

FEATURE

Palm Oil Was Supposed to Help Save the Planet. Instead It Unleashed a Catastrophe.

A decade ago, the U.S. mandated the use of vegetable oil in biofuels, leading to industrial-scale deforestation — and a huge spike in carbon emissions.

By Abrahm Lustgarten

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The fields outside Kotawaringin village in Central Kalimantan, on the island of Borneo, looked as if they had just been cleared by armies. None of the old growth remained — only charred stumps poking up from murky, dark pools of water. In places, smoke still curled from land that days ago had been covered with lush jungle. Villagers had burned it all down, clearing the way for a lucrative crop whose cultivation now dominates the entire island: the oil-palm tree.

The dirt road was ruler straight, but deep holes and errant boulders tossed our tiny Toyota back and forth. Trucks coughed out black smoke, their beds brimming over with seven-ton loads of palm fruit rocking back and forth on tires as tall as people. Clear-cut expanses soon gave way to a uniform crop of oil-palm groves: orderly trees, a sign that we had crossed into an industrial palm plantation. Oil-palm trees look like the coconut-palm trees you see on postcards from Florida — they grow to more than 60 feet tall and flourish on the peaty wetland soil common in lowland tropics. But they are significantly more valuable. Every two weeks or so, each tree produces a 50-pound bunch of walnut-size fruit, bursting with a red, viscous oil that is more versatile than almost any other plant-based oil of its kind. Indonesia is rich in timber and coal, but palm oil is its biggest export. Around the world, the oil from its meat and seeds has long been an indispensable ingredient in everything from soap to ice cream. But it has now become a key ingredient of something else: biodiesel, fuel for diesel engines that has been wholly or partly made from vegetable oil.

Finally we emerged, and as we crested a hill, the plantations fell into an endless repetition of tidy bunches stretching for miles, looking almost like the rag of a Berber carpet. Occasionally, a shard of an old ironwood tree shot into the air, a remnant of the primordial canopy of dense rain forest that dominated the land until very recently.

Our driver, a 44-year-old island native and whistle-blower named Gusti Gelambong, had brought us here to show us the incredible destruction wrought by the growing demand for palm oil. The oldest male among nine siblings, he was modestly built but exuded a wiry strength. His father, he told us, was a king of one of Borneo's dozens of Dayak tribes, the sixth descendant of the sultan of Old Kotawaringin, and his mother came from a line of warriors who served in the Indonesian special forces. In 2001, he said, he took part in a brutal ethnic cleansing of Indonesians who had moved in from the nearby island of Madura. He macheted his way through the nearby town of Pangkalan Bun, slaughtering dozens of people. He felt no remorse about the violence. But the palm-oil companies, Gelambong said, were much stronger than the Madurese. As we approached an intersection, we could see two plantation guards lying back in a shack, rifles propped against their knees. He sped past the guards, averting his eyes.

Most of the plantations around us were new, their rise a direct consequence of policy decisions made half a world away. In the mid-2000s, Western nations, led by the United States, began drafting environmental laws that encouraged the use of vegetable oil in fuels — an ambitious move to reduce carbon dioxide and curb global warming. But these laws were drawn up based on an incomplete accounting of the true environmental costs. Despite warnings that the policies could have the opposite of their intended effect, they were implemented anyway, producing what now appears to be a calamity with global consequences.

The tropical rain forests of Indonesia, and in particular the peatland regions of Borneo, have large amounts of carbon trapped within their trees and soil. Slashing and burning the existing forests to make way for oil-palm cultivation had a perverse effect: It released more carbon. A lot more carbon. NASA researchers say the accelerated destruction of Borneo's forests contributed to the largest single-year global increase in carbon emissions in two millennia, an explosion that transformed Indonesia into the world's fourth-largest source of such emissions. Instead of creating a clever technocratic fix to reduce American's carbon footprint, lawmakers had lit the fuse on a powerful carbon bomb that, as the forests were cleared and burned, produced more carbon than the entire continent of Europe. The unprecedented palm-oil boom, meanwhile, has enriched and emboldened many of the region's largest corporations, which have begun using their newfound power and wealth to suppress critics, abuse workers and acquire more land to produce oil.



A worker on an oil-palm plantation on Borneo. Ashley Gilbertson/VII, for The New York Times

We arrived at another plantation and stopped near where a stream coursed through the bog. People still lived here: A mother bathed two children beneath a culvert, and a shirtless young boy ran through row after row of identical young palms in the distance, surrounded by dragonflies and sparrows. The uniformity of the world he was growing up in was striking, like the endless plains of drilling rigs in an East Texas oil field. It was, in a way, an astounding achievement, the ruthless culmination of mankind's long effort to extract every last remaining bit of the earth's seemingly boundless natural wealth. But it was also frightening. This was what an American effort to save the planet looked like. It was startlingly efficient, extremely profitable and utterly disastrous.

2. 'Oh, My God, What the Hell Is Happening Here?'

The last thing anyone expected from President George W. Bush's 2007 State of the Union address was a proposal for the largest-ever cut in the nation's use of gasoline. The president was no climate champion — he had backed out of the Kyoto Protocol shortly after taking office in 2001 — but he did favor what he called “energy independence.” He had declared the United States “addicted” to foreign oil, yet dependence on Middle Eastern fuel continued. Hurricane Katrina, and the lingering damage it did to oil pipelines and refineries, had pushed up gas prices, renewed fears of global warming and kept a firm thumb on the economy.

