
PHOTO: © CTFS

LANDSCAPE-SCALE RESEARCH IN THE PANAMA CANAL WATERSHED

WHAT GETS MEASURED, GETS MANAGED

The geopolitical significance of the Panama Canal needs no introduction. But as one of the tropics' clearest examples of ecosystem services in action, its benefactors do: the basin transports 4% of seafaring trade, generates $2.5 billion annually for Panama and provides two million people with their freshwater.

How will climate change impact ecosystem services in the tropics? What are efficient ways to return degraded tropical land to economic productivity? How do different land uses affect the flow and capture of water? To answer these questions and help inform policy decisions with implications for billions of people, the 700 hectare Agua Salud Project casts light on the ecological, social and economic services provided by tropical landscapes. By brightly quantifying the ecosystem services provided in the Panama Canal Watershed specifically, the project will lend empirical evidence for 'best practice' land management decisions in tropical watersheds and landscapes the world over. Further, a combination of the project's intimate relationship with the Panama Canal Authority (ACP), the Ministry of Environment and the credibility of Smithsonian science leads to a "real-time" uptake of information where science is put into practice without waiting years for data to be published and noticed by decision makers.

The Agua Salud's nine experimental watersheds – ranging from reforested areas to cattle pasture to silvopastoral farm to mature forest – investigate the roles of deforestation and afforestation on hydrological ecosystem services such as flood mitigation and water purification. How water enters, 'exists' and exits different landscapes is the primary focus, but by no means the whole. Carbon and biodiversity inventories help monitor and identify those areas that are environmentally productive in other ways, while regular soil samples measure for chemical and carbon content across the different landscapes. Meanwhile, coffee, teak and silvopastoral plantations provide examples of how different land uses might bring innovative solutions and economic opportunities to rural and other landholders in the tropics.

The rationale behind the Agua Salud project is perhaps best understood through a real life event. In 2010, a monster storm dumped more than 30 inches of rain across the Panama Canal Watershed. It not only cost lives, the storm came a whisker away from causing a truly devastating situation. The Canal's two dams – which, remember, protect the transport route responsible for 4% of seafaring world trade and generate $2.5 billion in annual revenues – came perilously close to blowing. Things, however, could have been worse if the Watershed was any more deforested than it already was (~50%). Whereas water flows quickly over the packed soils of cattle pastures, by comparison, forested areas better percolate water down the holes made by animals and plant roots, soaking up and storing water deep in the soil. Analysis following the storm confirmed that if the upper watershed had been covered in cattle pasture rather than forest, about 100 million tonnes of extra water would have hit one of the dams at the precise moment it was most vulnerable.

One can only imagine the consequences. Agua Salud research underscored the importance of the government's decision and both the Ministry of the Environment and Canal Authority's vigilance in banning forest clearing in much of the canal's watershed.

Land management choices are already becoming increasingly critical as climate change heats up, bringing with it more frequent extreme weather in the tropics. Hydrological, carbon storage, and biodiversity-related services can all be maximized, though not always simultaneously. Measuring their respective benefits and trade-offs, the Agua Salud Project offers a leading example of a multifaceted project that will shape how future NCS are employed around the world.

NATURE'S CLIMATE STATISTICS

The Agua Salud Project focal research site consists of 530 hectares of naturally regenerating secondary forest, native species and teak plantations. Over the first 10 years of the project, forest growth accounted for 10,655 tonnes of CO_2 equivalent, illustrating the incredible potential of naturally regenerating and planted forests to capture atmospheric CO_2.

Agua Salud Project researchers have consistently found that the forest functions as a sponge, enhancing dry seasons stream flow by approximately 12%. Researchers suggest that the 100,000 hectare Chagres National Park alone accounts for between one and two months of dry season water used by the 2 million people who get water from the Panama Canal Watershed.

Other watershed projects in the tropics are harnessing NCS to increase ecosystem, economic and energy resilience. To ensure water quantity and quality, provide economic opportunity for local communities, and create incentives for companies, hydropower heavyweight, Itaipu Binacional planted more than 44 million trees and created an environmental conservation area around Itaipu Dam, which straddles Brazil and Paraguay. The protected areas there now total over 100,000 hectares, including reserves and wildlife refuges. A 2014 analysis using similar principles, suggested that restoring cloud forests near Colombia's Calima dam could recuperate around 5% of the output from the dam, enough to provide power to around 10,000 families.

KEY FIGURES

9 EXPERIMENTAL WATERSHEDS,
from mature forest to coffee plantations.

To date, the project has planted more than
140,000 TREES
in an experimental design that makes it possible to address a wide variety of questions related to reforestation.

Forest
132 HECTARES

Mosaic
153 HECTARES

Pasture
40 HECTARES

Native Species
75 HECTARES

Teak
30 HECTARES

Managed Forest
90 HECTARES

Canal Grass
20 HECTARES

Secondary Succession
7 HECTARES

PROJECT BACKGROUND

Founded on the basis of becoming the largest field experiment of its kind, aiming to quantify the environmental services (water, carbon, and biodiversity) provided by tropical forests over a 30-year timeframe.

EXECUTING ENTITY

Collaborators include the Smithsonian Tropical Research Institute (STRI), the Panama Canal Authority, the Ministry of the Environment of Panama, the University of Wyoming, the US Geological Survey, University of Potsdam, the School of Forestry and Environmental Studies of Yale University, and the University of Alberta.

FUNDING

The project launched with significant support from the HSBC Climate Partnership and the Panama Canal Authority, Stanley Motta, Frank Levinson, and the Hoch family. It has received significant funding from the National Science Foundation with additional funding from a variety of other donors. It is now supported principally by sustained funding from Stanley Motta, Frank Levinson, and Steven and Roland Hoch, and the Smithsonian Tropical Research Institute (STRI).

SDGs

LOCATION

VIDEOS & STORIES

https://youtu.be/jFTCW_h6U78

https://youtu.be/DoONualTMR4

https://youtu.be/7A-b2SuzJcc

https://youtu.be/UxyPwfwIhts

https://youtu.be/SaLLxaG-Epc
(Spanish version: Learning from nature)

https://youtu.be/jg95j7qW_tU
(Spanish version: Too much water)

https://www.globallandscapesforum.org/video/interview-with-jefferson-hall-glf-bonn-2018/

Other Smithsonian Institution Working Land and Seascapes projects: https://wls.si.edu/

CONTACT

Jefferson Hall
hallje@si.edu

Robert Stallard
stallard@Colorado.edu