap to grow, says Halley Froehlich, a marine biologist at the University of California, Santa Barbara, who studies sustainable ocean aquaculture.

Compared to land-based crops, kelp requires very few resources—just spores, sea, and sunlight—and far less labor and harvesting equipment. The ocean crop can withstand environmental conditions, ranging from cold snaps to tumultuous storms, and, in North America, many of the most commercially important kelp varieties are harvested in chilly winter months that don't heavily overlap with harvest seasons for other kinds of shellfish, like lobsters, crabs, and scallops. But, Froehlich says, kelp's real superpower is that it grows quickly—faster than almost any other plant on the planet. For farmers, “growth is king,” she says. “The faster you can grow something to meet market demand, the lower your cost is going to be.”

Sugar, bull, and giant kelp are some the most popular varieties grown commercially in the US, and they all mature in just a few months. Giant kelp, which is native to California, can grow at an average of 11 inches per day. One key to the plant's speedy growth lies in the way it's designed to maximize sunlight absorption, Froehlich explains.

Unlike other red and green seaweeds, some varieties of brown microalgae, including kelp, have tiny, pocket-like structures called pneumatocysts that are located where the plant's leaf-like blades connect to its main trunk. Pneumatocysts, also called gas bladders, are basically mini-flotation devices. As kelp grows, its blades spread out like a canopy, Froehlich says, giving the plant more surface area to absorb sunlight, while the gas bladders, which are mostly filled with a mixture of nitrogen, oxygen, and carbon dioxide, push the blades away from the lightless depths below and towards the ocean surface where they absorb sunlight. Kelp varieties can have lots of small pneumatocysts—giant kelp, for example, has one sitting where each individual blade connects to the stem—or a single pneumatocyst that can grow to the size of a tennis ball. These biological balloons keep the kelp pointing upwards, regardless of weather or other environmental activity.

Kelp's phenomenal growth is also fueled by nutrients in the ocean, particularly nitrogen, says Christopher Gobler, a marine scientist and director of the Center for Water Technology at Stony Brook University. Kelp blades are lined with cells that contain sulfated polysaccharides, which are essentially chains of sugar molecules that give kelp its slimy texture. These polysaccharides bind with nitrogen and phosphorous, pulling both out of the water and dissolving the nitrogen into a compound called nitrate, which fuels growth for many different kinds of plants and is a key component in commercial fertilizers. These sulfated polysaccharides transform kelp into a nitrogen-absorbing machine, Gobler says. Gobler's

lab estimates that a one-acre ocean farm could generate 70,000 pounds of kelp, removing 200 pounds of nitrogen pollution in the process.

When grown alongside shellfish, this water filtration ability gets amplified. In regenerative ocean farming models like GreenWave's, shellfish, including scallops, mussels, oysters, and clams, are grown in mesh baskets that sit deep beneath the ropes holding sunlight-seeking kelp. These species bring in additional income for farmers without requiring a lot more resources, and they're also natural water purifiers. Kelp absorbs nitrogen through its blades, but clams and other mollusks pump water into their gills, which capture oceanic particles and microscopic phytoplankton—the organism that feeds on nitrogen. The shellfish eat the phytoplankton and use nitrogen to build tissues and shells.

Together, this system of kelp removing nitrogen near the surface while shellfish do the same down below creates powerful water filtration, says Charles Yarish, an emeritus marine evolutionary biologist at the University of Connecticut who studies seaweeds. One meta-analysis by researchers at the National Oceanic and Atmospheric Administration (NOAA) examined 26 studies on shellfish and seaweed farms and found that, on average, these farms remove 575 pounds of nitrogen per acre. But, Yarish adds, this farming model long predates GreenWave, where Yarish serves as a chief scientist. “If you go into the Chinese literature, even to ancient Egypt, you will see examples of those cultures having integrated aquaculture,” he says.

The fast growth rate, short spore-to-harvest cycle, and capacity for pollution absorption make kelp a natural environmental remediation. However, for all their environmental benefits, commercial kelp farms fundamentally change their ecosystems and can have some drawbacks, Froehlich says. Mismanaged kelp farms can introduce new diseases or invasive species into an underwater environment. Kelp lines planted in shallow water can block sunlight from native plants, change water flow patterns, alter population genetics within an ecosystem, and take nutrients away from marine species that rely on them. “You are putting a thing into the water and it can have [an] impact,” she says. “There is no free lunch, unfortunately, for growing anything.”

But, she adds, these issues pale in comparison to the environmental problems and ecosystem devastation that excess nitrogen and phosphorus cause. One study published last year found that between 2003 and 2013, excess nitrogen increased 65 percent in marine environments worldwide. Roughly two-thirds of domestic coastal ecosystems in the US are contaminated with this pollution, causing what the National Wildlife Federation calls “mass deaths at sea.”