Now, Bush proposed, homegrown energy could be drawn from the rural places most in need of an economic boost. Clean-coal initiatives would generate the electricity of the future, but it was biofuels — in particular ethanol, which is largely distilled from corn, and biodiesel, made with vegetable oil — that would power the vehicles of the future. Within 10 years, the country would replace 35 billion gallons of petroleum, or one-fifth of all the gas and diesel burned, with fuel made from plants. The measure, as he put it, would confront “the serious challenge of global climate change.” Unsaid, but clear to anyone paying attention, was that it would also please America's agriculture industry, which had been lobbying for ethanol and advanced biofuel research for years. The House chamber erupted in applause.

On the night of the president's address, Timothy Searchinger sat on his couch in Takoma Park, Md., just a few miles from the Capitol, and watched on television, struck by what seemed to him a glaring lapse in logic. “Oh, my God, what the hell is happening here?” he recalls wondering aloud.

Searchinger wasn't a scientist; he was a lawyer, working with the Environmental Defense Fund. But he saw a serious flaw in the claim that the president's proposal would ameliorate climate change. Searchinger knew that cropland had already consumed virtually every arable acre across the Midwest. Quintupling biofuel production would require a huge amount of additional arable land, far more than existed in the United States. Unless Americans planned to eat less, that meant displacing food production to some other country with unused land — and he knew that when forests are cut, or new land is opened for farming, substantial new amounts of carbon can be released into the atmosphere. Forests hold as much as 45 percent of the planet's carbon stored on land, and old-growth trees in particular hold a great deal of that carbon, typically far more than any of the crops that replace them. When the trees are cut down, most of that carbon is released.

Scientists and lawyers who study environmental impact often deploy “carbon-life-cycle analysis” to determine just how much carbon a given product is removing from, or introducing to, the environment over the course of its production and consumption. When a truck burns biodiesel, the carbon emissions that come from its tailpipe aren't much different from those of a truck burning petroleum. But a part of the biodiesel emissions aren't counted, because — in theory — they have been balanced out: Plants absorb carbon from the atmosphere when they grow, and fuel experts subtract that sequestered carbon from the tailpipe emission, completing a transaction that they say balances at zero.

In ideal circumstances — unvegetated land planted for the first time — this balancing out really happens. When corn grows, it soaks up carbon, and when it is consumed (whether as food or fuel), it releases that carbon back into the air. But the analysis breaks down when faced with the reality of land use. Almost everywhere in the world, planting more corn or soy for biofuel would involve creating more farmland, which in turn would involve cutting down whatever was already growing on that land. And that would mean releasing a huge amount of carbon into the air, with nothing to balance the books. As Searchinger watched Bush's call for an unprecedented increase in biofuel production, his hunch was that the biofuel balance sheet would turn out to be tragically shortsighted.

Representative Henry A. Waxman, at the time a powerful 16-term Democrat from California who had presided over several failed efforts to pass climate legislation, was also skeptical about Bush's plan. But he knew that one of the most vexing aspects of global emissions reduction was the question of how to replace transportation fuels. It was hard enough to upgrade several thousand electrical power plants to draw on wind or solar or even nuclear power. That would take years. But transforming the more than 100 million cars and trucks on America's roads would take far longer, decades even, and in the meantime those vehicles were producing 28 percent of carbon emissions in the United States. Waxman thought a biofuel requirement could be a turning point in climate legislation, a moment when Washington stopped pretending.

Trucks carrying eight-ton loads of palm fruit. Ashley Gilbertson/VII, for The New York Times

Within months of Bush's speech, the House and the Senate were reconciling a draft of a sprawling omnibus bill that would eventually be called the Energy Independence and Security Act, or EISA. In addition to requiring carmakers to improve fuel standards, a longtime priority for Democrats, the bill updated and expanded renewable-fuel standards, requiring fuel producers to mix in soy, palm and other kinds of vegetable oil with diesel fuel and to use ethanol from corn and sugar in gasoline. The bill also set tough standards for how much cleaner, in terms of carbon, each of those categories of fuel had to become — 50 percent for diesel, 20 percent for gas — and empowered the Environmental Protection Agency to judge what qualified.

The expected gains were enormous. The switch to biofuels, the E.P.A. would later calculate, promised to stop the release of 4.5 billion tons of carbon over three decades, the equivalent of parking every single American automobile for more than seven years. Before the bill passed in December 2007, Speaker Nancy Pelosi called it “the shot heard round the world for energy independence.”

The law had a profound effect. Biodiesel production in the United States would jump from 250 million gallons in 2006 to more than 1.5 billion gallons in 2016. Imports of biodiesel to the United States surged from near zero to more than 100 million gallons a month. As fuel markets snatched up every ounce of domestic soy oil to meet the American fuel mandate, the food industry also replaced the soy it had used with something cheaper and just as good: palm oil, largely from Malaysia and Indonesia, which are the sources of nearly 90 percent of the global supply. Lawmakers never anticipated that their well-intentioned plan — to help the climate by helping American farmers — might instead transform Indonesia and present one of the greatest threats to the planet's tropical rain forests. But as Indonesian palm oil began to flood Western markets, that is exactly what began to happen.

