



DISRUPTIVE INDUSTRY

Plundering Africa

Voracious fishmeal factories intensify the pressure of climate change

Aquaculture provides seafood in a warming world. But this global industry is taking a staple called sardinella from the mouths of people who need it the most.

By [MATTHEW GREEN](#) in NOUADHIBOU, MAURITANIA

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eyround Bay was once a place where old ships came to die. A wild stretch of coast on the western edge of the Sahara, its shallows made a convenient, if desolate, spot to scuttle an obsolete trawler, freighter or tug. So many vessels went to their graves here, the nearby port of Nouadhibou seemed captive to a ghostly armada keeping vigil over the dunes.

Today, navigators plotting a course for this gateway to the West African nation of Mauritania have no intention of abandoning ship. Turkish fishing boats bob at anchor, laundry strung out to dry above deck. In the open sea, the convex hulls of Chinese vessels carve V-shaped wakes through the swells. Nearer shore, nomads-turned-octopus-catchers scan the surface through the eye-slits of headgear that once shielded them from sandstorms.

But the most lucrative activity of all takes place behind high walls. It would be easy to miss entirely — were it not for the stomach-turning stench.

On a recent Saturday, factory manager Hamoud El-Mami watched through a warehouse gate at Africa Protéine SA as two of his workers trudged knee-deep through a silvery, undulating heap of sardinella, a sardine-like fish that thrives by the billion in the Canary Current off northwest Africa.

Seemingly oblivious to the smell, the rubber-booted laborers shoveled the fish into a proboscis-like chute. Armed with a giant rotating screw, the device liquidized each sardinella on contact, then sucked the resulting gray goo through a hole in the wall and into the bulky contraptions of the factory proper.

The hungry machines of Africa Protéine are producing fishmeal – a nutrient-laden powder that fuels the \$160 billion aquaculture industry. One of the world’s fastest-growing food sectors, aquaculture is rapidly overtaking wild-capture fisheries as the biggest source of fish for human consumption.

From the shrimp ponds of China’s river deltas to the salmon cages of Norway’s fjords, the industry thrives by feeding fish to other fish. Its needs are so voracious, roughly 20 percent of the world’s wild-caught fish don’t even go near anyone’s plate but are instead ground up to make fishmeal.

With relentless demand from China pushing fishmeal prices to record highs, companies have set their sights on West Africa as a new source of supply. From state-owned conglomerates to adventurous entrepreneurs, Chinese investors are racing to build new factories on the shores of Mauritania and its two neighbors to the south, Senegal and Gambia.



But in the rush for sardinella, global business interests are snatching a staple of West Africa’s diet from the people who need it the most. And the blades of the grinding machines are posing a new threat to the species at a time when climate change already has sardinella swimming for its life.

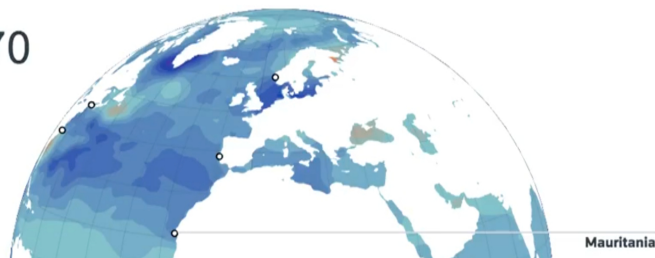
“In four or five years, there won’t be any fish stocks left; the factories will close, and the foreigners will leave,” said Abdou Karim Sall, president of an association of small-scale fishermen in Senegal known by its French acronym, Papas. “We’ll be left here without any fish.”

