

TRÓPICOS



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**HUMAN CONNECTION
AND RESILIENCE**

Why is Smart Reforestation® Studying Bees?

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A reforestation project begins in the Ngäbe-Buglé Comarca in Panama — a challenging initiative in a land inhabited by Indigenous people deeply connected to their land but also historically impacted by fire and cattle. At the same time, the project creates an opportunity to understand how the diversity of bees as pollinators changes as native forests are re-established. Embedded in principles of environmental and social justice, local community participation becomes essential for this project.

León Santos, a landholder participating in the reforestation project in the Ngäbe-Buglé Comarca, points to one of the reforestation plots from the township of Buenos Aires, in the Nürüm district, within the Ngäbe-Buglé Comarca.



Beyond the Soil

People living in a city likely spend days, weeks, or even months without stepping on bare ground, and they rarely think about the health of the soil underfoot. The health of the soil that grows the food we eat every day, that sustains the animals we rely on, and that filters the water we drink, is often taken for granted. But people living in the countryside may have a deeper connection to the land, especially if they work in agriculture. Although city life may seem distant from rural life, we all depend on the land and the ecosystems it sustains.

“Assessing how different land uses affect ecosystem services is one of the main goals of the Agua Salud Smart Reforestation® project,” explains Adriana Tapia, project manager of this initiative at STRI. “Ecosystem services are the direct and indirect benefits provided by ecosystems, such as increasing the soil’s filtration capacity, improving the quality and quantity of water in streams, increasing biodiversity, and enhancing carbon capture,” Tapia added.

Researchers working with the Agua Salud project, which began in the Panama Canal watershed in 2008, have planted more than 150,000 trees on plots with different land uses, including grasslands, pastures, traditional cattle pastures, silvopastoral farms, and forests. In addition, the project has collected data on tree growth, as well as hydrological and weather information.

Science and Community

After 13 years of gathering the scientific knowledge behind Smart Reforestation® — that is, learning to plant the right species, in the right place, at the right time, and for the right reasons, in 2021 a donation from the Rohr Family Foundation provided the opportunity to create a series of restoration plots in the Ngäbe-Buglé Comarca, Panama’s largest Indigenous territory, located about 300 kilometers from Panama City.

“The project came to our district because I was in contact with Professor Francisco Herrera, a retired history and anthropology teacher who works at CEAS-PA (Panamanian Center for Social Studies and Action Association), during a seminar I organized here,” explains Pedro Nola, former president of the Ngäbe-Buglé General Congress. “I told him I thought a reforestation project would be good if the community accepted it. We would have to explain the goals and sign a written agreement. I said that because, in the case of the

pine trees, there was never a signed document guaranteeing that the project would truly benefit the community in the future,” Nola adds, referring to previous issues with pine trees planted for community use during the Torrijos Herrera and Noriega administrations for community use.

Bringing Smart Reforestation® to the comarca entailed several challenges distinct from those faced at the Agua Salud site in the Panama Canal watershed: the dry season is longer, the local tree diversity was unknown, and there were governance challenges, underscoring the need to work with the comarca leadership and to involve local communities. But Smithsonian staff scientist and Agua Salud project director Jefferson Hall saw not obstacles, but opportunities: “At Agua Salud, we had already learned a lot about the natural process of forest recovery in deforested areas, as well as how to intervene to accelerate recovery and which tree species can establish and grow in infertile and moisture-stressed soils.”

The initiative in the comarca is a 20-year project with a clear goal: to reforest 100 hectares with plots containing a mix of about 30 native tree species. But the project also has added benefits. For the first four years, plot landholders commit to following maintenance and fertilization recommendations in exchange for payments for their labor in the plots, with all supplies and equipment provided. Because reforestation helps mitigate the effects of climate change while storing carbon, these financial aids are a kind of carbon payment. After the first four years, land holders will receive a payment of \$130 per hectare per year until the project completes its 20-year term, as compensation for monitoring the plots and protecting them from fire, which seems to have been less common lately. At the end of 20 years, landholders will decide the future of the trees. Furthermore, they can leave the project at any time with no penalty.

