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Why the world is running out of sand

* Vince Beiser (@vincelb) is the author of “The World in a Grain: The Story of Sand and How It Transformed Civilization”.

(Image credit: Getty Images)



By Vince Beiser 18th November 2019

It may be little more than grains of weathered rock, and can be found in deserts and on beaches around the world, but sand is also the world’s second most consumed natural resource.

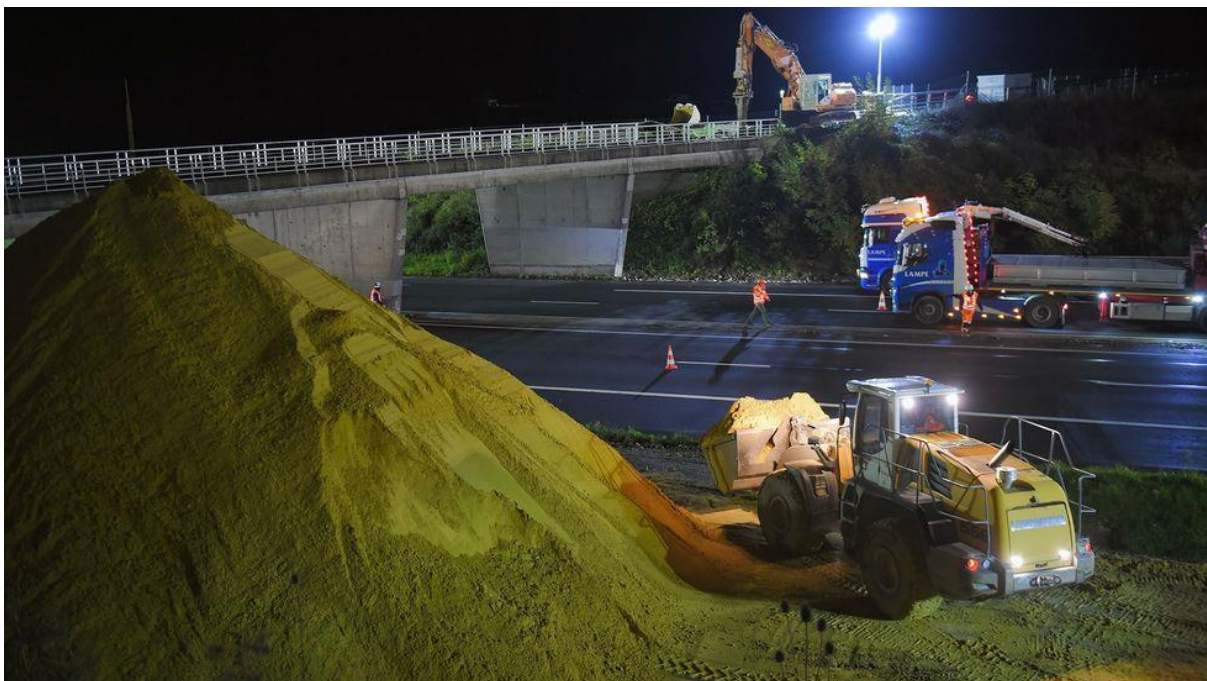
A South African entrepreneur shot dead in September. Two Indian villagers killed in a gun battle in August. A Mexican environmental activist murdered in June.

Though separated by thousands of miles, these killings share an unlikely cause. They are some of the latest casualties in a growing wave of violence sparked by the struggle for one of the 21st Century’s most important, but least appreciated, commodities: ordinary sand.

Trivial though it may seem, sand is a critical ingredient of our lives. It is the primary raw material that modern cities are made from. The concrete used to construct shopping malls, offices, and apartment blocks, along with the asphalt we use to build roads connecting them, are largely just sand and gravel glued together. The glass in every window, windshield, and smart phone screen is made of melted-down sand. And even the silicon chips inside our phones and computers – along with virtually every other piece of electronic equipment in your home – are made from sand.

And where is the problem with that, you might ask? Our planet is covered in it. Huge deserts from the Sahara to Arizona have billowing dunes of the stuff. Beaches on coastlines around the world are lined with sand. We can even buy bags of it at our local hardware shop for a fistful of small change.