“We saw great promise,” Waxman told me recently, sitting in a glass conference room at Waxman Strategies, the Washington lobbying firm of which he is chairman. But he is no longer so hopeful. He is now also the chairman of the environmental organization Mighty Earth, which lobbies food and agriculture companies to deploy more climate-friendly production methods. In 2007, he and other lawmakers were

focused on the benefits of biofuels and the bridge they promised to even greener technologies. Now the soft-spoken Waxman is far more concerned about the other side of the equation. “We didn’t think we were going to pay such a heavy price,” he said.

3. 'No One Fights for Their Rights'

Palm-oil producers had been lobbying American lawmakers to introduce biofuel incentives for years, and they were well prepared for the moment when the incentives became law. Wilmar — the colossal Singaporean conglomerate that controls nearly half of the global palm-oil trade — announced in 2007 that it would quadruple its biodiesel production. In Indonesia, officials directed state-owned and regional banks to make loans on more than \$8 billion worth of palm-oil-related development projects and pledged to produce 5.9 billion gallons of biofuel within five years. They also announced that Indonesia would convert more than 13 million acres of additional forest to industrialized palm production. It was as if in response to a law in China, the United States undertook a plan to convert every single acre of New Jersey to soybean crops, and then threw in all of Connecticut and New Hampshire.

To make Indonesia’s plan a reality, a complicated question of land ownership had to be addressed. Much of the new development was focused on Borneo, where many villages were settled before there were nations, let alone land deeds. To create a legal basis for development, the Indonesian government established a commercial land-share system in the 1980s. In theory, the system let villages sign over development rights in return for some part of the profit. But in practice, many villagers said, companies often secured the permits they needed through some combination of intense lobbying, bribery and strong-arming, and the result was broken promises and missing payments.

Villagers were often simply outmatched by their huge negotiating partners. Wilmar was already a powerhouse in 2007, with operations in 23 countries on four continents, employing more than 60,000 people. When Wilmar said it would buy more than 200,000 acres in the states surrounding Gusti Gelambong’s village, it was a signal for others, too, to rush in. One of Indonesia’s largest conglomerates, the Salim Group — which owns Indofood, the nation’s largest maker of instant noodles — said it would pay \$13 million for 200,000 acres in East and Central Kalimantan. Anthoni Salim, the company’s chief executive, was closely tied to Suharto, Indonesia’s longtime dictator who was overthrown in 1998. When the dictatorship fell, an angry mob firebombed Salim’s family mansion in Jakarta, and the new government forced him to abandon dozens of holdings. Within a few years, though, Salim had rebuilt his empire.

Even before the boom, Gelambong told me, he saw promise in the new palm industry, and he decided to stake his own welfare to it. When the large companies began to expand their timber and palm-planting to Kalimantan, they brought roads, construction and an influx of goods. They also offered jobs. By the end of 2007, Gelambong was already two years into working with a wildcat palm-oil operation, overseeing the process of putting millions of palm-tree seedlings into the ground.

Palm fruit harvested by a worker at a plantation in Sintang; crude oils for cooking and biofuel products are extracted from the fruit and sold abroad.

Ashley Gilbertson/VII, for The New York Times

The oligarchs had once brazenly plundered whole states, but Gelambong thought this time would be different. In the post-Suharto era, it was private business capitalizing on free markets, and the companies promised to share profits with the smallholders — the villagers — who gave up their land. To win access to protected ancestral lands, the corporations promised schools for local children and wages that far exceeded those from harvesting jackfruit and jalut timber.

Gelambong's company was owned by a midsize upstart named Bumitama, run not by an oligarch but by the grandson of a Chinese immigrant who moved to remote eastern Borneo and opened a grocery store in 1915. The family built a fortune out of mining and timber, and Bumitama — which sells its palm to mills run by Wilmar and has direct distribution to the American and European markets — was its palm-oil subsidiary.

As Bumitama's plantations grew, so did Gelambong's responsibility. He became the public liaison for Bumitama's local operations, a company called B.G.A. — in part, he thought, because officials knew that his family held influence over the people who lived there. The deeper he got, however, the more he began to understand that many landowners weren't being paid. As he gained access to more company documents, Gelambong said, he found new contracts where village elders had agreed to smaller and smaller shares of profit. He offered a theory: The elders, often rewarded with gifts by the companies, weren't looking out for the interests of their people, and their people simply had no way of knowing. "No one fights for their rights, because almost no one can write or read," he said.

In his role as liaison, Gelambong was also sometimes responsible for delivering the very gifts that local officials found so persuasive. Indonesia's new democratic government had reached an uneasy détente with its rural islands by giving them a very long leash to run their own affairs, including the authority to issue permits for developing palm and timber. Acquiring such a permit typically required hefty contributions to one or more local political campaigns. Gelambong said he handled the small stuff; payoffs to the police, military patrols and local chiefs. (Bumitama officials say that Gelambong's official position was in "documents and licensing," and that while they cannot "comment on his individual doings," Bumitama complies with antibribery laws.)