These toxic blooms kill fish and other wildlife by the ton each year, and they're getting bigger, more frequent, and more toxic over time. They also won't be slowing down any time soon as climate change

pushes more nitrogen pollution into water systems. One 2017 study published in *Science* found that increased rainfall and extreme weather driven by global warming will increase the amount of nitrogen in US continental waterways by 14 to 19 percent before the end of the century.

For seafood harvesters, toxic algae blooms threaten, and sometimes permanently destroy, their livelihoods. One report from the US National Office for Harmful Algal Blooms—a research group funded by NOAA—estimates that, conservatively, algae blooms cost US commercial fishermen \$18 million per year, on average, in lost wages, while monitoring and management of algal blooms tack an additional \$2 million onto the yearly tab. The report also acknowledges "a difficulty in assigning a dollar cost" to algal events and notes that other estimates are much higher. NOAA, for example, ballpark damage to domestic seafood and tourism industries by algae blooms at around \$82 million annually, creating real economic incentive to expand kelp farming fast.

### **Legislating kelp**

But doing that isn't so easy. For Thiele, legalizing kelp farming, even on a small scale, took seven long years. Thiele first learned about kelp farming around 2009. By then, the Brown Tide was long gone, the Peconic Bay had been added to the National Estuary Program—a federal initiative that funds conservation and restoration in estuaries of national significance—and Thiele had been serving in the New York State Assembly for 13 years.

In August of 2009, the State of New York gave Suffolk County 110,000 acres of underwater land in the Peconic Bay and Gardiners Bay to help boost local aquaculture programs in an effort to recoup economic losses the seafood industry had suffered from and since the Brown Tide. To figure out how to divvy up the land, the state established an initiative called SCALP—the Suffolk County Shellfish Aquaculture Lease Program—that would lease 10-acre plots to area shellfish farmers and investigate ways to improve aquaculture, both economically and environmentally.

Nitrogen pollution was a top priority—Thiele says that the Suffolk County Executive declared it "public enemy number one"—so the SCALP team quickly launched a program to replace outdated septic systems, but the work would take time and they needed a faster fix. That's when they started talking about kelp farms, which were already thriving next door in Connecticut. But, at the time, it wasn't clear if kelp could be a viable industry in New York, says Stephen Schott, a marine botany and habitat restoration specialist at the Cornell University Cooperative Extension. "Seaweeds, especially around [Suffolk County's] south shore, had already started to disappear due to climate change," he explains.

To figure out how, and whether, significant amounts of kelp could be grown in the area, Suffolk County partnered with Schott's group and with Charles Yarish from the University of Connecticut to launch a small feasibility study in 2016. Hoping to figure out the best depth for kelp growth and how potential future crops might be impacted by variables like boating traffic and salinity changes throughout the Long Island Sound, the team got funding from Suffolk County and obtained an experimental permit from New York's Department of Environmental Conservation (DEC) to plant six individual kelp lines, each planted vertically, at six different sites around the area, including Flanders Bay, Gardiners Bay, Orient Harbor, and parts of the Peconic Bay.

Knowing that six single kelp lines could only generate a tiny amount of data, the team also set their sights on launching a larger study on underwater land regulated by SCALP, but they hit a major problem: It wasn't legal. Under state law, land within SCALP's jurisdiction could only be used for commercial shellfish cultivation, not for research. Working with state Senator Ken LaValle, Thiele co-sponsored legislation that would allow Suffolk County to launch a pilot program to assess whether kelp farming was economically feasible and ecologically sustainable in certain parts of the Peconic and Gardiners bays and to figure out if kelp farms here could work with existing local oyster farms.

By the spring of 2017, kelp from the feasibility study was ready for harvest. The six individual lines produced 41 pounds of kelp in total—enough to prove that the crop could grow in these waters—and Thiele and LaValle's new legislation, which had passed by that point, set the stage for a second, larger study. SCALP partnered with Christopher Gobler's lab at Stony Brook University, GreenWave, and some local maritime businesses, and began forming a plan to lease one-acre ocean plots to a few experienced shellfish farmers who wanted to try growing sugar kelp—a species that thrives in cold, estuary waters and can grow in a few months. By then, Thiele was already thinking of the next steps. He had started drafting legislation that would later become the Kelp Bill.

By 2018, Thiele had found a sponsor: State Senator Todd Kaminsky. In November, the bill was in front of the Marine Resources Advisory Council, a division within the DEC that votes on legislation that's slated to go to the state Senate. That's when Sean Barrett first got wind of the bill. A seasoned fisherman, restaurateur, and member of the DEC's Advisory Council, Barrett knew that current commercial fishing practices weren't sustainable in the long run and was immediately excited about the potential impact kelp farming could have. "I successfully got the entire council unanimously to vote in favor," says Barrett, who would break into the kelp business himself just a few years later.