But believe it or not, the world is facing a shortage of sand. How can we possibly be running low on a substance found in virtually every country on earth and that seems essentially limitless?



Creating the buildings and roads needed for the world's growing urban population requires vast volumes of sand (Credit: Getty Images)

Sand, however, is the most-consumed natural resource on the planet besides water. People use some **50 billion tonnes of “aggregate”** – the industry term for sand and gravel, which tend to be found together – every year. That’s more than enough to blanket the entire United Kingdom.

The problem lies in the type of sand we are using. Desert sand is largely useless to us. The overwhelming bulk of the sand we harvest goes to make concrete, and for that purpose, desert sand grains are the wrong shape. Eroded by wind rather than water, they are too smooth and rounded to lock together to form stable concrete.

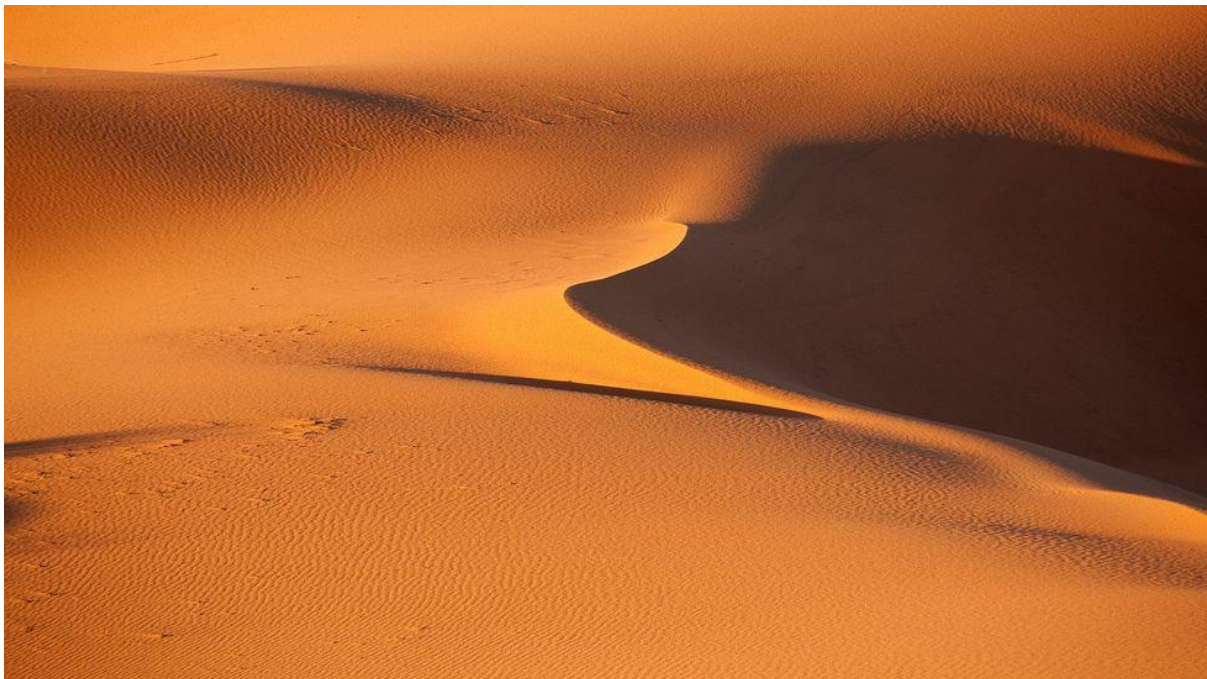
We cannot extract 50 billion tonnes per year of any material without leading to massive impacts on the planet and thus on people's lives - Pascal Peduzzi

The sand we need is the more angular stuff found in the beds, banks, and floodplains of rivers, as well as in lakes and on the seashore. The demand for that material is so intense that around the world, riverbeds and beaches are being stripped bare, and farmlands and forests torn up to get at the precious grains. And in a growing number of countries, criminal gangs have moved in to the trade, spawning an often lethal black market in sand.

“The issue of sand comes as a surprise to many, but it shouldn't,” says Pascal Peduzzi, a researcher with the United Nations Environment Programme. “We cannot extract 50 billion tonnes per year of any material without leading to massive impacts on the planet and thus on people's lives.”