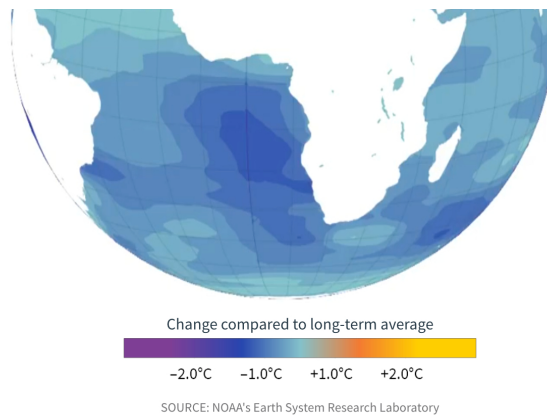
Satellite data indicate that the waters off northern Senegal and Mauritania are warming faster than any other part of the equator-girdling belt called the tropical convergence zone, once known to sailors simply as the “doldrums.” This hidden-from-view climate change has had an ominous impact: A new study by researchers at the Marseille-based institute IRD-France found that the rising temperatures have pushed sardinella an average of 200 miles north since 1995.

Decades of warming

Annual change in ocean temperature

1970





The findings, the results of which were shared with Reuters, provide the first clear evidence that West Africa's sardinella are joining a worldwide diaspora of sea creatures fleeing poleward or deeper as waters warm. The sheer scale of this mass migration dwarfs anything taking place on land: Fish are moving 10 times farther on average than terrestrial animals affected by rising temperatures, according to Professor Camille Parmesan, an authority on climate impacts on marine life at the University of Plymouth.

Climate change is not only displacing sardinella from their traditional habitat, it's putting pressure on the fish in another, indirect way, by increasing the incentives for West African fishmeal production even further.

Peru is by far the world's biggest exporter of fishmeal, manufactured from its vast shoals of anchovies. As such, the country exerts an influence on fishmeal prices comparable to Saudi Arabia's role as a swing producer of crude oil. Since the early 1970s, the El Niño weather phenomenon has periodically caused catastrophic losses to Peru's gigantic anchovy catch by disrupting the upwelling mechanism that provides that fish with nutrients. In the past decade, climate change appears to have increased the frequency of El Niño's effects, which can in turn cause fishmeal prices to track significantly higher.

This growing volatility might bode well for West Africa's fishmeal producers, who stand to make more money each time prices spike. But overproduction could have dire consequences for millions of the region's people, by endangering the fish they depend on for their primary source of employment, income and protein.



Fishing boats crowd the harbor at Nouadhibou, the main port in Mauritania.

Demand for fishmeal has already caused Mauritania's annual catch of sardinella to surge from 440,000 tons to 770,000 tons within the space of a few years, according to a European Union-funded report published in 2015. Senegalese boats working under contract to the plants increased their landings tenfold between 2008 and 2012 alone, the report found. The Canary Current's fish stocks, marine scientists say, won't be able to withstand this kind of pressure for much longer.

Coastal communities in West Africa are already among the populations most vulnerable to the effects of climate change. Rising seas have begun to swallow coastal villages whole, while rougher weather is making fishing ever more perilous. Droughts and irregular rainfall have forced farmers to abandon their land and head for the shore, swelling the fast-growing ranks of men whose best hope of feeding their families lies beyond the breakers.





A man drives a horse-drawn cart through the surf at Joal-Fadiouth, a hub of the Senegalese fishing industry.

But on the spit of land in Nouadhibou where laborers await the arrival of the next truckload of fish, factory bosses shrug their shoulders at talk of the swirling shoals of sardinella ever running out.

"Fish are still abundant," El-Mami said, gesturing toward a nearby beach with a grin. "If you take your fishing rod over there now, you'll catch a beautiful fish."



Changing fortunes



A porter carries fish from a boat to the beach at Joal-Fadiouth, where a gold-rush mentality has taken hold.

Painted eyes stare from the prows of the pirogues wallowing in the surf at Joal-Fadiouth, the frenetic hub of Senegal's fishing industry. Emblazoned with the names of revered spiritual leaders whose influence permeates all tiers of Senegalese society, some also reflect more worldly

aspirations: the neatly rendered crest of Manchester City football club or the words “Barack Obama.”

A gold-rush mentality has doubled the size of the country’s small-scale fishing fleet in the past decade. Eager to win votes, the government has subsidized outboard motors to allow fishermen to rove even farther. Now directly or indirectly employing 600,000 people, or 17 percent of the workforce, the fast-growing fleet is threatening to throttle the very resource that sustains it.