The Kelp Bill moved to the New York State Assembly, but was overlooked for a few election cycles, Barrett says, as legislators claimed they didn't have enough information on the benefits of kelp. Just as it looked like the Kelp Bill might never be up for vote, Barrett stepped in again and leveraged his

community connections to build momentum for the legislation. In late 2019, he launched public awareness and action campaigns about the bill, partnering with environmental groups like Draw Down East and the Environmental Action Committee. One petition calling for a vote on the bill garnered more than 7,000 signatures.

Towards the end of the campaign, results from the Stony Brook pilot program were published. It showed that oyster farmers were able to grow kelp, some with blades as long as four feet, in shallow estuary waters. The study also revealed that kelp grew best in an integrated system with oysters and other shellfish, proving that the crop could be a viable source of revenue for shellfish farmers while improving water quality. These results “were key to getting the bill passed,” says Thiele, adding that the bill quickly moved through the legislative chain soon afterward.

Kathy Hochul, New York’s newly-instituted governor, signed the Kelp Bill into law on December 7th, 2021. The bill legalizes farming sugar and horsetail kelp species on 110,000 acres of land in the Peconic and Gardiners bays, but, so far, there hasn't been much progress in launching kelp farms. The state hasn't issued any kelp farming permits yet, according to reporting in *The New York Times*, and experts agree that it's too early to tell whether the bill will meaningfully expand kelp farming across the state or if bureaucratic red tape will prevent the industry from getting off the ground.

Meanwhile, the Shinnecock Kelp Farmers, whose water rights don't fall under state purview, are growing. Danielle Hopson Begun says that she's noticed environmental changes since the farm started —“a lot more birds, the water is clear,” she says. “We have not seen an elevated water testing problem in the area since we’ve had the kelp.” But, she adds, the Kelp Bill's stalled rollout prevents industry vendors and support services from launching in the area and it limits who the Shinnecock can work with.

Froehlich says that the kelp industry's success in the US will depend on how well federal and state governments recognize and address the myriad obstacles hindering ocean farmers. “Our ecosystems and our policies and our laws are just now starting to try to figure out, okay, how does seaweed fit in?” she says.

### **Challenges by land and by sea**

Peter Stein is among the many who are excited and stymied by the Kelp Bill. Stein is a former management consultant who left his desk job in 2016 to open Peeko Oysters, an aquaculture farm that operates out of a former bait and tackle shop on the northern side of the Peconic Bay. Peeko's headquarters sit on the water across from a quiet street of residential homes. Oyster cages and fishing

equipment line the front yard in neat rows. Chopped wood for fire sits on the front porch. Just inside, some of Stein's team wash, count, process, and freeze oysters, while others repair cages they'll soon place somewhere on the 131 acres of underwater land the company owns.

For Stein, oysters alone were never the endgame. The year before opening Peeko Oysters, Stein learned about GreenWave's regenerative farming model and immediately knew that he wanted to eventually start farming kelp if, and when, New York would allow it. Stein says that he's primarily motivated by environmental reasons, but recognizes the economic incentives as well "In a good growth year, you could produce north of 50,000 pounds of wet kelp per acre," he says. If he harvests on all of his land, "that's like 7 million pounds of kelp."

Stein has spent years putting the infrastructure for kelp harvesting in place. That meant acquiring waterfront property, which is essential for quickly preparing kelp for processing. Processing must be done in 12 hours or less after the crop is pulled from the ocean—miss that window and it starts to lose its flavor and value. With venture capital support, Stein recently purchased two waterfront properties at Brick Cove Marina, which is about a seven-minute drive from Peeko headquarters. He says he was lucky to find available space at all: Most waterfront property in the area is private and used for recreational activities, leaving little room for kelp farms and limiting the environmental benefits they can yield.

Waterfront availability is one challenge Stein believes will prevent kelp farming from expanding. Permits are another. Despite spending serious time and money preparing for kelp farming, Stein can't apply for a permit this year because the state hasn't fully laid out how the process will work, when permits will be available, or how long it will take to get one. (Fred Thiele says that plans to formalize those regulations are in the works, but that he can't divulge that information yet.)

Even in states where procedures are clear and longstanding, permitting is still a problem. Obtaining the proper permits and approvals can take close to two years and often requires navigating a tangle of bureaucratic rules. In Washington state, for example, getting a permit involves going to nine different agencies, according to one report from The Pew Charitable Trusts. Space and permits aren't the only obstacles hindering kelp's expansion, says Anoushka Concepcion, a marine aquaculture educator at Connecticut Sea Grant, a coastal research and conservation program run by the federal government and the University of Connecticut. Market and financing infrastructure play important roles, too.

