INDIGENOUS AND ANCESTRAL TECHNOLOGIES
NATURE-BASED SOLUTIONS FOR WATER SECURITY

Traditional water management practices are being rediscovered and adapted for 21st-century water crises.

For billions of people, the impacts of climate change will be felt mainly through water. By 2040, one in four children on the planet will live in a region facing extremely high water stress.

But people have been living in places of water extremes for thousands of years, and have found ways to cope with droughts, floods, heat waves, and unpredictable rainfall.

Long before modern science, these communities had a deep understanding of hydrology and geology, and used it to ensure they had reliable water supplies, even during dry seasons.

A new field of hands-on research seeks to understand how they did it.

MAPPING INDIGENOUS AND ANCESTRAL WATER TECHNOLOGIES AROUND THE WORLD

CAREOS, SPAIN
In the Sierra Nevada, spring snowmelt from the high peaks fills streams and rivers. But water disappears in the dry Mediterranean summer. A system of irrigation channels, which date as far back as the ninth century, divert water from streams in the highlands to areas where the water can infiltrate the permeable soils and weathered bedrock, recharging groundwater.

Image: Rodrigo Martos Rosillo.

SAND DAMS, KENYA
In eastern Kenya, rivers are intermittent and surface water quickly evaporates. Small check dams are constructed across river channels. When rivers begin flowing after rains, water and sand are trapped, slowly building up a thick layer of sand saturated with water. Water is available in this sand reservoir long after the rains end. No exposed water means evaporation is low and fewer breeding grounds for mosquitoes.

Image: Wikimedia Commons.

MUYONG FORESTS AND TERRACES, THE PHILIPPINES
The mountains of Luzon, with high elevations, abundant rainfall, cooler temperatures, and steep, rugged slopes, are poorly suited to traditional lowland rice cultivation. But the Ifugao people have developed an ingenious system anchored in muyong forests that infiltrate rainwater and recharge aquifers, protecting the water that supplies rice paddies.

AHUPUA'A SYSTEM, HAWAII
A “mountains to sea” system relies on protected upland forests (including cloud forests) to capture and infiltrate precipitation, regulating the flow of water through terraced farm fields and aquaculture ponds. This ensures an adequate supply of water for communities and farms on the coastal plain. and also traps sediments, protecting coral reefs and fisheries.

Image: Wikimedia Commons.

AMUNAS or MAMANTEO, PERU
A 1,400-year-old network of diversion canals, infiltration canals, infiltration zones, and ponds in the Andes "sows" water from streams. Water then resurfaces in a cascading series of ponds, springs, and streams, points for harvesting water along the hillslopes.

TANK CASCADES, SRI LANKA
The dry zones of Sri Lanka get 80% of their annual precipitation during short, intense monsoon storms, followed by a long eight-month dry season. Thousands of years ago communities began creating systems of cascading village “tanks” to collect water during monsoons, for a reliable supply of water for drinking, livestock and irrigating crops.

Image: Google Earth.

VIRDAS, INDIA
The groundwater in Gujarat is mostly brackish. Virdas are shallow depressions made in the sandy soils or the sands of dry riverbeds and lakes. They are surrounded by grassy areas which assist in infiltration.

The virdas create a lens of freshwater in an upper layer on top of higher-density brackish or saline groundwater. Sweet freshwater can be collected from this upper layer.

Source: This map is derived from a forthcoming book co-edited by Forest Trends, which identifies dozens of systems in Chile, China, Ecuador, Ethiopia, Hawai'i, India, Kenya, Peru, Rapa Nui, Spain, Sri Lanka, and Tunisia. To be published by Elsevier in early 2021, the book is a practical reference volume for decision-makers,with contributions from a diverse international group of leading practitioners of nature-based solutions.

All of these technologies have allowed people to thrive where water is scarce or highly variable. But around the world, we risk losing ancient knowledge. For instance, at the time of British colonization in Sri Lanka, almost 20,000 tank cascades are estimated to have existed. But only a few hundred are functioning today.

Many more such systems have already been lost. So has traditional knowledge, which often leaves no archaeological record. As older members of the communities pass away, ancestral knowledge – essential to the operation of these systems – is at risk of disappearing.