On a recent Tuesday, captain Doudou Kotè clambered out of his boat and onto a cart pulled by a horse evidently at home in the waves. Borne regally through the surf in this amphibious taxi, Kotè echoed what many of his fellow fishermen are saying: Sardinella, a talismanic species in Senegal, is in the midst of a vanishing act.

“Nowadays, there are more pirogues: People who didn’t own any pirogues now own one, and people who used to own one now have two,” said Kotè, a stout mariner who wore green waders and a conical lambskin hat. “Often we come home without catching anything — not enough to buy fuel, or even to eat.”



Fisherman Doudou Kotè stands on the beach at Joal-Fadiouth. “If I had any other job to do, I’d stop fishing,” he says.

A naturally jovial man with two wives and six children, Kotè’s expression darkened as he predicted that pressure on sardinella would soon cause stocks of the fish to collapse. “If I had any other job to do, I’d stop fishing,” he said.

It’s not just Senegalese who are losing out because their staple is being turned into fishmeal. In Mauritania, the industry has been grinding at least 330,000 tons of fish a year that were previously sold in West African markets such as Ghana, Nigeria and Ivory Coast, researchers estimate. That’s nearly equivalent to the entire annual fish consumption of Senegal’s population of 15 million.





Although Senegal produces only a fraction of the volume of fishmeal exported by the roughly 30 Mauritanian factories, its dozen plants could pose a disproportionate risk by disrupting a delicate market mechanism that once limited how much fishermen would take.

In the past, in seasons when sardinella migrated closer to shore, Kotè and his comrades could easily land more than the local market could absorb. Crews would dump the fish they couldn't sell to rot on the sand, then stay home until the glut passed. With the factories now willing to buy every last fish, there's nothing to stop the fishing fleet from pushing stocks to the point of collapse.

"We could face a catastrophic situation," said Patrice Brehmer, a marine scientist at IRD-France, who co-authored the study revealing that warming waters are pushing sardinella northward.

The growing imbalance between people and nature in the Canary Current has fishermen wondering if they will soon be forced to return to the poverty of their ancestral villages.

Ibrahima Samba once scratched a living by growing peanuts and millet on his family plot outside the Senegalese town of Mbour. When the rains began to arrive either too early or too late, he joined other farmers swapping their hoes for nets.

"We could see the climate changing: Things never worked out like we hoped, and there were always surprises," Samba said. "With the sea, you go out today, you fish today, and you sell straight away – and you don't need to be a real professional to do it. We saw the fisherman had beautiful cars and were building houses, so we joined them."

After 22 years as a fisherman, Samba says climate change is once again threatening his livelihood, this time by chasing away sardinella. "Climate change doesn't just affect the agricultural sector, but fishing as well," he said. "People who sold their land may well have problems, because there's a good chance we'll have to go back to farming."

The impact of the fishmeal factories is already apparent in the faces of local women. Not far from the beach at Joal-Fadiouth, lazy pillars of smoke spiraled from a complex of outdoor ovens where tightly packed rows of sardinella dried slowly over glowing cinders. Many were destined to be marinated and served on a bed of spicy rice in Senegal's national dish, known as thiéboudiène.

When times were good, the thousands of workers at this outdoor fish-drying facility – almost all of them women – could make more money than the fishermen many had married, saving enough to buy them new engines, or even boats.

Among them was Rokeya Diop, a matriarchal figure of good standing among the community that dries, smokes and salts fish for sale in local markets. These days, the acrid pall hanging over the near-deserted complex matched her mood.



 FOR NOW, FISH APLENTY

As Diop watched, fire-keepers still dutifully fed straw kindling into the empty ovens and used long poles to give the smoldering ashes an occasional stir. But the fishmeal factories are willing to pay twice as much as Diop and her friends can for fresh sardinella, leaving them with nothing but time on their hands.

"Each day I stay until 10 o'clock at night but I go home empty-handed," Diop said, slapping her palms together.

