photographs by Adam Ferguson

# The Sand and the Fury

## Computer chips. Glass. Concrete. The world is built on sand. Mess with the mafias that control it and you could pay with your life.

by Vince Beiser

**The killers rolled** slowly down the narrow alley, three men on a single motorcycle. It was a little after 11 am on July 31, 2013, the sun beating down on the modest residential buildings lining a backstreet in the Indian farming village of Raipur Khadar. The smells of cooking spices, dust, and sewage seasoned the air. The men stopped the bike in front of the orange door of a two-story house. Two of them dismounted, eased open the unlocked door, and slipped into the darkened bedroom on the other side. White kerchiefs covered their lower faces. One of them carried a pistol.

Inside the bedroom Paleram Chauhan, a 52-year-old farmer, was napping after an early lunch. In the next room his wife and daughter-in-law were cleaning up while Paleram's son Ravindra played with his 3-year-old nephew.

Gunshots thundered through the house. Preeti Chauhan, Paleram's daughter-in-law, rushed into the bedroom, Ravindra right behind her. Through the open door they saw the killers jump on their bike and roar away.

Paleram lay on his bed, blood bubbling out of his stomach, neck, and head. "He was trying to speak, but he couldn't," Preeti says, her voice breaking. Ravindra borrowed a neighbor's car and rushed his father to a hospital, but it was too late. Paleram was dead on arrival.

Despite the masks, the family had no doubts about who was behind the killing. For a decade Paleram had been trying to get local authorities to shut down a powerful gang of criminals headquartered in Raipur Khadar that had for years been robbing the village of a coveted resource, one of the most sought-after commodities of the 21st century: sand.

That's right. Paleram Chauhan was killed over sand. And he wasn't the first, or the last.

**Civilization is literally** built on sand. It's been a critical component of construction since ancient times. In the 15th century an Italian artisan figured out how to turn it into the transparent glass that made possible the microscopes, telescopes, and other technologies that helped drive the Renaissance's scientific revolution (also, affordable windows). Sand is an essential ingredient in detergents, cosmetics, toothpaste, solar panels, silicon chips, and buildings; every concrete structure is basically sand and gravel glued together with cement.

Apart from water and air, humble sand is the natural resource most consumed by human beings. People use more than 40 billion tons of sand and gravel every year. But not just any sand: Desert sand, shaped by wind rather than water, is too round to bind together for construction.

In fact, only sand worn by water will do. And the worldwide construction boom of recent years—all those mushrooming megacities, from Lagos to Beijing—is devouring unprecedented quantities. Extracting it is a $70 billion industry. In Dubai enormous land-reclamation projects and breakneck skyscraper construction have exhausted all nearby sources, so insatiable builders now look elsewhere for their supply. Exporters in Australia are actually selling sand to Arabs.

As land quarries and riverbeds become tapped out, sand miners are turning to the seas, where ships vacuum huge amounts of the stuff from ocean floors. As you might expect, this all wreaks havoc on ecosystems. Sand mines in the US are blamed for beach erosion, water and air pollution, and other ills from the California coast to Wisconsin's lakes. India's Supreme Court

recently warned that riparian sand mining is undermining bridges and killing birds and fish all over the country. But regulations are scant, and the will to enforce them is lacking.

Sand mining has erased two dozen Indonesian islands since 2005. The stuff of those former islands mostly ended up in Singapore, which needs titanic amounts to continue its program of artificially adding territory. The city-state has created an extra 50 square miles in the past 40 years and is adding more, making it by far the world's largest sand importer. The environmental damage has been so extreme that Indonesia, Malaysia, and Vietnam have all restricted or banned exports of sand to Singapore.

As a result, the global black market is booming. Half the sand used for construction in Morocco is estimated to be mined illegally; whole stretches of beach there are disappearing. One of Israel's most notorious gangsters got his start stealing sand from public beaches. Dozens of Malaysian officials were charged in 2010 with accepting bribes and sexual favors in exchange for allowing illegally mined sand to be smuggled into Singapore.

On Indonesia's island of Bali, far inland from the tourist beaches, I visit a sand mine. It looks like Shangri-La after a meteor strike. In the middle of a beautiful valley, surrounded by jungle and rice paddies, is a 14-acre pit of exposed sand and rock. On its floor, men in shorts and flip-flops wield sledgehammers and shovels to push sand and gravel into clattering, smoke-belching sorting machines. "Those who have permits to dig for sand have to pay for land restoration," says Nyoman Sadra, a former member of the regional legislature. "But 70 percent of the sand miners have no permits." Even companies with permits spread bribes around so they can get away with digging wider or deeper pits.

