

Climate change and the Angkor empire's growth and eventual demise

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Image 1. The main complex of Angkor Wat is pictured in 2005. Photo from Wikimedia Commons

ANGKOR, Cambodia — Angkor Thom is one of the walled cities that make up Angkor, the ancient Khmer empire in Cambodia. Next to the road leading into the ancient city stands a solitary but crumbling bridge with arches made out of recycled sandstone blocks. The bridge seems to be of little significance, and no water runs beneath it. Few, if any, of the tour buses shuttling visitors to the temple grounds, stop for tourists to have a look.

Dan Penny is an expert in environmental history who has studied the Angkor civilization for many years. For him, the bridge tells an intriguing story. Its damage in the recent past, he says, is a reminder that while it was water — or the control of it — that built the city of Angkor, it was also water that helped to destroy it.

The cause of the Angkor empire's decline in the early 15th century long remained a mystery. However, researchers have now shown that intense monsoon rains that followed a prolonged drought in the region caused widespread damage to the city's infrastructure. That damage ultimately led to the empire's collapse.

"The destruction of this bridge is suggestive of a huge flow of water," said Penny, who is a researcher in the geosciences department at the University of Sydney. The water was "far more than the canal could cope with, coming down through the middle of the city. It did a huge amount of damage to infrastructure that people who were living here at the time simply couldn't repair."

The Pre-Industrial World's Largest City

The Angkor period is said to have begun in 802. That year, from a location in the Kulen Mountains overlooking the future city plain, Jayavarman II proclaimed himself chakravartin, or "god king," of the Khmer empire. Over the next few centuries, a vast city complex with nearly 1 million inhabitants emerged as Angkor grew into the biggest city of the pre-industrial world.

From the beginning, water was central to the development of Angkor. Channels and reservoirs were constructed to collect and store water coming from the hills, both for flood control and for distribution for agriculture. A system of overflows and bypasses carried surplus water to the Tonle Sap Lake to the south of the city.

"It was a water management infrastructure that had no equal on Earth," Penny said.



After A Few Centuries, Something Went Wrong

The canal network had a history of additions and modifications. Earlier channels both distributed and disposed of water. From the 12th century onward — around the time the most famous temple, Angkor Wat, was built and the empire reached its peak — the large new channels primarily disposed of water to the lake.

Over the next couple of centuries, the system seems to have functioned pretty well as the city continued to thrive. However, in the mid to late 1300s, Angkor began suffering from persistent drought. This was followed by several years of unusually strong monsoon rains, producing heavy flooding that the city's infrastructure was not strong enough to deal with.

The flooding caused serious erosion in the system, with links in it being systematically broken. To the south of the city, canals were choked with material eroded from the center of Angkor.

The bridge at Angkor Thom was built from reused stone blocks from temples, with many of them carved in intricate ways.

"That they would take apart a temple and use it for something as mundane as a bridge suggests there is something seriously going wrong," Penny said.

"It has long been thought that the damage to the water management system put an end to a long period of decline at Angkor."

"Culture And Climate Are Connected"

Judging by the damage done to the bridge, which had its eastern end destroyed, the efforts to control the floodwaters were ultimately unsuccessful. In the end, the Siem Reap River, which was

supposed to run under it, carved a way around the bridge. Today, the river runs about 25 feet below its original course.

As the flooding destroyed the infrastructure, the city of Angkor collapsed, and in 1431 it was taken by the Siamese army. Many of the temples were later overgrown by jungle, while others remained important religious sites for the Khmer people. The ruins were unknown to much of the world until French explorers were taken there in the 1860s.

Today, researchers are working on the sustainable development of the Lower Mekong River Basin as part of an aid project called "The Wonders of the Mekong." They said that there are important lessons to learn from what happened to Angkor.

"Culture and climate are connected," said Sudeep Chandra, director of the University of Nevada Global Water Center, which is leading the research.

"We see communities around the world struggle with understanding how to respond to the increased variability from a changing climate," he added.

The Empire Was Unprepared

In the efforts to control water flow, the Angkorian engineers diverted water from existing river systems, creating new drainage areas. This might have had negative environmental consequences, destabilizing the city and eventually leading to its collapse.

"The medieval Khmer were confronted with a period of climatic instability that they had no experience of," Penny said. The new climate "fully changed the rules of the game that they had been playing for hundreds of years," and they were not prepared for it.

"A similar scale of challenge is now confronting contemporary communities, as the climate begins to change."