Although demand from factories is just one of many factors affecting the availability of fish from season to season in Senegal, whispering is growing louder along the coast of more monumental changes taking place at sea.

"We can't just blame everything on the factories," Maimouna Diokh, the treasurer for a local council that manages fishing activity in Joal-Fadiouth, said as men loaded crates of iced fish into trucks parked in a beachside loading bay. "Climate change is warming the waters, so there are fewer fish."



The seas are getting hotter



Years of sun and saltwater have conspired to give the Amrigue, a catamaran moored in Nouadhibou harbour, a distinctly weather-beaten aspect. But the twin-engined vessel is still seaworthy enough to ferry teams of scientists out into Greyhound Bay to gather data on the warming seas.

One Saturday, the Amrigue weighed anchor near a sandbar called Gazelle Bank, about two nautical miles from the harbor. Abdoul Dia, a laboratory chief at the Mauritanian Institute of Oceanographic Research and Fisheries, or Imrop, heaved a device used to gather sediment from the seabed off the vessel with a splash. Hoisting a sample onto the deck, he dumped the gravel into a plastic tub and began rummaging through it with a sieve and hose. He was looking for micro-organisms that could help his colleagues build a more detailed picture of how conditions are changing.



Researcher Jeman Abed, pictured in his lab coat, retrieves a seawater sample off the coast of Nouadhibou, the main port in Mauritania.

The big picture is already clear: Thirty years of measurements show that the balmy waters off Mauritania are getting hotter. “If you look, you’ll see an increase in average temperature that confirms the warming trend,” Dia said, an orange life jacket slung over his white lab coat.

At Imrop’s headquarters, on a bluff overlooking the bay, Dia explained why this warming was so significant. Nouadhibou sits near a convergence zone where cooler waters to the north collide with tropical waters to the south. The precise latitude of this thermal front oscillates a little every year. But as waters have warmed, it has begun fluctuating much farther north, even roving as far as the Moroccan city of Casablanca, 870 miles away. The center of gravity of the sardinella stock has moved northward in tandem as the species has sought to maintain an optimal temperature.



The shift is good news for Mauritania's fishmeal factories, because the sardinella are now concentrated closer by. But it's bad news for fishermen to the south in Senegal and Gambia, whose lifeline fish stocks are migrating farther away.

Some researchers believe that, over time, the warming trend might actually increase the abundance of fish in the Canary Current as new species find a foothold in the changing conditions. But others see a more dystopian future.

Vicky Lam, a fisheries economist at the Institute for Oceans and Fisheries at the University of British Columbia in Canada, and three researchers published a study in 2012 of the possible impact of climate change on fisheries in 14 West African nations, including Mauritania, Senegal and Gambia. Their projections for 2050 were bleak: a 21 percent drop in the annual landed value of catches, a 50 percent decline in fisheries-related jobs and an annual loss of \$311 million to the regional economy.

The fishmeal industry is only adding to the pressure. Ad Corten, who chairs the sardinella committee in a stock assessment group that advises the U.N. Food and Agriculture Organization, said fishing vessels were taking too much from the Canary Current even before the factories came.

"This is going to burst within one or two years," Corten told Reuters. "We're already noticing a scarcity of sardinella in Mauritanian waters. We hear the same stories from Senegal."

Fishermen sense that the sea's character is changing. Last year, the coldest snap off Nouadhibou in 20 years hurt catches of sardinella and octopus. Swallows migrating through the nearby dunes turned up six weeks late. The fierce wind that normally roils the ocean from March to June refused to blow. In Morocco, snow fell in the desert city of Zagora — the first in half a century.

"Last year the ocean was completely crazy," Abdel Aziz Boughourbal, manager of Omaurci SA, one of the biggest Mauritanian fish-processing and fishmeal companies, said over a dish of fried octopus at a waterfront restaurant where visiting sailors crack open cans of imported beer. He said a Chilean crewman on one of his vessels was astonished recently when his boat ran into a huge shoal of anchovies — the kind normally found off Peru.



A rush of Chinese investors





A worker stands outside Continental Seafood, one of the many Chinese-owned fishmeal factories around Nouadhibou.

