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# Working in the Himalayas to Prevent Disastrous Flooding

By AMY YEE

NEW DELHI — With its massive chalk-white face of ice and snow, Thorthormi glacier in northern Bhutan looms high against a bright blue sky, nearly 4,450 meters above sea level. At the glacier's base, a wide lake of murky water completes the dramatic scene at the rooftop of the world.

But the beauty of the majestic landscape hides a threat. Thorthormi's swelling glacial lake is expanding at an alarming rate as the surrounding ice bed melts 30 to 35 meters, or 100 to 165 feet, a year.

Because of warmer temperatures attributed to [climate change](#), Thorthormi lake has nearly tripled in size since 2001, to 3.42 square kilometers, or 1.32 square miles, while the natural moraine dam of rocks containing it has shrunk to half its height, according to the environmental group W.W.F.

If the moraine around Thorthormi lake collapses, as many as 14 million gallons, or 53 million liters, of water, rocks and debris would gush through nearby valleys, affecting tens of thousands of people and destroying their livelihoods. The surrounding area is home to 10 percent of Bhutan's 700,000 people and constitutes about 8 percent of its arable land, in a country that relies heavily on agriculture.

In a worse case, Thorthormi lake would breach a narrow moraine and merge with Rapshteng, an enormous adjacent glacial lake, and unleash a catastrophic torrent of water through Bhutan.

A glacial lake outburst flood, or GLOF, of Thorthormi lake would devastate not only Bhutan but also communities downstream, with flooding very likely in neighboring India and Bangladesh.

GLOFs are just one of the big threats from climate change in the Himalayas. There are also grave long-term consequences of melting glaciers. Himalayan glaciers, the world's second-largest source of fresh water, after the polar ice caps, are shrinking at a rate of 30 to 60 meters a decade, the United Nations Development Program estimates. Yet these "water towers" of Asia feed seven of the continent's major rivers, including the Yangtze, Ganges, Indus and Mekong, upon which 1.3 billion people depend.

Reduced flow of fresh water from shrinking Himalayan glaciers across Pakistan, China, Nepal, India and Bhutan could create water shortages in the world's most populous region.

To address multiple threats from climate change, Bhutan hosted a summit meeting of Himalayan countries on Nov. 19 in Thimphu, its capital. Government officials from India, Nepal, Bangladesh and Bhutan attended the meeting, along with aid agencies, donors, NGOs and environmentalists, to discuss ways to mitigate risks to food security, water, energy and biodiversity.

They sought to create a collective 10-year blueprint to cope with the reality of climate change in the region. While Bangladesh is far from the snowcaps of the Himalayas, its low-lying position as a basin for 56 major rivers makes it especially vulnerable to changes among its mountainous neighbors.

"Climate change is a shared problem, and regions bound by common issues and geographical boundaries should coordinate efforts to deal with its impact," said Dr. Lyonpo Pema Gyamtsho, Bhutan's minister for agriculture and forests.

So-called least developed countries like Bhutan and Bangladesh account for a tiny fraction of the greenhouse gas emissions responsible for global warming. But poor countries like them will bear the brunt of climate change because of their geography and lack of money and technology to protect themselves.

As delegates gathered at the U.N. summit meeting in Durban, the far smaller Himalayan climate summit served as a proactive way to address pressing issues in the region. Bhutan "cannot wait for a global agreement to reduce emissions," said Jorgen Thomsen, director of conservation at the Chicago-based MacArthur Foundation, one of the meeting's partners. "They need to act now, and are doing so. They are setting an example for how the global community must work together. "

The forward-thinking approach is in keeping with Bhutan's emphasis on protecting its

environment and culture during its recent modernization. The former kingdom was closed to the outside world until the 1970s; it lifted a ban on television and the Internet only in 1999.

It has modernized politically, too. Bhutan willingly abandoned its centuries-old monarchic rule in 2008. It has pledged to conserve 60 percent of its territory as forest, and 40 percent as national parks and protected areas.

While it could have flung open its doors to lucrative foreign tourism like Nepal, Bhutan aims to cap tourists and protect its environment by requiring visitors to spend a minimum of \$200 a day (including hotel and other expenses). Conserving the environment is part of Bhutan's "gross happiness index," a holistic measure of quality of life there.

Since Bhutan has no power to reduce global greenhouse gas emissions, it must mitigate the ill effects of climate change. Herculean efforts to shrink Thorthormi lake are one example.

Each year since 2009, more than 300 Bhutanese have trekked 10 days to reach the remote Thorthormi glacier to drain its lake. Heavy equipment cannot be carried to the [avalanche-prone](#) site so horses and yaks haul supplies. There, male and female workers use ropes, shovels and sheer muscle to move boulders and dig a channel to drain the lake.

The high-altitude conditions at Thorthormi claimed several lives last year. But so far the three expeditions, backed by government support and international financing from the U.N.D.P., W.W.F. and other agencies, have lowered water levels in the lake by 3.63 meters, staving off what seemed like an imminent GLOF in 2010. Project leaders hope to reduce water levels by a total of 5 meters in 2012.

In another example of climate change mitigation, an early warning system has been established near Thorthormi lake to alert locals of floods. If water levels rise, sensors activate and trip an alarm at a control station. Sirens blare to warn locals to relocate to evacuation sites. The station would communicate updates to government officials, including Bhutan's Department of Disaster Management. Officials, in turn, would convey information to locals via pre-distributed mobile phones.

The early warning system is equipped with 17 sirens, four automatic water level stations, three automatic weather stations and a control station manned 24 hours a day. It shares water level information with the neighboring Indian states of Assam and West Bengal, which are prone to downstream flooding.

The Himalayan summit meeting sought to forge more regional cooperation of this kind. But the challenges remain immense. There are 2,600 glacial lakes in Bhutan; Thorthormi is the largest and most dangerous, but another 82 are deemed to be growing risks.

In addition to glacial floods, Himalayan countries have to battle other severe consequences of climate change. unpredictable rains; rising temperatures that affect crops and promote pests; and expanding or receding forests that endanger animal habitats.

In the far reaches of Bhutan, it is not enough for locals to move mountain lakes. Vulnerable Himalayan countries need more resources to tackle climate change, said Dr. Gyamtsho, Bhutan's minister of agriculture and forests. Otherwise "Bhutan may yet be fighting a losing war to save the planet and humanity, despite winning some minor battles locally."