As the money flowed, so did the development. From 2007 to 2014, palm concessions in Kalimantan more than tripled. Bumitama alone was planting roughly 37,000 acres of palm each year. Across Indonesia, trees were cut down at a rate of three acres every minute to make room. Soon, palm plantations extended from Kotawaringin in every direction.

The palatial remains of Gelambong's family estate still stand in Kotawaringin, their wood grayed and weathered, ringed by a tall fence capped with elongated spikes that for centuries has turned away tigers and thieves alike. It was there that Gelambong took me to retrieve a box of papers he had acquired. After leaving Bumitama in 2011, he had become the head of his village's microfinance group, which gave him access to records that helped explain how his former employer had been able to so thoroughly take over the village and its land in the early years of the oil-palm boom. Bumitama, it appeared from the documents, had used the microfinance group as a kind of front to justify putting up land owned by residents as collateral for a \$26 million bank loan, effectively mortgaging it to the industry's financial backers.

Sifting through the files, he retrieved copies of three contracts the company presented to its banks. Each contained a list of signatures — purportedly those of hundreds of villagers, consenting to let the microfinance corporation control their land and represent their views to the bank. Gelambong pointed to the long rows of names. Dozens of these people, he said, couldn't read or write. When he asked some of them about their names in the document, they told him that they had never seen the paper before and that the signature on it wasn't theirs. At least six of the signatures were from people who had died before the oil-palm companies arrived.

The Roundtable on Sustainable Palm Oil, a voluntary global governance organization for the industry, is formally investigating Gelambong's claims. Bumitama officials said that nothing about their deal in Kotawaringin was improper; the company had the consent of village representatives, and it had undergone due diligence from the banks. A spokesman for Wilmar said that it abides by its sustainability commitments and was watching the Bumitama land inquiry closely but that the company's internal monitoring program had not yet triggered any alerts about Bumitama's subsidiary outside Tanjung Puting National Park.

A worker unloading a haul of palm fruit at a mill. Ashley Gilbertson/VII, for The New York Times

Gelambong's discovery had left him cynical about the industry that had overtaken his home. Promises had given way to despair, and he was humbled by the belief that he and others were suckered into giving up their only true assets. Now they were fighting simply for the right to take back a small sliver of land to farm for themselves.

4. 'It Was Really Sort of Shocking'

Timothy Searchinger spent a year researching cropland demand, and in February 2008, just two months after Bush signed the biofuels mandate into law, he and eight co-authors published their findings in the journal *Science*. It was a rare coup for a layman — peer-reviewed scientific journals seldom take an interest in the work of activist lawyers — but Searchinger had done something important. He had tried to quantify how increasing the demand for biofuel would change land use. According to his calculations, the ripple effects from land use would be so great that ethanol wasn't going to be better for the climate at all; instead, it would create nearly double the greenhouse-gas emissions of conventional fuels.

How was this possible? A typical life-cycle analysis adds up just the carbon emissions involved in the chain of fuel production and use: the carbon produced by burning the fuel, the carbon spit out by the tractor in the field, the carbon produced by the fertilizer manufacturer and so on. By this accounting, vegetable-oil-based biofuel fares well against petroleum fuels, reducing CO₂ emissions by as much as 80 percent.

What that analysis does not take into account, though, is that there is only so much land. The supposed carbon gains of plant-based fuels have to be offset, Searchinger argued in subsequent papers, by one of three things: reducing food consumption, increasing yields from existing cropland or — most likely — creating entirely new cropland, probably in the countries with the largest “underutilized” forests. And the typical analysis doesn't count the carbon produced by cutting down these forests or — if that deforestation happens to take place in Indonesia — emissions from disturbing the extremely carbon-rich peatland soils that much of the forest grows upon.

Jeremy Martin, a fuel-policy expert with the Union of Concerned Scientists, said that before Searchinger's research was published, the significance of land-use change had been dismissed. “It was really sort of shocking,” Martin said. Climate scientists quickly agreed on the general notion that land use was an important factor to take into account, but there the consensus ended. The numbers varied depending on who did the analysis using what model, and as the research evolved, few could agree on the scale of the problem.

Predicting how people will use land can be challenging. Scientists use a suite of complex models to try to capture the nuance of interactions among commodity prices, vegetation coverage, carbon content of that vegetation, fuel use, the weather and the global political situation.

Accounting for the “substitution effect,” which describes the way more or less interchangeable commodities like palm and soybean oil tend to be swapped out for one another as buyers seek the lowest price, has proved to be a particularly challenging problem. The American biofuels law, for instance, was designed to support soybean and corn farmers, not palm-oil producers. But the United States began increasing foreign palm-oil imports nonetheless — they more than doubled by 2017 — in large part because so much of the domestic soybean production that once went to food was now being used for fuel. Much of that palm oil went to food production. But the increased use of palm oil in food production was largely a byproduct of the increased fuel-oil production. (In Europe, which also passed a biofuels mandate in 2009 and uses large amounts of palm-based biodiesel directly in its vehicles, the calculation was simpler.)

