The (C)arbon Equation

Can Forests Save Us From Climate Change? By Jane Braxton Little

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CARBON CYCLE:
Deforestation around the world releases 17 percent of carbon and other heat-trapping pollutants each year. In Indonesia, where 80 percent of emissions are due to deforestation, the Conservancy is helping build markets that would pay communities to protect forests as carbon stores.

It's a

lesson right out of third-grade science class: Trees and other plants absorb carbon dioxide (CO_2) through photosynthesis. This phenomenon—whereby sunlight-fueled plants convert water and CO_2 into sugar and oxygen—supports just about all life on Earth.

Now, The Nature Conservancy and its partners are working to harness the power of photosynthesis to fight climate change. If they succeed, the venture could become a breakthrough for forest conservation and efforts to reduce the greenhouse-gas emissions scientists have tied to melting glaciers, rising sea levels and stronger hurricanes.

The plan is straightforward: Protect forests that are slated to be cut down and restore lands that have been heavily logged or otherwise degraded. The strategy will require almost no new high-tech equipment—no solar panels, deep-cycle batteries or plug-in electric vehicles.

Slowing deforestation—32 million acres of woodland are cleared each year—could turn out to be a great way to soak up carbon. Tropical forests alone absorb nearly one-fifth of the annual emissions of CO_2 from burning oil, coal and other fossil fuels, according to research in the journal Nature.

Right now, however, logging and forest loss account for a whopping 17 percent of the emissions responsible for climate change—more than from all the planes, trains and automobiles on Earth. (Transportation generates 13 percent of greenhouse-gas emissions.)

This concept of using forests for "carbon sequestration," as scientists call it, is rapidly gaining acceptance around the world. Proposals for forest protection are front and center as world leaders prepare to meet this December in Copenhagen to design a new international climate treaty to replace the provisions of the Kyoto Protocol that expire in 2012.

In 1997, when Kyoto was being drawn up, government negotiators rejected provisions that would have given countries credit for protecting forests slated to be logged—there were just too many uncertainties around verifying carbon stores locked up by avoiding deforestation.

A lot has changed in a decade. Forest protection is now seen as one of the most powerful and cost-effective tools we have to combat climate change, says Greg Fishbein, director of the Conservancy's forest carbon program. Fishbein and his team are working with governments to create international markets to buy and sell the carbon stored in forests. The goal is to give landowners financial incentives to protect trees.

"This is a tremendous opportunity to create monetary value in standing forests through carbon markets," says Fishbein. "We need to find more ways to protect nature beyond charitable contributions and traditional government aid."

But what specifically has changed since Kyoto? Have scientists learned to quickly and accurately measure the amount of carbon stored in forests? How do we place a dollar value on each ton of carbon stored in a protected forest? And why should landowners get money now for an activity nature has performed at no cost for millennia?

For the past decade, Conservancy scientists and others have been racing to address these questions, forging partnerships and creating some of the largest on-the-ground demonstration projects in the world to help provide answers.

X Trees = Y Tons Carbon

Measuring a tree's carbon content is actually a straightforward process. Scientists use a sighting scope to help estimate the tree's height and then wrap a tape measure around its trunk to gauge the diameter. When those measurements are entered into an equation, the carbon content pops up. (The equations are developed by cutting up sample species and oven-heating the trunks, branches and leaves to evaporate the water content. Half the weight of a dried-out tree is carbon.)

Tallying an entire forest's carbon content is based on the same principles, but it is a lot more work. Researchers measure the height and diameter of thousands of trees in sample plots, run equations and combine the results with satellite data to determine the carbon content of the entire forest.

In 2005 Noel Kempff became the first avoided-deforestation project in the world to receive certification by a third-party verifier.

BOLIVIAN AMAZON:
Noel Kempff Mercado National Park—a biological gem on Bolivia's border with Brazil—is home to more than 600 bird species.

HEART OF CARBON:
Field staff prepare to dissect and weigh—piece by piece—a 100-foot-tall tree in order to measure its carbon content. The effort—which took place on a logging concession outside Bolivia's Noel Kempff Mercado National Park in the late 1990s—required two days of work.

In a large forest, measuring the thousands of trees needed to take a statistically significant sample can be daunting. In a malaria-infested tropical rainforest larger than the state of Connecticut, it's a Herculean ordeal.

The Conservancy embarked on just such an endeavor 12 years ago when a team of researchers trekked into the Bolivian Amazon to test the feasibility of using forest protection to fight climate change. The team figured that if a forest carbon project could work on such a massive scale in one of the remotest parts of Bolivia, it could work just about anywhere.