Some Chinese investors don't seem to share the fishermen's fears. Over the past few years, major fishing companies have signed deals worth hundreds of millions of dollars to establish fish-processing and fishmeal plants around Nouadhibou, their giant new complexes towering above the sand. Even the port's smaller Chinese players want to expand.

"If we have the opportunity, we'll do other projects — from more fishmeal to processing and freezing," said Fan Yongzhen, a harried manager at Continental Seafood, one of the fishmeal factories in Nouadhibou.

In the capital, Nouakchott, the China Road and Bridge Corp., which has built giant infrastructure projects across Africa, has submitted proposals to develop a 40-square-mile marine industrial park south of the city. According to the company's feasibility study, seen by Reuters, the plant will feature facilities to process, freeze and export fish — and, of course, fishmeal.

With everyone from Chinese industrialists to Senegalese subsistence farmers looking to the Canary Current to make their fortune, tensions have started to flare.

In January, fishermen rioted in the Senegalese port of Saint-Louis after one of their colleagues was shot dead by Mauritanian coast guards. A senior coast guard official told Reuters the man was accidentally killed when an officer opened fire to try to disable the engine of a Senegalese pirogue intent on ramming the Mauritanian patrol craft.

Sardinella migrate across a 1,000-mile zone shared by Mauritania, Senegal and Gambia. Officials from each country insist that they want to manage their fish sustainably and develop the kind of processing, freezing and export industries that could create thousands of jobs. But with no effective regional management system yet in place, this goal may not be compatible with installing ever-more grinding machines for the benefit of fish farms producing food for Asia, Europe and North America.

Bamba Banja, permanent secretary to Gambia's fishing ministry, said his government's priority was to make sure local people had enough fish to eat. "If it comes to the crunch, we would rather close the fishmeal factories and allow ordinary Gambians — women and the vulnerable — to have access to these resources," he said.

Despite the government's assurances, the Gambian town of Gunjur has emerged as a symbol of the conflict that fishmeal can unleash.



In 2016, a Chinese industrialist opened a beachside plant called Golden Lead. Although many in Gunjur are grateful to work as porters for the factory, one of three to spring up along the tiny country's 50-mile coast, others fear that the company's demand for fishmeal is putting the

country's 50-mile coast, owners fear that the company's demand for fishmeal is putting the community's long-term survival at risk.

In March, dozens of people assembled on the beach and dug up a pipe pouring factory effluent into the sea. Local activists accuse Golden Lead of fouling a nearby lagoon, a spawning ground and feeding area for migratory ospreys where crocodiles emerge to lounge on sandbanks in the mid-morning heat. They later showed Reuters photos of floating dead fish and an ugly red stain clouding the water.



This waste pipe belonging to Golden Lead, a Chinese-owned fishmeal factory in Gunjur, was the object of a protest early this year.

Golden Lead has since been ordered by Gambia's environment agency to extend its waste pipe 350 yards into the sea, according to an official document seen by Reuters. A few weeks after the youths dug it up, workmen arrived to make the required extension. Factory managers marked the occasion by hoisting a Chinese flag on the beach.

Golden Lead says it respects Gambian regulations and has benefited the town in multiple ways, including by providing work for dozens of laborers, making improvements to a school and donating sheep to elders at Ramadan.

"We are a business," said a member of staff, who declined to be named. "If we didn't do it, somebody else will come."

Lamin Jassey, an English teacher, played a leading role in the protests against Golden Lead. He is among a small group of activists who have since been charged with criminal damage, trespass and "intimidating and annoying" the company. He had to post an \$8,400 bail — almost 20 times the annual average income in Gambia.

"Today Gunjur is booming — we have a lot of fishermen. We have thousands of others coming from Senegal," he said, watching as porters waded waist-deep into the water to unload fish to carry to the factory door. "But if the fish stock is under pressure, and at the end it's very scarce, what do you think about the future?"

Additional reporting by Diadie Ba in Dakar, Senegal.
Edited by Kari Howard



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Washington Post / *Environmental Protection Agency*



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