But nowhere is the struggle for sand more violent than in India. Battles among and against sand mafias there have reportedly killed hundreds of people in recent years—including police officers, government officials, and ordinary people like Paleram Chauhan.

**The area around** Raipur Khadar used to be mostly agricultural—wheat and vegetables growing in the Yamuna River floodplain. But Delhi, less than an hour north, is encroaching fast. Driving down a new six-lane expressway, I pass construction site after construction site, new buildings sprouting skyward like the opening credits of *Game of Thrones* made real. Besides countless generic shopping malls, apartment blocks, and office towers, a 5,000-acre "Sports City" is under construction, including several stadiums and a Formula 1 racetrack.

The building boom got in gear about a decade ago, and so did the sand mafias. "There was some illegal sand mining

Activist Paleram Chauhan and the bed where he was killed by three masked assassins.

Workers wash stone before it gets crushed into sand at an illegal mine near Raipur Khadar.

before," says Dushynt Nagar, head of a local farmers' rights organization, "but not on a scale where land was getting stolen or people were getting killed."

The Chauhan family has lived in the area for centuries, Paleram's son Aakash says. He's slim, with wide brown eyes and receding black hair, wearing jeans, a gray sweatshirt, and flip-flops. We're sitting on plastic chairs set on the bare concrete floor of the family's living room, a few yards from where his father was killed.

The family owns about 10 acres of land and shares some 200 acres with the whole village—or used to. About 10 years ago a group of local "musclemen," as Aakash calls them, led by Rajpal Chauhan (no relation—it's a common surname) and his three sons, seized control of the communal land. They stripped away its topsoil and started digging up the sand deposited by centuries of the Yamuna's floods. To make matters worse, the dust kicked up by the operation stunted the growth of surrounding crops, according to a complaint Paleram and other locals filed.

As a member of the village panchayat, or governing council, Paleram took the lead in a campaign to get the sand mine shut down. It should have been pretty straightforward. Sand mining is not permitted in the Raipur Khadar area at all, because it's close to a bird sanctuary. And the government knew it was happening: In 2013 a federal fact-finding team found "rampant, unscientific, and illegal mining" all over the district.

Nonetheless, Paleram and other villagers couldn't get it stopped. They petitioned police, government officials, and courts for years—and nothing happened. Conventional wisdom says that many local authorities accept bribes from the miners to stay out of their business—or are involved in the business themselves.

For those who don't take the carrot of a bribe, the mafias aren't shy about using a stick. "We do conduct raids on the illegal sand miners," says Navin Das, the official in charge of mining in the district. "But it's very difficult because we get attacked and shot at." In the past three years, sand miners have killed at least three police officers and attacked many others, as well as officials, journalists, and whistle-blowers.

According to court documents, Rajpal and his sons threatened Paleram and his family, as well as other villagers. Aakash has known one of the sons, Sonu, since they were kids. "He used to be a decent guy," Aakash says. "But when he got into the sand business and started making fast money, he developed a criminal mentality and became very aggressive." In the spring of 2013, police arrested Sonu and impounded some of his outfit's trucks. He was soon out on bail.

One morning Paleram rode his bicycle out to his fields, right next to the sand mine, and saw Sonu. "He said, 'It's your fault I was in jail,'" according to Aakash. "He told my father to drop the issue." Instead Paleram complained to the police. A few days later, he was shot dead.

Sonu, his brother Kuldeep, and Rajpal were arrested, but all of them are out on bail. Aakash sees them around sometimes. "It's a small village," he says.

**The broad, murky** Thane Creek, just outside Mumbai, is swarming with small wooden boats on a recent winter morning. Hundreds of them are anchored together, hull to hull, in a ragged line stretching at least half a mile. The creek's banks are lined with

**VINCE BEISER** (@vincelb) *wrote about biometrics in India in issue 19.09.*

Sand-mining boats work illegally on Thane Creek in Maharashtra, India. Divers scoop up sand from the creek bed with a bucket; the crew hauls it to the surface.

An illicit sand-dredging operation near Mumbai.