Wrangling precisely how much palm demand resulted from using a gallon of soy for fuel, and how much rain-forest carbon, in Indonesia for example, might be emitted as a result, became a question that was increasingly influenced by political factors. The E.P.A., in 2009, made one of the most significant efforts to model and predict the carbon from biofuels, using three of the most established models and an overlay of satellite imagery of agricultural lands around the world, including those in Indonesia. The agency determined that the carbon footprint of land-use changes overshadowed any other consideration, and not by a small margin. In fact, when land changes were accounted for, the climate benefit of biofuels was entirely wiped away. Because a huge pulse of emissions comes from land change immediately after forests are cut, the E.P.A. concluded that it would take 32 years before biodiesel from soybean oil was truly net-zero for carbon on an annual basis, and a century for it to reach the level of benefit required under the law.

PT Murini Sam-Sam palm-oil mill.

Ashley Gilbertson/VII, for The New York Times

But that finding did not last long. The agriculture industry went to war to save the mandate they worked so hard to put in place. They lobbied the E.P.A. to abandon its consideration of indirect land-use change, describing it as a “radical” approach that could hold American farmers responsible for business decisions made by villagers halfway around the world. They supported research suggesting that the E.P.A. had overestimated the expansion of crops into tropical rain forests and said farmers were getting better crop yields off the same land than the models had acknowledged.

By the time the E.P.A. released its final rule in early 2010, it had made a complete about-face. Its models now found that the impact from land-use changes were almost negligible. For Indonesia, the E.P.A. estimated that just 110,000 acres of forest would be converted to cropland as a result of the American biofuels law, and almost none of it on sensitive peatland. It also extended the scope of its analysis to 2022, which had the effect of minimizing the short-term emissions. And it worked: Corn ethanol just barely cleared the law’s hurdle, and soybean biodiesel suddenly appeared to be vastly cleaner than regular diesel.

It was nearly two years later that the E.P.A. issued its analysis of palm oil; it said in a cursory three-page draft rule that palm oil did in fact fall short of the E.P.A.’s bar, because of its direct impact on Indonesian forests. And that analysis, which remains in draft form today, simply ignores the substitution effect — which, calculated in any form, would suggest an even greater carbon cost.

Searchinger, who now is a research scholar at Princeton’s Woodrow Wilson School, argues today that instead of developing evermore complex models, it makes more sense to step back and consider some simple logic: Land has competing uses, and taking more of it for agriculture has to have some consequence for the climate. “We could be off by 100 percent,” he says of his biofuels findings, “and it’s still incredibly bad.”

5. 'It's All a Deception'

After the palm-oil companies gained control of the land, the clearing began. The fastest method was to rip out the forests with excavators and torch what remained. In 2015, the fires spread out of control. Kalimantan — and most of Indonesia, for that matter — was overwhelmed by billowing clouds of smoke and ash, visible from hundreds of miles away. NASA satellites detected more than 120,000 hot spots. As far away as Singapore and the Thai islands, people covered their faces with masks and prayed that their air-conditioners could filter out the soot. The smoke was so thick that Zenzi Suhadi, a leading activist with the Indonesian environmental group Walhi, was unable to land at Pangkalan Bun airport the day he was supposed to arrive late that September. Nor could he land the next day. But Suhadi needed to get closer — right into the heart of the flames.

A biologist who wrote his thesis on Indonesia’s wild orchids, Suhadi switched to environmental work because he thought it could have broader impact. He has taken on the pulp and paper, logging and palm industries with a zeal that seems to grind against his quiet, soft-spoken nature. At 37, he has been riotous and unflagging in the face of powerful government ministers, corporate lawyers and even would-be assassins — all of whom he has faced off with at one time or another.

Forest fires are an annual event in Indonesia — sparked in the dry early fall as village farmers clear their fields and then extinguished by the monsoons. But this year was different. NASA officials said they were the worst fires they’d ever observed. Indonesians suffering from the effects of smoke inhalation were streaming into hospitals by the tens of thousands. Researchers at Columbia and Harvard later estimated that the fires led to 100,000 premature deaths. And the fires wouldn’t stop. Suhadi, long a critic of how the palm-oil companies managed their plantations, feared that they had now done something cataclysmic.

His team — including an American conservationist from Friends of the Earth and Gusti Gelambong as a guide — had already arrived in Kalimantan. Now he asked them to continue on without him, traveling west toward Kotawaringin and to the jungle of Tanjung Puting National Park. The only way to learn the truth of what was unfolding was to investigate it for themselves.

Sludge settles on low-grade cooking oil extracted from palm fruit at a mill in Sintang.

Ashley Gilbertson/VII, for The New York Times

What the Walhi crew found that week in Kalimantan was not just deforestation and misery but a virtual hole ripped into one of the largest banks of concentrated carbon in existence. At every turn — by motorbike and motorboat — shards of burned stumps, a crop of shimmering silvery charcoal, stuck out from the blackened earth like gravestones. This apocalyptic landscape stretched as far as they could see, punctuated by only the rare tuft of scorched but otherwise healthy juvenile palm. They traced what they describe as telltale signs that the fires had been started by the palm companies — which is illegal and which all the palm-oil companies strongly deny doing, but which is also the fastest, cheapest way to raze the land.

The process is simple and devastating. First, workers bring in excavators to cut deep trenches across the swampland. These quickly fill with water that drains from the adjacent forest, thereby creating canals that serve as near-instant inroads on which to transport heavy machinery by boat or barge. With the machinery, the forests are cut down, their timber efficiently removed, and the swampy peatland they sit on is left to drain and dry. Once it's dried, it's burned.

