

# Causes of the great famine, one of the deadliest environmental disasters

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From 1876-78, droughts cause crop failures around the world, causing millions to die. Credit: dasroofless via Flickr

From 1876 to 1878, the Great Famine killed between 30 and 60 million people around the world. Drought enveloped much of the planet, causing food shortages all the way from Brazil to India and China, and wiping out approximately three percent of the global population.

Climate scientist Deepti Singh from Columbia University's Lamont-Doherty Earth Observatory recalls reading about the droughts' devastation and wondering, "What could cause something like this? And what's the likelihood that it could happen again in the coming decades?"

She and her colleagues are quantifying the extent and severity of the global drought, and trying to find out what made it so severe. She presented the research on Friday at the meeting of the American Geophysical Union in New Orleans, Louisiana.

The Great Famine was "arguably the worst

environmental disaster to ever befall humanity," the team notes in a forthcoming paper. It "helped create the global inequalities that would later be characterized as 'first' and 'third worlds'." Understanding the drought's driving forces is important, says Singh, since they could strike again at any time—perhaps worse than ever, since hotter temperatures make droughts more intense.

Scientists have long suspected that El Niño was partially to blame for the global famine. Driven by temperatures in the equatorial Pacific Ocean, El Niño is a climate pattern that often comes with warm and dry conditions in India, Australia, and South America. In their paper (which has not yet been published), Singh and her colleagues provide some of the first quantitative evidence that this environmental catastrophe was likely driven by the strongest El Niño that human instruments have ever measured. Other record-breaking conditions may have been at play as well, they find.

## A Global Problem

To find out exactly where, when, and how long the droughts occurred, as well as their severity, the researchers turned to tree-ring based drought atlases. Tree rings grow thicker during wet years, so old trees can provide a history of past climate conditions. Edward Cook, co-author and director of Columbia's Tree Ring Lab, developed three of the atlases used in the paper. Rain gauge data, some of which goes back 175 years, also indicated how scarce water was at the time of the drought.

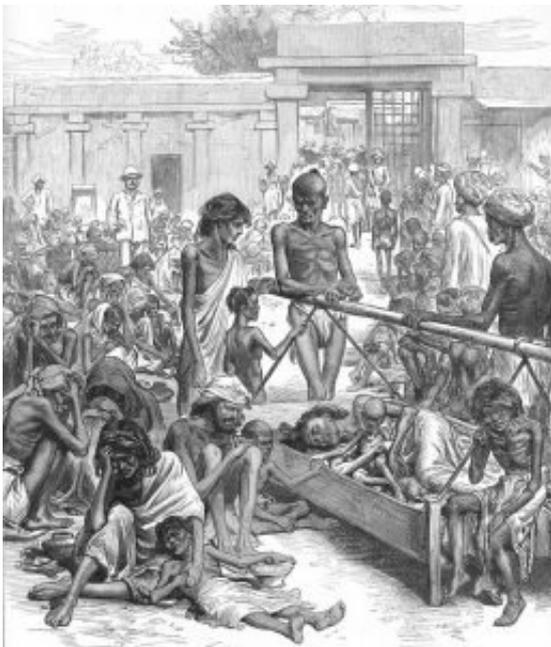
The team's findings suggest that the 1876-78 droughts extended far beyond Brazil, India, and China, although that's where famine struck the hardest. The search turned up evidence for dry conditions in Egypt, Morocco, Australia and even southwestern and eastern North America. Tree rings suggested Asia's drought was the worst in 800 years or more.

## Prelude to Disaster

To find out what made the conditions so severe, the researchers looked at [sea surface](#) temperature data collected by sailors going back as far as the 1870s.

Sea surface temperatures confirmed that there was indeed an intense El Niño that persisted for the larger part of two years of the Great Famine (1877-78). But the extreme El Niño may have been primed by cooler waters in the central tropical Pacific from 1870 to 1876. This prolonged period of coolness—the longest on the record—may have led to immense buildup of warm water in the western tropical Pacific. This ended in a strong La Niña event in 1875-76. The La Niña kicked off dry conditions in India, Mexico and the southwestern U.S., then discharged into a strong El Niño, which brought along more dryness across a large fraction of the globe.

"It's like a pendulum," explains Singh. "If you keep pushing it in one direction, further and further from the center, and then release it, it's going to go to the extreme in the other direction."



The Great Famine killed an estimated 12 to 29 million people in India. Credit: Wikimedia Commons

## Oceanic Accomplices

El Niño didn't work alone in generating the Great Famine. Singh and her colleagues found evidence of exceptional conditions in the Atlantic and Indian oceans as well.

In 1877, the Indian Ocean experienced exceptionally warm temperatures, particularly in its western portion, generating a dipole in sea surface temperatures. These contrasting conditions in the Indian Ocean can often lead to dry conditions in Australia and South Africa. But in 1877, the thermal contrast between the two halves was the strongest ever recorded before or since, which likely assisted El Niño in generating severe droughts in those regions.

In 1877 and 1878, the north Atlantic was the warmest it has ever been, according to records that date back to the 1850s. This may have pushed moisture-carrying atmospheric winds northward, away from the Brazilian Nordeste, which lost two million lives during the famine that followed.

Scientists disagree over whether El Niño could have triggered these effects in the Atlantic and Indian oceans. Maybe it was just bad luck that extreme conditions happened in all three oceans at once. But the oceans are all connected, and Singh and her colleagues suspect El Niño set off the cascade of effects.

"It's hard to think that all of this was a coincidence," Singh says.

## Looking to the Future

All in all, the team concludes that a host of record-setting conditions—an intense and long-lasting El Niño, likely primed by a cool Pacific, and exacerbated by a warm Atlantic and strong thermal contrasts in the Indian Ocean—combined into the perfect storm that was the Great Famine. And it could happen again.

Since the conditions that cooked up the Great Famine arose from natural climatic variation, there's nothing to stop a global drought from recurring. If those [conditions](#) were to arise again, they could

again put global food security in jeopardy.

In fact, it could be worse the next time around. As the global thermostat rises, the warmer temperatures could make future droughts more severe, says Singh.

Next, she and her colleagues hope to find out how often events like this might happen in the future, how severe they might be, and which countries would be worst affected. Understanding what caused the global [drought](#) could help to predict and prepare for the next one, in hopes that it won't trigger another global famine.

The study is currently in preparation for submission to a peer-reviewed journal.

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