**40 BILLION** TONS OF SAND AND GRAVEL USED WORLDWIDE EACH YEAR // **657 MILLION** TONS OF CONSTRUCTION SAND AND GRAVEL SHIPPED FROM THE U.S. IN THE FIRST NINE MONTHS OF 2014 // **50** SQUARE MILES OF LAND CREATED IN SINGAPORE SINCE 1974 // **570 MILLION** TONS OF SAND IMPORTED TO SINGAPORE SINCE 1994 // **56.4 MILLION** TONS OF INDUSTRIAL SAND AND GRAVEL USED IN THE U.S. IN 2013 // **72.3 MILLION** TONS OF INDUSTRIAL SAND AND GRAVEL USED IN THE U.S. IN 2014 // CHINA HAS USED MORE CEMENT IN THE PAST **3** YEARS THAN THE U.S. DID IN THE ENTIRE 20TH CENTURY // **58** PERCENT OF WORLD CEMENT PRODUCTION USED IN CHINA IN 2012 // **2.5 MILLION** TONS OF SILICA SAND EXPORTED FROM AUSTRALIA IN 2012–2013

Indian workers crush stone into sand at an illegal mine near Raipur Khadar.

## Thane Creek's sand will soon be mined out. "If it gets much lower, we'll be out of a job."

mangroves, towered over by apartment blocks. There's a faint tang of salt in the air from the nearby Arabian Sea, mixed with diesel from the boats' engines.

Each boat carries a crew of six to 10 men. One or two of them dive to the creek bottom, fill a bucket with sand, and return to the surface. Then two others, standing barefoot on planks jutting from the boat, haul up the bucket with ropes. Their lean, muscular physiques would be the envy of any gym rat if they weren't so hard-earned.

Pralhad Mhatre, 41, dives about 200 times a day, he says. He's worked the job for 16 years. It pays nearly twice what the pullers get—about $16 a day. Mhatre wants his son and three daughters to go into some other profession; he thinks the Thane will soon be mined out. "When I started, we only had to go down 20 feet," he says. "Now it's 40. We can only dive 50 feet. If it gets much lower, we'll be out of a job."

Rivers are excellent places to find sand. The stuff can be made by glaciers grinding up stones, by oceans degrading seashells, even by lava chilling and shattering upon contact with air. According to the Udden-Wentworth size scale, the most common geologic standard, sand is grains of any hard material between 0.0625 and 2 millimeters in diameter. But nearly 70 percent of all sand is quartz. Time and the elements eat away at rock, above- and belowground, grinding off grains. Rivers carry those grains, accumulating them in their beds, on their banks, and where they meet the sea.

Quartz—a form of silicon dioxide, also called silica—is one of the most common minerals on Earth. That's good, because silica is unbelievably useful. Mixed with cement, water, and gravel, it makes excellent concrete. "Quartz is one of the hardest materials around, and the angularity of its grains makes them lock together well," says Michael Welland, a geologist and author of *Sand: The Never-Ending Story*. "And there's a hell of a lot of it."

In the wild, quartz always comes mixed with other materials—iron oxides, feldspar, whatever prevails in the local geology. (Quartz is transparent; beach sand is yellow-brown, owing to a coating of iron-rich clay.) For refined commercial products, you have to filter that stuff out or start with a high silica content. The sand of France's Fontainebleau region, for instance, is upwards of 98 percent pure silica. Europe's finest glassmakers have relied on it for centuries.

Corning operates the world's largest ophthalmic glass production center in Fontainebleau; for lenses, the sand needs to be refined to 99.7 percent silica. Electronics-grade silicon is refined to at least 99.999999999 percent purity—nine nines after the decimal. As Welland writes, that's one atom of not-silicon among a billion silicon atoms.

The day after my trip to Thane Creek, Sumaira Abdulali, India's foremost campaigner against illegal sand mining, takes me to see a different kind of mine. Abdulali, 54, is a decorous, well-heeled member of the Mumbai bourgeoisie, gentle of voice and genteel of manner. For years she has been traveling to remote areas in a leather-upholstered, chauffeur-driven sedan, snapping pictures of sand mafias at work. In the process she's had her car windows smashed and been insulted, threatened, pelted with rocks, pursued at high speeds, and punched hard enough to break a tooth.

Abdulali got involved when sand miners started tearing up a beach near Mumbai where her family has vacationed for generations. In 2004 she filed the first citizen-initiated court action against

sand mining in India. It made the newspapers, which brought a flood of calls from others who wanted to stop their own local sand mafias. Abdulali has since helped dozens file court cases while keeping up a stream of complaints to local officials. "We can't stop construction. We don't want to halt development," she says in British Indian–accented English. "But we want to put in accountability."

Abdulali takes me to the rural town of Mahad, where sand miners once smashed up her car. Sand mining is banned in the area because of its proximity to a protected coastal zone. Nonetheless, in the jungled hills not far outside town, we come to a gray-green river on which boats, in plain view, are sucking up sand from the bottom with diesel-powered pumps. The banks are dotted with piles of sand, which men are loading onto trucks.