Though there's currently an abundance of grant money available to launch new farms, there's no guarantee that it will last, Concepcion says. Grant support largely hinges on political players who could get voted out and on advocacy groups that may decide to change focus. It's also tough for farmers to

estimate the real cost to produce kelp, she adds. Many kelp farms that are currently up and running are operated or financially supported by a university or government agency, meaning that the true cost of kelp production will likely be higher for individual farmers.

Even if new farmers can navigate the property, permitting, and financing sides of the kelp business, they'll also need connections with nearby processors, which, in some places, haven't kept pace with how rapidly ocean farms are expanding. For example, Concepcion says, "folks in Maine are working with one of four food processors. If you don't have a contract with them, they're not going to buy your crop. You have no place to sell."

Kelp advocates are trying to ease some of these structural obstacles. Three years after launching an awareness campaign to pass the Kelp Bill, Sean Barrett is attacking the processing bottleneck problem by becoming a kelp processor himself. In 2021, Barrett launched Montauk Seaweed Supply, New York's only certified manufacturer of kelp-based fertilizers. The company is currently the only processor and distribution operation in New York for seaweeds grown locally. He says that expanding kelp farming and ending the problems that kelp aims to solve will require upending industrial aquaculture to "find ways that we can generate more resources from the ocean in a way that is less extractive."

### **A model for change across state lines**

Whether kelp farming will be profitable and effective in New York will depend on how quickly ocean farmers and legislators can come together to lower the barriers. A few states away, seafood harvesters are tackling some of those issues on their own.

In Biddeford, Maine, Atlantic Sea Farms has long been a blueprint for seafood workers who want to augment or pivot their businesses with kelp harvesting. The company originally started in 2009 as a seaweed farm, the first commercially viable one in the US, but as it grew and took on new leadership, Atlantic Sea Farms transitioned into a support resource for fishermen and future farmers, explains Liz Johndrow, the company's seaweed supply manager.

Climate change has had a particularly harsh impact here. Between 2004 and 2013, Gulf of Maine waters have warmed seven times faster than average global temperatures, drastically reducing several commercially important ground and shellfish species, including crab, mussels, pollock, and haddock. Lobsters, one of the most famous and historically profitable catches in this area, are gradually moving north towards colder waters—one 2018 study by scientists at the Gulf of Maine Research Institute

estimated that populations will drop between 40 and 62 percent by 2050, though local populations are currently booming.

To help local fish and lobstermen diversify their incomes, Atlantic Sea Farms changed its business model in 2018, Johndrow says. Instead of being a farm itself, the company would provide spores from its own hatchery to partner farms, buy the kelp back once it was harvested, and manufacture it into products sold directly to consumers. They would also help ocean farmers throughout the state navigate the arduous process of making business plans, obtaining permits, and securing land leases, which can take anywhere from nine to 15 months to get approved, says Johndrow.

Atlantic Sea Farms maintains partnerships with 16 farmers across Maine. Most partner farmers are lobstermen who now earn income that Johndrow says is somewhere in the “high-five-figure or low-six-figure” range from kelp in addition to income from other seafood harvests. By helping farmers overcome the obstacles that hinder kelp harvesting, the company is establishing the necessary infrastructure to help the industry grow, “something that the state is definitely lacking,” she says.

While some kelp proponents are working in individual states to clear the legal hurdles, others are focusing on federal waters. Currently, aquaculture is prohibited in federal waters, which start from either three or nine nautical miles past the shoreline, depending on the area. Last year, a bipartisan bill called the Advancing the Quality and Understanding of American Aquaculture Act established the first regulations for offshore aquaculture, including kelp farming, in federal waters. The legislation is important, says Froehlich, because it “provides a bit more breathing room and flexibility” for ocean farmers, allowing them to move away from nearshore land, where availability is scarce, and into deeper waters if that works best for their businesses.

Back in New York, Fred Thiele has also continued his mission to legalize kelp farming throughout the state. This past spring, Thiele signed an amendment to the Kelp Bill that legalizes commercial cultivation of all seaweed species, not just sugar and horsetail kelp. He also pushed a new bill through the state Senate and Assembly that allows kelp cultivation in all New York maritime waters. It now awaits approval from the governor.

Thiele believes that within the next year, New York will have streamlined the kelp permitting process, laying the foundation for a growing industry throughout the state. But, he says, even after that happens, the work is far from over. For kelp farming to make a meaningful impact on the state’s seafood industry or environmental problems, “there needs to be a lot of other things that fall into place, processing centers, transport centers, buyers and sellers,” he says. “None of that exists right now.”



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