The main driver of this crisis is breakneck urbanisation. Every year there are more and more people on the planet, with an ever growing number of them moving from the rural countryside into cities, especially in the developing world. Across Asia, Africa, and Latin America, cities are expanding at a pace and on a scale far greater than any time in human history.

The number of people living in urban areas has more than quadrupled since **1950 to some 4.2 billion today**, and the United Nations predicts **another 2.5 billion** will join them in the next three decades. That's the equivalent of adding eight cities the size of New York every single year.



Smoothed by the wind, sand in deserts like the Sahara, which cover huge swathes of the planet, do not lock together well in concrete (Credit: Alamy)

Creating buildings to house all those people, along with the roads to knit them together, requires prodigious quantities of sand. In India, the amount of construction sand used annually has more than **tripled since 2000**, and is still rising fast. China alone has likely used more sand this decade than the United States did in the entire 20th Century. There is so much demand for certain types of construction sand that Dubai, which sits on the edge of an enormous desert, imports sand from Australia. That's right: exporters in Australia are literally selling sand to Arabs.

But sand isn't only used for buildings and infrastructure – increasingly, it is also used to manufacture the very land beneath their feet. From California to Hong Kong, ever-larger and more powerful dredging ships vacuum up millions of tonnes of sand from the sea floor each year, piling it up in coastal areas to create land where there was none before. Dubai's palm-tree shaped islands are perhaps the most famous artificial land masses that have been built from scratch in recent years, but they have plenty of company.

Lagos, the largest city in Nigeria, is adding a 2,400-acre (9.7 sq km) urban extension to its Atlantic shoreline. China, the fourth-largest nation on Earth in terms of naturally occurring land, has added hundreds of miles to its coast, and built entire islands to host luxury resorts.

River sand mining is also contributing to the slow-motion disappearance of Vietnam's Mekong Delta

This new real estate is valuable, but it often incurs steep costs. **Ocean dredging has damaged coral reefs** in Kenya, the Persian Gulf and Florida. It tears up marine habitat and **muddies waters with sand plumes that can affect aquatic life** far from the original site. Fishermen in Malaysia and Cambodia have seen their livelihoods decimated by dredging. In China, land reclamation has wiped out coastal wetlands, annihilated habitats for fish and shorebirds, and increased water pollution.

And then there's Singapore, a world leader in land reclamation. To create more space for its nearly six million residents, the jam-packed city-state has built out its territory with an additional 50 sq miles (130 sq km) of land **over the past 40 years**, almost all of it with sand imported from other countries. The collateral environmental damage has been so extreme that neighbouring Indonesia, Malaysia, Vietnam, and Cambodia have all **restricted exports of sand to Singapore**.

All told, according to a Dutch research group, human beings since **1985 have added 5,237 sq miles (13,563 sq km) of artificial land** to the world's coasts – an area about as big as the nation of Jamaica. Most of it built with gargantuan amounts of sand.



Sand is extracted on an industrial scale from rivers, lakes and beaches around the world to meet the global demand (Credit: Getty Images)

Mining sand to use in concrete and other industrial purposes is, if anything, even more destructive. Sand for construction is most often mined from rivers. It's easy to pull the grains up with suction pumps or even buckets, and easy to transport once you've got a full boatload. But dredging a riverbed can destroy the habitat occupied by bottom-dwelling organisms. The churned-up sediment can cloud the water, suffocating fish and blocking the sunlight that sustains underwater vegetation.

River sand mining is also contributing to the slow-motion disappearance of Vietnam's Mekong Delta. The area is home to 20 million people and source of half of all the country's food and much of the rice that feeds the rest of South East Asia. Climate-change-induced sea level rise is one reason the delta is losing the equivalent of one and a half football fields of land every day. But another, researchers believe, is that people are robbing the delta of its sand.

For centuries, the delta has been replenished by sediment carried down from the mountains of Central Asia by the Mekong River. But in recent years, in each of the several countries along its course, miners have begun pulling huge quantities of sand from the riverbed. According to a 2013 study by three French researchers, some **50 million tonnes of sand were extracted in 2011 alone** – enough to cover the city of Denver two inches deep. Meanwhile, five major dams have been built in recent years on the Mekong and another 12 are slated for construction in China, Laos, and Cambodia. The dams further diminish the flow of sediment to the delta.