Back on a main road, we find ourselves behind a convoy of three sand trucks. They rumble, unmolested, past a police van parked on the shoulder. A couple of cops idle nearby. Another is inside taking a nap, his seat fully reclined. This is too much for Abdulali. We pull up alongside. An officer who appears to be in charge—his khaki uniform has stars on its shoulders—lounges in the van, shoes off. "Didn't you see those trucks carrying sand that just went past?" Abdulali asks.

"We filed some cases this morning," answers the cop genially. "We're on our lunch break now."

Some time later I ask a local government official about this. "The police are hand in glove with the miners," says the official, who asks me not to name him. "When I call the police to escort me on a raid, they tip off the miners that we are coming." Even in the cases he'd brought to court, no one was convicted. "They always get off on some technicality."

**Back in Raipur Khadar,** after I finish talking with Paleram Chauhan's family, Aakash agrees to show me and my interpreter, Kumar Sambhav, the land the mafia has taken over. We'd rented a car in Delhi that morning, and Aakash directs our driver to the site. It's hard to miss: Across the road from the village center is an expanse of torn-up land pocked with craters 10 and 20 feet deep, stippled with piles of sand and rock. Clusters of men are smashing rocks with hammers and loading trucks. They stop to stare at our car as we drive slowly past on the rutted track running through the mine. Aakash points out a heavyset guy in jeans and a collared shirt: Sonu.

A short while later, deep inside the site, we get out to snap pictures of a particularly huge crater. After a few minutes Aakash spots four men, three of them carrying shovels, striding purposefully toward us. "Sonu is coming," he mutters.

We start making our way back to the car, trying to look unhurried. But we're too slow. "Motherfucker!" Sonu, now just a few yards away, barks at Aakash. "What are you doing here?"

Aakash keeps silent. Sambhav mumbles that we're just tourists as we all climb into the car. "I'll give you sisterfuckers a tour," Sonu says. He yanks open our driver's door and orders him out. The driver obeys, obliging the rest of us to follow suit. Aakash, wisely, stays put.

"We're journalists," Sambhav says. "We're here to see how the sand mining is going." (This conversation was all in Hindi; Sambhav translated for me afterward.)

"Mining?" Sonu says. "We are not doing any mining. What did you see?"

"We saw whatever we saw. And now we're leaving."

"No, you're not," Sonu says.

The exchange continues for a couple of tense minutes, until one of Sonu's goons points out the presence of a foreigner—me. This gives Sonu and his crew pause. Harming a Westerner could bring them a lot of trouble. We grab the opportunity to take off. Sonu, glaring, watches us go.

The case against Sonu and his relatives is grinding its way through India's courts. The outlook isn't great. "In our system you can easily buy anything with money—witnesses, police, administrative officials," a legal professional close to the case tells me, on condition of anonymity. "And those guys have a lot of money from the mining business."

Aakash keeps in touch with investigators and has tried to get India's National Human Rights Commission to take an interest. His mother pleads with him to drop the whole thing, especially since her other son, Ravindra—the main witness in the case—was found dead by some railroad tracks last year, run over by a train, apparently.

India is taking steps to get sand mining under control. The National Green Tribunal, a sort of court for environmental matters, hears citizen complaints about illegal sand mining. The government has enlisted India's space agency to provide satellite imagery to monitor river mining. Villagers have blocked roads to stop sand trucks, and pretty much every day some local or state official declares their determination to combat sand mining. Even the new magistrate of Raipur Khadar's district confiscated dozens of sand trucks and made several arrests this year. But India has hundreds, if not thousands, of illegal sand-mining operations.

And the world's population is growing. People want housing, offices, factories, and malls, as well as roads to connect it all. "The fundamental problem is the massive use of cement-based construction," says Ritwick Dutta, a leading Indian environmental lawyer. "That's why the sand mafia has become so huge." Economic development as we know it requires concrete and glass. It requires sand.

## A Typology of Sand

**FIG. 1 DESERT SAND**

Weathered by wind, desert sand is too round and smooth for the grains to bind together in concrete.

Desert sand grains tend to be smaller and more uniform.

**FIG. 2 AQUATIC SAND**

Land quarries and riverbanks were once the main sources for sand. As these sources run out, dredgers turn to coastlines and the sea.

Unlike aggregates from rivers and streams, marine sand must be washed to remove salt, which would compromise building quality.

Sand for construction is largely quartz, though marine sand can also consist of coral, shells, lava, and other minerals.

ILLUSTRATIONS BY LOUISE POMEROY

Construction in the Indian state of Uttar Pradesh. Any building that needs concrete needs sand.