The researchers settled on a project site—Bolivia's vast Noel Kempff Mercado National Park—after they found that 2 million acres adjacent to the park's western flank were slated to be logged by companies targeting commercially lucrative trees, such as mahogany. Once the cutting began, it was likely that the logged-over lands would be developed and homesteaded by ranchers and farmers. All told, the logging would lead to the release of millions of tons of carbon.

This was the opportunity the researchers were looking for. If they could save this forest from the chainsaws, they would be able to measure the benefits of using conservation to fight climate change. Specifically, they could calculate how much carbon would stay locked up in the now-protected forest, and then track how much carbon the trees would continue to absorb into the future.

To kick off the project, the team partnered with the Bolivian government and Fundación Amigos de la Naturaleza (FAN), a local conservation organization that would spearhead most of the on-the-ground work. Next, the group tracked down three energy companies interested in purchasing carbon credits to offset their corporate emissions. The companies—American Electric Power, BP Amoco and PacifiCorp—put up a total of $8.25 million in exchange for a promise of half the carbon offsets from the project (the Bolivian government would get the other half to sell on the international market).

Seed money in hand, the coalition paid $1.6 million to buy back the logging rights to the 2-million-acre forest. The Bolivian government then added the land to Noel Kempff, doubling the size of the national park to 4 million acres, and making it the world's largest forest-carbon project.

That's when FAN began the intimidating task of tallying

the forest's carbon content. Local workers fanned out to measure tens of thousands of trees in hundreds of permanent sample plots throughout the park. Researchers at FAN ran equations on their field data and combined the results with satellite data to determine the forest's carbon stockpiles.

They also used satellite images and data on local logging and deforestation rates to estimate how much carbon would have been released if the forest had been axed. By comparing the carbon content of the intact forest with estimates of a logged-over forest, FAN was able to determine the amount of carbon the project was preventing from being released to the atmosphere: 5.8 million metric tons of CO_2 over 30 years.

"That's the equivalent of taking more than a million cars off the road for a year," says Zoe Kant, the Conservancy's carbon finance specialist who works closely with FAN and other partners in Bolivia.

After the carbon measurements and calculations were audited and approved independently by the Swiss company SGS, in 2005 Noel Kempff became the first avoided-deforestation project in the world to receive certification by a third-party verifier. The project funds ongoing carbon check-ups by crews working for FAN, and pays salaries for some of the 27 park rangers who keep an eye out for illegal logging.

Not everything at Noel Kempff has gone according to the original plan, however. Some business ventures created by the project have struggled. Newly constructed ecotourism lodges with red-tiled roofs have not seen many visitors. A company set up by the project to market products made from local plants went bankrupt. And the local community has not received any income from the carbon credits, as the Bolivian government has not sold its share of offsets yet.

The partners have done their best to address each new challenge. Today, community members participate fully in the park's management committee, where all park operations are discussed. And the project provided the communities with the legal assistance they needed to acquire title to nearly 900,000 acres of their traditional lands. Proceeds from the project have also funded local schools, health clinics and other community services, including water treatment and road maintenance.

A key lesson from Noel Kempff has been the importance of inviting and sustaining local participation. "There is no road for pioneers," says Kant, "but at Noel Kempff we are helping build one for others by sharing what we have learned."

Y Tons Carbon = $Z Million

International commitments to reduce carbon emissions under the Kyoto Protocol have created a robust global market for carbon offsets. But the price of an offset in the United States is next to nothing. Right now, a company can purchase a credit for a metric ton (2,200 pounds) of CO_2 on the Chicago Climate Exchange for about 25 cents. (Compare that to the cost of burning a gallon of gasoline in a car, which releases about 19 pounds of CO_2 into the atmosphere.)

The U.S. carbon market is currently voluntary, though legislation moving through Congress may soon mandate emissions caps. For now, the voluntary market limits the value of a carbon offset in the United States. Many of the companies currently paying for carbon credits are hoping to get a head start, as they expect that mandatory state and federal programs will soon require emissions reductions and raise the price of an offset.

In the absence of a national mandate to limit emissions, some state governments have taken a leadership role. California, in particular, has blazed the trail to create carbon markets and other mechanisms to fight climate change. In 2006, the state passed into law the landmark Global Warming Solutions Act, which requires California to reduce its greenhouse-gas emissions to 1990 levels by 2020.

California has also adopted policies recognizing the role of forests in preventing and reducing greenhouse-gas emissions and put in place procedures for measuring forest carbon.

One redwood forest in Northern California, the Garcia River Forest, has been at the forefront of the state's efforts to capture carbon. The work has been so successful that this forest is one of the first two projects in California to be recognized as a verified source of forest carbon credits.