“I work my land as a paid job, which doesn’t happen much around here... it’s a benefit because I’m working my plot, but I’m helping myself, my children, and my nephews who also work with me,” says Isidro Hernández, who maintains one and a half hectares dedicated to the project. “There’s also a water source on that plot, and I thought of reforesting it so it can stay alive,” he adds.

“What I liked most about this project is that it’s been done hand in hand with the landholders and families



In 2022, after several community meetings with Indigenous leaders from the Ngäbe-Buglé Comarca, local families and scientists from STRI signed an agreement celebrating the reforestation project, an initiative that aims to reforest 100 hectares in 20 years. Photo: Jorge Alemán

from the very beginning. We didn't take a single step without consulting them, and it's beautiful to see that, beyond caring for the trees, their children can now go to school because their parents are receiving an income," Adriana explains.

Working hand in hand with the local Indigenous leaders and residents while recording data on the growth of the planted trees opened a unique opportunity for this transdisciplinary project: to pair the ecological research with social science and environmental justice research. To collaborate in this endeavor and ensure equitable reforestation in the project, Cornell University researcher Reem Hajar, together with CEASPA, led a participatory survey to understand how carbon payments are perceived in the community, including their effects on enhancing ecosystem services and local livelihoods. The baseline survey undertaken in 2025 will be repeated two years later to assess changes. The results will be crucial for the success of the overall reforestation project and for the implementation of new reforestation community-based proposals in the future.

Interactions and More Interactions

Understanding which tree species grow best to inform future reforestation initiatives is another important

goal of the reforestation project in the comarca. But Smart Reforestation® doesn't just aim to increase plant cover — it also seeks to transform a plot into a self-sustainable forest, with long-lived trees that reproduce naturally without human intervention.

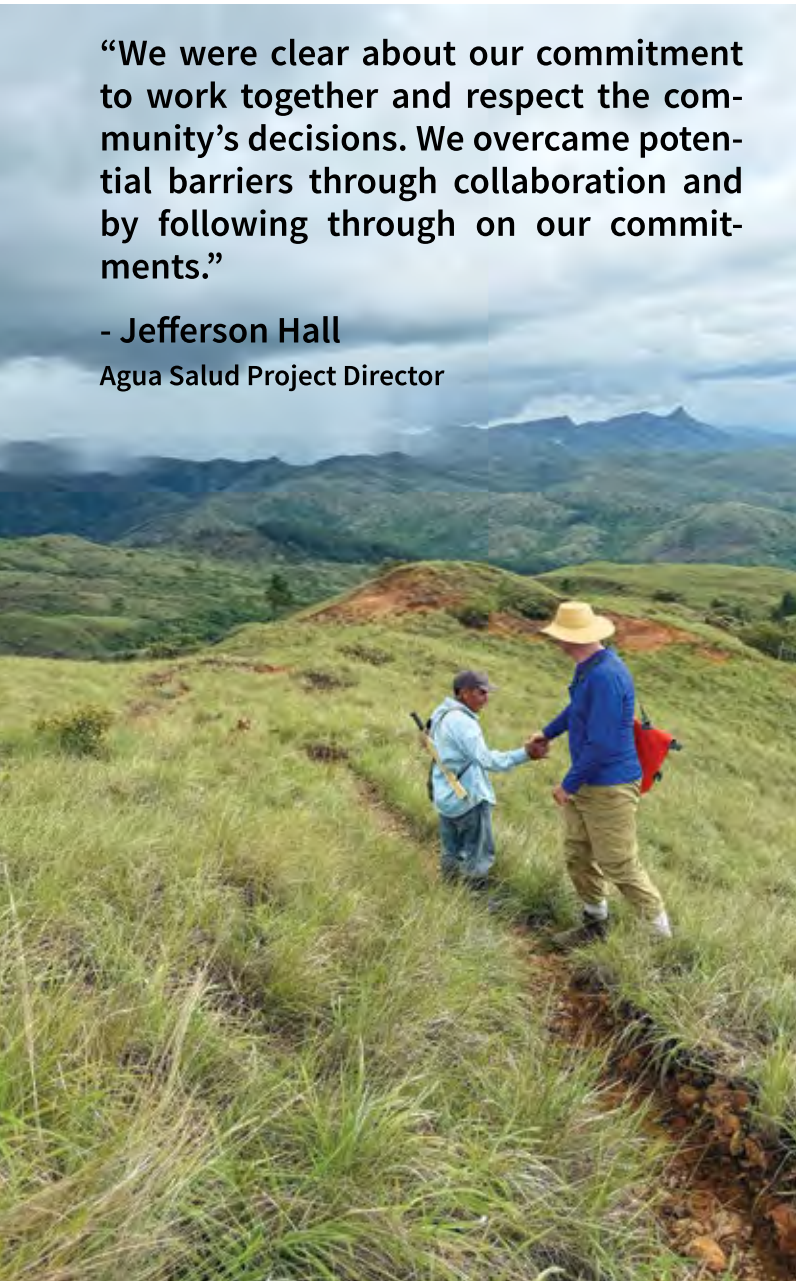
"Plants, in their tremendous diversity, depend on pollen transfer to reproduce and maintain genetic diversity — which is mostly done by pollinators such as bees; a highly diverse and specialized group," explains Global Centre on Biodiversity for Climate (GCBC) and STRI fellow Danny Hernández Cuadra. Danny is part of a team of STRI researchers led by STRI staff scientist William Wcislo, who study bee diversity in some of the plots established in the comarca, leveraging the reforestation project. The landholders and their family members also actively participate in this initiative, helping with bee censuses and informing scientists about the location of stingless bee nests, in exchange for payment for their local knowledge and work time. The goal is to use repeatable methods to establish a baseline of bee species' richness and abundance at select reforestation plots, long before any of the planted seedlings produce flowers. In the future, bee diversity could be reassessed using the same methods. Scientists will also begin documenting plant-bee interactions by analyzing pollen collected from bees in traps, to iden-