In other words, while natural erosion of the delta continues, its natural replenishment does not. Researchers with the Greater Mekong Programme at the World Wide Fund for Nature (WWF) believe that at this rate, **nearly half the delta will be wiped out by the end of this century.**



Extracting sand from quarries along river banks in places like Sri Lanka is back-breaking work (Credit: Getty Images)

To make matters worse, dredging the Mekong and other waterways in Cambodia and Laos is causing river banks to collapse, dragging down crop fields and even houses. Farmers in Myanmar say the same thing is happening along the Ayeyarwady River.

Sand extraction from rivers has also caused untold millions of dollars in damage to infrastructure around the world. The stirred-up sediment clogs water supply equipment. And removing all that material from river banks leaves the foundations of bridges exposed and unsupported. In Ghana, sand miners have dug up so much ground that they have dangerously exposed the foundations of hillside buildings, which are at risk of collapse. That's not just a theoretical risk. Sand mining caused a bridge to collapse in Taiwan in 2000, and another the following year in Portugal just as **a bus was passing over it, killing 70 people.**

The competition for sand has grown so intense that in many places criminal gangs have gotten into the trade

Demand for high-purity silica sands, which are used to make glass as well as high-tech products like solar panels and computer chips, is also soaring. America's surging fracking industry also needs the extra-durable high-purity grains. The result: acres of farmlands and forests in rural Wisconsin, which happens to have a lot of those precious sands, are being torn up.

The competition for sand has grown so intense that in many places criminal gangs have gotten into the trade, digging grains up by the megatonne to sell on the black

market. In **parts of Latin America and Africa**, according to human rights groups, **children are forced to work as virtual slaves** in **sand mines**. The gangs get away with all this the same way organised crime does everywhere – by paying off corrupt police and government officials to leave them alone. And, when they deem it necessary, by assaulting and even killing those who get in their way.



Criminal gangs have found that illegally extracting sand from beaches or quarries and selling it on the black market is a lucrative business (Credit: Getty Images)

José Luis Álvarez Flores, an environmental activist in the southern Mexican state of Chiapas who campaigned against illegal sand mining in a local river, was shot dead in June. A note threatening his family and other activists was reportedly found with his body. Two months later, police in Rajasthan, India, were shot at when they tried to stop a convoy of tractors carrying illegally mined sand. The ensuing gun battle left two miners dead and two police officers hospitalised. And early this year, a sand miner in South Africa was shot seven times in a dispute with another group of miners.

Those are only the latest casualties. Violence over the sand trade in recent years has taken lives in Kenya, Gambia, and Indonesia. In India, “sand mafias”, as the local press calls them, have injured hundreds and killed dozens of people. The victims include an 81-year-old teacher and a 22-year-old activist who were separately hacked to death, a journalist burned to death, and at least three police officers run over by sand trucks.

Awareness of the damage caused by our addiction to sand is growing. A number of scientists are working on ways to replace sand in concrete with other materials, including fly ash, the material left over by coal-fired power stations; **shredded plastic**; and even crushed oil palm shells and **rice husks**. Others are

developing **concrete that requires less sand**, while researchers are also **looking at more effective ways to grind down and recycle concrete**.

In many Western countries, river sand mining has already been largely phased out. Getting the rest of the world to follow suit will be tough, though. “Preventing or reducing likely damage to rivers will require the construction industry to be weaned off river sourced aggregate,” says a recent report on the global sand industry by WWF. “This type of societal shift is similar to that required to address climate change, and will necessitate changes in the way that sand and river are perceived, and cities are designed and constructed.”



Sand-covered beaches are often depicted as paradise, but in some parts of the world they are being dug up and sold by the tonne (Credit: Alamy)

Mette Bendixen, a coastal geographer at the University of Colorado, is one of a growing number of academics calling for the United Nations and the World Trade Organization, to do more to **limit the damage caused by sand mining**. “We should have a monitoring programme,” says Bendixen. “More management is needed because right now it’s not being managed at all.”

At present, no one even knows exactly how much sand is being pulled out of the earth, nor where, nor under what conditions. Much of it is undocumented. “We just know,” says Bendixen, “that the more people there are, the more sand we need.”

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