

The effects of melting glaciers on tropical communities

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Tropical glaciers in the Andes Mountains in August 2014. Karl Zimmerer, professor of geography, has been researching the effects that climate change has had on these glaciers, which are receding, and the tropical communities that rely on their runoff. Credit: Karl Zimmerer

A Penn State professor is researching the trickle-down effects that melting tropical glaciers have on food security and biodiversity, and what regional communities, like Cusco and Huaraz in Peru, can do about it.

Karl Zimmerer, professor of geography, conducts research focused on the impacts of climate change on glaciers and in tropical mountains, and how this affects agrobiodiversity and [food security](#) in communities.

Agrobiodiversity is the biological diversity of domesticated crops and animals within an ecosystem, as well as the cultural landscapes and human-environmental interactions of a particular region.

Zimmerer develops and tests models of these human-environment interactions of agrobiodiversity that he and his collaborators then apply to climate change challenges, as well as to the adaptation and resilience of sustainable food systems.

Zimmerer conducts most of his research as director of the Geographic Syntheses for Social-Ecological Sustainability (GeoSyntheSES) Laboratory at Penn State, and he also completed research in Peru during his recent sabbatical.

"Working with my students and collaborators, I primarily focus on figuring out how to conserve agrobiodiversity in the world while making it more sustainable for the people that grow these foods and can reap the nutritional and health benefits," said Zimmerer.

Agrobiodiversity and food security are increasingly crucial topics as glaciers melt in tropical locations like Peru, Bolivia, Colombia, and other countries in western and northern South America. Scientists consider at least three-quarters of the more than 25 million people in this region to be highly vulnerable to climate change.

"Tropical glaciers of South America are fragile systems that are responding to rising air temperatures and the warming of ocean currents with increased melting," said Zimmerer.

As [tropical glaciers](#) melt, runoff increases. As a result, the amount of stored water in these areas decreases, which has critical impacts on communities that rely on runoff for irrigation during the different seasons.

In the Andes Mountains in Peru, farmers are forced to combat the effects that climate change has on their access to water while ensuring that their families can eat. Increasing challenges, such as seasonal water deficits and major droughts, often result in worsened food security.



El Misti, a volcano, can be seen in the distance. Located near Arequipa, Peru, the volcano's snowfield is shrinking. Karl Zimmerer, professor of geography, has been researching the effects that climate change has had on tropical communities like Arequipa and the glaciers that provide vital runoff. Credit: Karl Zimmerer

"Poverty leads many of these Andean farmers to sell either their seed or the nutritious food that they grow to make some money," Zimmerer said.

International conference on climate change

During his sabbatical, Zimmerer reported on his research while

delivering the keynote at an international conference in August 2016 titled "International Forum on Mountain Glaciers and Ecosystems," which focused on [climate change](#) impacts in tropical regions. More than 1,500 people attended the conference, which included leading international experts in the geosciences and the social sciences.

As part of his research, Zimmerer discussed innovative cellphone technology that could link farmers together to share information about the availability of seed, which could prevent food shortages.

"Connecting people on a regional level could help to share resources more quickly," he said. "This is critical, as the need for food increases in communities like those in Peru, which threatens the sustainability of agrobiodiversity."

In addition, Zimmerer discussed the migration of farmers and the effects that this has on agrobiodiversity.

"Part-time farming has profound effects on the sustainability of agrobiodiversity in particular human-environmental systems," he said. "We're often finding that migrant workers continue to care more about sustaining their supply of foods and so they use more of their money from migration toward farming in these areas."

Addressing global climate change and agrobiodiversity through international partnerships

Zimmerer also shared his agrobiodiversity research through an interview in Lima, Peru, with Modesto Montoya, one of Peru's well-known physicists and host of the radio and internet program, "Encounters with Science and Engineering." Montoya interviewed Zimmerer along with his son, Eric, a sophomore studying chemical engineering at Penn State,

in July 2016.

In addition to discussing the research he presented during the conference, Zimmerer and his son talked with Montoya about their plans to further connect Penn State with Peruvian universities to address climate and agrobiodiversity challenges.

"I hope to continue to connect more communities through our research so that we can make agrobiodiversity as efficient as possible by blending the new and old practices in land use and food systems," said Zimmerer. "This work is vital to humanity's sustainable food future."

Provided by Pennsylvania State University

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