In most of the places the Walhi crew visited, the fires appeared to have been extinguished, but the earth remained hot, smoldering underground. And this — more than the landscape destruction itself — was what concerned the group most. The dried and decaying peatland soil in this part of Borneo would almost certainly continue to burn for many more months, even years, releasing volumes of carbon dioxide into the atmosphere that far exceeded those from the rain-forest deforestation itself.

Peatland is boggy, waterlogged ground, loaded with layers of decomposing plants that can't get enough oxygen to support the microorganisms that would normally break them down. So they accumulate, layer by layer, season by season, compressing into a dense, black carbon-rich mud of partly decayed matter that sinks below the shallow water table and is preserved there in an anaerobic state. Left alone for a couple hundred million more years, the peat would solidify into coal.

Exposed peatland can spew carbon into the atmosphere for decades, even centuries, after the land is first disturbed. Indonesia's peatland destruction — just the amount that has already occurred — is roughly the equivalent of opening 70 new, large coal-fired power plants. And if even a fraction of these emissions are counted as land-change effects in the process of evaluating biofuels, the scales are forcefully tipped. "It's all a deception," Suhadi said. "There is no sustainability."

Globally, peatlands from Norway to Brazil hold a volume of carbon equivalent to 21 percent of the entire carbon content in the earth's soil. Indonesia's peatlands alone (which are greater in size than others anywhere in the world except for those in Russia and Canada) now emit more than 500 megatons of CO₂ each year, an amount greater than the entire annual emissions of the state of California. Peatland forests hold 12 times as much carbon as other tropical rain forests around the world. This makes destroying them one of the planet's greatest threats — and protecting them one of the most accessible opportunities to curb rising global emissions.

The peatland problem had been known for some time. It's one reason that six of the world's leading carbon-modeling schemes, including the E.P.A.'s, have concluded that biodiesel made from Indonesian palm oil makes the global carbon problem worse, not better. The World Agroforestry Center found that peatland-based biodiesel could produce nearly four times the emissions of petroleum diesel. In 2011, the government began a process to survey and designate millions of acres of Indonesia as protected peatland. In 2013, Wilmar signed a pledge to avoid peatland from inside the industry, and other companies eventually followed. American investors and regulators have taken solace in these pledges, assuming that they have lessened the environmental threat. And yet in 2015, as the peat fires raged aboveground and below, Suhadi could see only that none of that mattered.

6. 'We Call Them Shadow Companies'

In early July, I traveled to Kalimantan to investigate rumors that large-scale illegal peatland logging operations were still underway. Gelambong met me in a shaded garden behind my hotel. He was deeply uncomfortable and believed he was being followed. We switched tables to move farther into the yard, away from the town officials he suspected were listening. Gelambong's life hadn't been the same since he went public with documents accusing Bumitama of seizing his village's land. The company accused him of embezzlement, and he was arrested in 2016. He spent six months in the Pangkalan Bun jail before a judge determined that there was no evidence to hold him and dismissed the charges.

Members of the Wehea Dayak tribe walking past a palm-oil tanker during an initiation ceremony in East Kalimantan. Ashley Gilbertson/VII, for The New York Times

The palm companies keep getting stronger. In 2014, Indonesia's highest judge and three associates were convicted in a huge bribery scandal that journalists have linked to palm land deals in Borneo. A few years later, a Kalimantan governor was caught granting palm concessions to family members, who flipped them back to the companies that paid for his election. Stories of corruption, and threats to keep it quiet, were legion. I was reminded of the threats that Suhadi had described — a series of anonymous phone calls and an intimidating run-in at a market in Jakarta. Suhadi went dark for several weeks as a result — hiding out in a friend's house outside the city. His fear was justified. In 2015, one of Suhadi's colleagues was stabbed to death outside a Jakarta nightclub in a case that news reports speculated was linked to his environmental work, and Global Witness has counted at least eight assassinations of Indonesian environmentalists fighting palm oil.

Gelambong drove us out of downtown that afternoon, to the ramshackle waterfront port of Kumai. There, he turned us over to a boat pilot, and we squeezed into a tiny wedge of wood and fiberglass with a large outboard engine. We motored past derelict anchored ocean tankers, toward the entrance to Tanjung Puting National Park.

Tanjung Puting is one of Indonesia's most protected and beloved landscapes, rimmed by mangrove swamps around a core of heath forests that are home to orangutans, proboscis monkeys, clouded leopards and sun bears, as well as some 230 species of birds. Its 1,100 square miles of peatland bogs are one of the last remnants of an ecosystem that used to dominate the southern coast of Borneo; Gelambong said its peatland bogs once stretched most of the way from here to Kotawaringin, two hours by truck. Ecotourists come from around the world to see what remains of them, cruising the Sekonyer River on private *klotoks*, long wooden ships outfitted with netted open-air bedrooms.

The exception to the devastation of South Kalimantan is supposed to be the national parks. But the parks are not safe, either. As our boat cruised out the mouth of the Kumai River, a teacup skipping over the white caps into the open sea, our guide, Fajar Dewanto, warned us that a large part of the park was threatened by palm development. Dewanto works for Orangutan Foundation International, a group that has resettled many of the more than 5,000 orangutans here in the park. But because it's the widespread conversion of the land to monoculture plantations that threatens the orangutan habitat, Dewanto has also become a de facto park ranger, policing the forest where officials don't have enough staff, or willingness, to do it themselves.