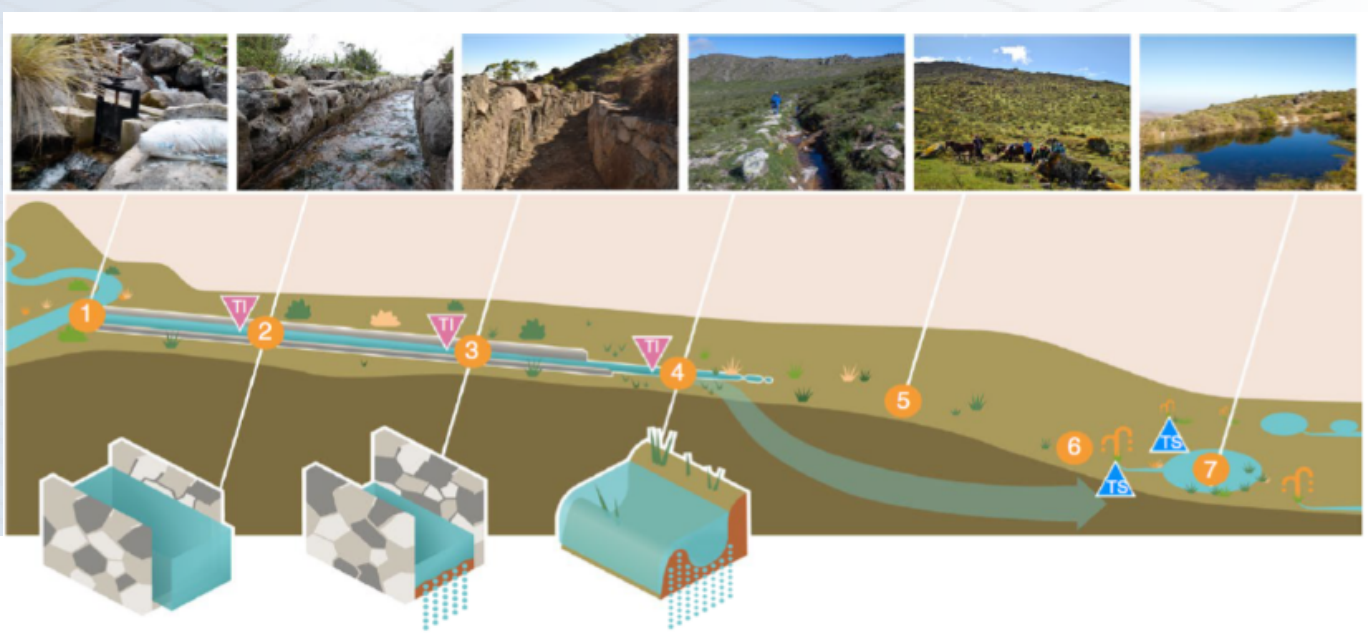
Forest Trends is working to support a new generation of participatory research and knowledge-gathering. With our partners we’re publishing state-of-the-art research, working to catalogue traditional technologies, and supporting efforts to transmit knowledge from elder generations to younger community member before it is lost.

RESTORING PRE-INCAN SYSTEMS IN PERU

More than 1,400 years ago in Peru, pre-Incan peoples created an extensive network of infiltration channels in the Andean highlands known as *amunas*. These were designed to address dry season scarcity on the western slope of the Andes caused by the extremely variable precipitation of the South American monsoon system. Wet-season rains rapidly run off the highlands, filling rivers and causing floods. But when the rains disappear in the dry season, water for crops, people, and livestock becomes scarce.

***Amunas* divert water during the wet season from natural streams into a complex of infiltration areas that collectively serve to temporarily store surface water, delaying the flow of water downhill and recharging groundwater on the mountain slopes.**

Today, local communities in Peru are actively rehabilitating amunas and other traditional water systems, with the help of local NGOs, regional governments, the Ministry of Agriculture, and international development agencies. They’re joined by similar revitalization efforts in Span, Hawaii, Kenya, and Ethiopia.



Pre-Incan infiltration systems include diversion canals (1 and 2), infiltration canals (3 and 4), infiltration hillslopes (5), springs (6) and ponds (7). A recent study injected dye tracer at injection points (IT) upstream and monitored its later emergence in springs downslope (MT) using activated carbon samplers. Injection points (IT) and monitoring points (MT) are marked schematically in the diagram. The results showed that restoring these ancient systems could increase the volume of river flows to Lima during dry months by an astounding 33%.

Image source: Ochoa-Tocachi, B. F., Bardales, J. D., Antiporta, J., Pérez, K., Acosta, L., Mao, F., ... & Gammie, G. (2019). Potential contributions of pre-Inca infiltration infrastructure to Andean water security. Nature Sustainability, 1.