The Garcia, which is situated about 130 miles north of San Francisco, is not the iconic redwood forest you might see in postcards and photographs. The redwoods here are young, barely 50 years old. Most measure well under 25 inches in diameter. In the past, timber companies cut this forest time and time again, denuding the slopes of the Garcia and skidding the logs right down the stream channel—practices that helped push coho salmon in California's north coast to the brink of extinction.

But what these fast-growing young trees lack in girth, they make up for in carbon-sequestering potential. Redwoods, which soak up a huge amount of carbon as they grow, are among the most prolific carbon storehouses, holding 500 metric tons of CO_2 an acre, according to the Forest Service.

To Louis Blumberg, director of the Conservancy's climate-change work in California, every spindly redwood sapling in the Garcia represents a big opportunity. Each healthy, standing tree that would have been logged in the past now translates into stored carbon that is helping curb climate change. And that stored carbon can be sold as emissions offsets, bringing money that can be reinvested in restoring this forest and the river cascading through it. "Nature is our greatest ally in the fight against climate change," Blumberg says.

The Garcia River Forest project didn't start as a carbon-storage demonstration project. The Conservation Fund, a nonprofit land-protection group based in Virginia, purchased the 24,000-acre forest in 2004 with plans to sustainably manage the tract of land as a working forest.

The idea was to experiment with a sustainable harvest that would pay for upkeep and provide local jobs, says Chris Kelly, the fund's California director. The fund would initially target smaller, weaker trees for harvest, leaving the rest to grow back into an older, more productive forest. The Conservancy got involved as a partner in 2004, when it paid the fund $3.5 million for a conservation easement, which prohibits future development in the forest.

Blumberg was among the first to see the forest's potential for a carbon project. A self-described policy wonk, Blumberg has dedicated a decade to working on climate-change policies, including California's global-warming law. To him, setting up this huge forest-restoration project as a verifiable carbon sink under the state's new law made perfect sense.

The Conservation Fund began a meticulous inventory of the forest, which is larger than the island of Manhattan. Crews trekked through the woods, setting up hundreds of sample plots to tally the size, type, and age of the trees and other plants. They also inventoried wood on the ground and used above-ground carbon measurements to gauge the carbon stored by the roots of the trees.

From this detailed sampling, the scientists calculate that the Garcia will suck up 77,000 metric tons of CO_2 annually—about the equivalent of taking 14,000 cars off the road each year. By the end of the century, the forest will have absorbed about 4.17 million metric tons.

After running the gauntlet of independent verification and review, the Garcia was independently registered as a source of carbon credits. Once the certification was complete, The

REDWOOD REVIVAL:
Conservancy scientist Jennifer Carah tracks water temperatures in the Garcia River Forest. Efforts to manage the forest to store carbon have also improved water quality for threatened coho salmon.

MAP: © XNR PRODUCTIONS

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WORKING FOREST:
The Conservation Fund is testing how careful harvesting in the Garcia River Forest can conserve biodiversity, provide jobs and help slow global warming by storing carbon. While a small logging operation helps keep the local sawmill operating, the fund sells credits for the carbon captured by healthy trees that would have been logged under past logging practices.

Conservation Fund began selling the carbon credits to companies seeking to offset their emissions.

Pacific Gas & Electric Co. (PG&E), a large utility company based in California, has agreed to purchase 200,000 metric tons of carbon offsets from the Garcia as part of its ClimateSmart program. The Conservation Fund will receive more than $2 million from the company's program, which is voluntarily funded by utility ratepayers. "Carbon is helping us fix this forest," says Kelly.

Once the carbon credits have been sold, keeping track of them is critical. Each of the Garcia's carbon-offset tons has a unique serial number. When PG&E buys a ton, that serial number is transferred from the fund's carbon account to PG&E's account, ensuring that the carbon credits are neither sold nor purchased more than once.

"This is uniquely complex, but we're figuring it out," says Kelly. "We have an on-the-ground opportunity to show how this methodology works and to make it even better."

Y Tons Carbon = N Local Jobs

International climate negotiations have broken down several times after rich and poor countries squared off over who should take what steps to reduce emissions. Countries such as China, India, Brazil and Indonesia have been reluctant to accept rules that might slow their development.

Why, they ask, should developing countries restrict industry, limit logging, lock up lands and risk losing local jobs to absorb the emissions of European countries, the United States and other nations that have already exploited their own natural resources? Legitimate or not, this international blame game has stalled attempts to address the threats of global warming.