A week before our arrival, Dewanto's team found the rigid body of an orangutan, half buried under a fallen log next to a scar of freshly cut forest in a peat bog being razed for a new palm plantation. They turned the orangutan over. It was riddled with bullet holes to the chest, arm and thigh. As more than a dozen police officers and wildlife experts established a crime scene, an excavator continued ripping down trees on the peat bog behind them, unwilling to lose even a day of progress.

Dewanto couldn't get the scene out of his head. As our boat rounded a small point of mangroves toward a little-visited swatch of parkland, he wasn't sure what he would find. Our captain slowed the motor and turned into a small tributary crowded with nipa, a stalky canelike plant that is a food staple for native people here, and from there we navigated into a recently dredged canal no wider than 10 feet. Dewanto had been here one month earlier and seen forest. Now the forest was gone.

This level of deforestation on protected peatland supposedly wasn't happening anymore. In Jakarta, a string of officials — from the government palm-oil agency, the Ministry of Maritime Affairs, the palm-industry association, the Peatland Restoration Agency — all denied to me that peat deforestation in Kalimantan still took place. Uniformly, they insisted that Indonesia had learned its lesson and solved its palm-oil problem, that peatland bans were in full force. Restoration was even underway, they claimed, painting a picture of a palm industry on a sustainable path — farming only on dry land and focused on increasing yields, not expanding footprints.

But where we stood, a broad expanse had been laid bare, the splinters of wood still so fresh they were pungent, crisscrossed by deep pools of black, boggy water. About a mile back, the tree line marked the new edge of Tanjung Puting National Park, a threshold protecting the largest population of orangutans left in the world. Beside an idle excavator, 24-inch tufts of baby palms had been set in rows, the mound of dirt around their base still fresh from planting. Dewanto wasn't particularly surprised to find the devastation. "This is every day in Borneo," he said.

Timothy Searchinger, a research scholar at Princeton University, teaching a class on global land-use challenges. Ashley Gilbertson/VII, for The New York Times

In government documents from 2011, this field was mapped not only as protected peatland but also as part of the national park. When the Walhi group visited during the fires of 2015, the forest was still protected. Records show, however, that a nearby village petitioned the Indonesian Ministry of Environment and Forestry to carve the plantation out of the park, and this allowed Bumitama, which farms there along with the village, to expand its operation. The government agreed. The park got smaller.

A few days later, we drove north, 20 hours on punishing mountain roads, toward the Malaysian border and the West Kalimantan district of Sintang. There, a meeting was planned with the local county governor, or *bupati*, to discuss a similar situation.

North of Sintang, a grim commercial town of concrete and rebar at a fork in the Kapuas River, two palm plantations were being developed on peatland bogs. These plantations, too, were located on tracts that Indonesian government maps had at one time explicitly labeled protected peatland, which should have placed them under the moratorium on palm development. The maps had since been changed. Yet there was no mistaking that this was peatland: Paths submerged into black goop, teams of dragonflies swarmed over the hot water, reeds and forest grew from their depths. And here came a flatbed truck, carrying an excavator toward the entrance gate, where a guard in a neatly pressed dark blue uniform turned away visitors.

The permits named two obscure companies, but a villager at the gate told us that he thought both plantations were run by the same company and that it had been clearing the forest for months. It's not uncommon for Indonesian companies to use layers of subsidiaries to hide their connections to illegal palm operations. "We call them shadow companies," said Eric Wakker, a founder of Aidenvironment Asia, an environmental consultancy that has investigated the two plantations. Upon further scrutiny, it appeared that the two companies may indeed have been linked to the Salim Group. They shared a business address with a Salim subsidiary in Jakarta and employed the same plantation managers in Kalimantan. Salim was also a buyer of the palm that would come from the Sintang plantations.

The connection matters because the Salim Group has benefited from more than \$1.5 billion in loans and capital from foreign investors, including the American firms BlackRock and Vanguard, and Salim companies have pledged that their palm oil is not a product of recent deforestation or peatland destruction. Satellite images from 2017 confirmed that the forests on the Sintang plantations were now virtually gone. (A Salim Group executive, Mark Wakeford, declined to comment about the Sintang companies.)

At the *bupati's* house, an elegant, 19th-century Dutch-built compound bursting with tropical flowers, I pressed him to explain how these peatland forests could be cut down when the government insisted that such land clearing had stopped. The *bupati*, a doctor named Jarot, had moved to Borneo from Java and had developed a local reputation as a conservationist. He greeted us jovially, barefoot and dressed in bluejeans and a crisp, untucked blue button-down shirt. He said the rural districts must balance economic growth with sustainability, and while he has pledged to control corruption and illegal permits, he also described himself as helpless against the currents of a central government that is close to the big corporations and constantly changes both the rules and the playing field. United Nations forest programs pay communities to leave their trees in the ground. Such funding would help him strike a better balance here, he said, casually shrugging off the plantation case I asked about. "We do what we can do," Jarot said. "We cannot do it by ourselves. ... We need a fiscal incentive."