Top left: Isidro Hernández at his home, in the township of El Peñón, in the Ñürüm district, within the Ngäbe-Buglé Comarca. Isidro and his family are one of approximately 40 families involved in the reforestation project in the comarca. Many tropical trees depend on pollinating bees for reproduction. The project will also monitor the diversity and abundance of bees leveraging the reforestation project. Top right: Agua Salud project director Jefferson Hall, project manager Adriana Tapia, and León Santos, a landholder participating in the reforestation project in the Ngäbe-Buglé Comarca. Bottom left: Jeff Hall and León Santos.

“We were clear about our commitment to work together and respect the community’s decisions. We overcame potential barriers through collaboration and by following through on our commitments.”

- Jefferson Hall
Agua Salud Project Director





STRI fellow Danny Hernández Cuadra and STRI intern Gabriel Santo examine some recently collected bees from the reforestation plots in the Ngäbe-Buglé Comarca. “All terrestrial ecosystems have associated vegetation, and in many of them, bees play a key role as pollinators,” explains Hernández.



coloring book about the importance of bees into Ngäbe, one of the local Indigenous languages spoken in the comarca. The trilingual book was written in Spanish by Danny Hernández Cuadra and William Wcislo and translated into Buglé, another local language, by a participant in the project, León Santos. Damond Kylo designed and drew the coloring book and helped with writing and ideas. Some students in local schools in the Ñurüm district received a copy of the book and a box of colored pencils during educational outreach programs.

Thanks to the Ngäbe-Buglé community and their generosity in opening their lands and collaborating with Smithsonian researchers, science is taking root here — offering an opportunity to show how local and scientific knowledge can come together to transform the future of ecosystems and their surrounding communities. From studying native trees for over 100 years on Barro Colorado Island in the Panama Canal, to studying plots with different land uses in the Canal watershed near the city, and now beginning to understand the interactions among reforestation, bees and local communities, science bridges life in the countryside and life in the city.

tify which plant species are visited by bees, whether those plants are inside the plots or nearby crops that local families rely on.

“This project is also conducting environmental education activities to teach schoolchildren about the diversity of bees in the comarca and their ecological importance,” explains Gabriel Santo, a Ngäbe intern in this project. Gabriel also translated a children’s



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