Forest carbon projects can provide a path for countries to move beyond the stalemate. As the Bolivian government's work on Noel Kempff demonstrates, nations might be more willing to protect forests and slow emissions rates when there are financial incentives to do so.

Creating a robust international market for forest carbon credits with strong standards and verification will encourage governments to embrace the potential of large-scale forest protection. That's exactly what is happening in Indonesia, where the Conservancy is working with the government to take lessons learned in Bolivia and California to an unprecedented scale and level of complexity.

The Conservancy is helping to design a program to keep forest cover over vast stretches of the 5.4-million-acre Berau district on the island of Borneo, in the Indonesian province of East Kalimantan. This is an area where dense tropical forest now covers about three-quarters of the land.

"This is an opportunity to do conservation work on a scale that's never been done before," says Lex Hovani, a forest carbon advisor with the Conservancy's Indonesia climate team.

In recent years, logging and the rapid growth of palm oil plantations have carved away huge swaths of the region's forests. In fact, deforestation in Indonesia is so widespread that it releases around 80 percent of the country's greenhouse-gas emissions.

As Hovani and his team design the Berau program, they are building on the lessons the Conservancy learned in Bolivia and elsewhere: Local communities need to play a central role in the project. The idea is to protect forests by delivering incentives for sustainable timber harvesting and other activities that help reduce the current level of carbon emissions.

The Conservancy is facilitating negotiations at the federal, provincial and local level, and is working with partners to resolve thorny issues including land tenure, indigenous rights and law enforcement. The district government has stepped up to champion the project, which should help ensure benefits go to local residents. "A lot of hard conversations are going on, but we're using a collaborative approach, and it's working," Hovani says.

To determine the region's capacity to store carbon, the Conservancy is using baseline data gathered from local forests. Plots on the ground in Berau are providing the numbers that will be used to calculate how much forest conservation will reduce greenhouse-gas emissions. The goal is to offset emissions by reducing the release of around 5 million metric tons of carbon a year, almost the amount Noel Kempff is sequestering over 30 years.

Deforestation in Indonesia is so widespread that it releases around 80 percent of the country's greenhouse-gas emissions.

DOWN AND OUT:
Since 1990, more than 100,000 square miles of Indonesia's forests have been cut—an area larger than the state of Oregon.

CARBON COUNTS:
In Berau, Indonesia, the Conservancy is helping to train logging company employees in reduced-impact logging methods. Targeting only the most commercially valuable trees, and taking care not to damage others nearby, helps the forest—and carbon stores—regenerate more quickly.

Designed to start work on the ground in 2010, the Berau project has the potential to be the world's largest effort to protect a forest for its carbon—"the Garcia River times 40," says Hovani. And success in Indonesia could spur other nations to introduce carbon conservation programs that reward them for keeping their forests intact while strengthening local economies.

Forest Protection ≠ Global Warming

Carbon is the fundamental building block of all life on Earth. Each tree, each blade of grass is about half carbon. The total carbon stored in all of the forests in the world together adds up to about 1 trillion tons—about 1.5 times the amount found in the atmosphere.

So when 32 million acres of forest worldwide are cleared each year—an astonishing acre per second—the volume of carbon emissions can be breathtaking. Slowing the rate of deforestation and ramping up restoration have the potential to play a huge role in fighting global warming.

Forest protection is a significant new part of the plans conservation groups and many governments will be promoting at the Copenhagen climate negotiations. If forest clearing accounts for 17 percent of the problem, they argue, protecting woodlands could represent 17 percent of the solution.

Over the past 15 years, the Conservancy's work on carbon sequestration and avoided deforestation has helped demonstrate the feasibility of protecting forests to fight climate change. "We have been blazing some trails here," says Zoe Kant. "We have created entirely new methodologies for doing conservation."

Getting international agreement around these innovations will be an enormous challenge, as new scientific findings are likely to dictate new procedures, and the politics are in constant flux. "I feel like we're driving a train while the tracks are still being built," says Kelly of The Conservation Fund.

But the incentives are compelling: The Conservancy's climate team envisions that functioning carbon markets could help protect and restore nearly 100 million acres of forest. And the team has been working hard to make this a reality: Each year of work in Noel Kempff, the Garcia and Berau has generated lessons that have helped refine and validate the role of forest protection in carbon markets.

The Conservancy's work with partners to develop model climate projects has already protected more than 1.5 million acres of forests, says Kant. "Even without the carbon work, this has been a huge success for conservation."

ONLINE: WHAT DO YOU THINK ABOUT THE CONSERVANCY'S EFFORTS TO COMBAT CLIMATE CHANGE? TELL US AT NATURE.ORG/MAGAZINE