An aide offered a more nuanced explanation. The phrases "peatland" and "forest" have distinct legal meanings in Indonesia, he claimed; not all treed areas are forests, and not all peat-filled bogs are peatland. In the strictest legal sense, he was correct. The Sintang regency alone, according to Indonesian government estimates, contains more than 160,000 acres of old-growth, heavily treed land that it has not designated as "forest" under the law and more than 86,000 acres of nondesignated peatland. After a request from the companies, the government maps for Sintang were revised to change the peatland borders. New maps show the bog boundaries tracing perfect 90-degree angles and straight lines — lines that happen to match the boundaries of the companies' land holdings. How do you account for such details in a life-cycle analysis?

7. 'It Was a Mistake'

This September, with late-season heat pounding Washington, Zenzi Suhadi cleared security at the Russell Senate Office Building, preparing to brief Senate aides about the impact that palm-oil development was having on Indonesia's environment. I asked if he was nervous, and he said no. "These are just people. I don't have to face any tigers." He didn't seem to be joking.

Henry Waxman, a longtime member of the House of Representatives and former chairman of the Energy and Commerce Committee.

Ashley Gilbertson/VII, for The New York Times

Suhadi wanted to tell the lawmakers the same thing he told them in two previous visits to Capitol Hill: that the palm trade, driven by American investment, is slowly killing his country. “It’s important for you to understand that all acts of deforestation in Indonesia start with a signature,” he said. “And more than a little of it starts right here.” He was not confident that he would be heard — the last time he visited Washington, lawmakers chewed up their time asking him about water buffalo in his village. But still he felt compelled to speak.

From Washington, Suhadi traveled to San Francisco to attend a climate march and address a group of hedge-fund investors. Just down the street, Michael Bloomberg implored strong immediate action on emissions reductions at the Global Climate Action Summit, one of the nation’s largest gatherings on climate goals. But the conference was light on substance when it came to the subject of forests. There was scarcely any mention of peatland at all.

When Nancy Pelosi took the stage, she looked back on the 2007 fuel-economy bill and biofuels mandate she shepherded into law. The initiative should be credited, she said, with “charting a new path to clean energy, reducing emissions, increasing the use of renewables.” She made no mention of Indonesia. When I asked her about the deforestation in an earlier email, her office wrote back defending the bill, citing the Union of Concerned Scientists and arguing that even with the Indonesian forest effect accounted for, biodiesels were cleaner than fossil fuels. “Bottom line,” the office responded, “the biofuels in your tank are better for the planet than 100 percent fossil fuels.”

Henry Waxman, of course, doesn’t agree. He said Congress was so focused on domestic climate policy that it failed to see the repercussions of those policies around the world — repercussions that now seem obvious. “We’ve created a situation that is so contrary to what we had hoped for,” he said. “We’re doing more harm to the environment. It was a mistake.”

The advanced cellulosic-biofuels program that once seemed so promising has been a failure. It never attracted the investment it needed, and the E.P.A. has allowed biodiesel to serve as a substitute in meeting the mandate. President Trump has wandered into the renewable-fuels-standard debate, too, and found himself caught in a thicket, at one moment poised to reform the fuel standard completely and the very next snagged by the interest of a powerful agriculture industry grown accustomed to its enormous benefit. The result is likely to be at least a near-term doubling down on American biofuels use, no matter the cost.

It may no longer be possible to slow the momentum behind Indonesia’s palm markets. Sitting in the lavish dining room of the Mandarin Oriental hotel in Jakarta in July, over an awkward meal of mushroom consommé and blanched scallops, officials from Indonesia’s Palm Oil Development Fund made a case for their industry. I asked how important the American biofuels mandate has been, given that other countries buy more Indonesian palm oil than Americans do. The answer was unequivocal: It’s what got Indonesian palm off the ground. “The U.S. is not only a market,” said Ruddy Gobel, the chief political adviser to the director. “It also sets the global agenda.” Now, according to the Indonesian development officials, 80 million Indonesians depend economically on palm oil, and nearly half the industry consists of individual landowners like the people in Kotawaringin. “If you pull out biofuel, the whole system will collapse,” said Dono Boestami, the fund’s director.

In perhaps the final turn of the life cycle, Indonesia is now working to become its own largest customer. In 2016, it instituted a 20 percent biofuels mandate for its domestic fuels, and this August, it extended that mandate to cover railways and power generation too. Then it upped the pressure further, simply making it compulsory that Indonesians buy and use biodiesel. Officials offer a simple justification for this push: Under the Paris climate accord, they say, converting Indonesia to renewable fuels is the only way the country can meet its own climate goals.

The central problem, of course, is that the goals of Paris — slowing planetary warming just enough to allow humans time to adapt to excruciating and inevitable changes, including flooding coastlines, stronger hurricanes and perpetual famine and drought — are unlikely to ever be achieved without stopping deforestation. The planet’s forests have the potential to sequester as much as a third of the carbon in the air. Right now deforestation globally contributes 15 percent of the planet’s total emissions, the same as all the cars and trucks and trains across the globe. On paper, biodiesel is a way to make all those modes of transportation produce less carbon. But in the world as it is, that calculation is far more likely to lead to catastrophe.