

Strengthening Forest Monitoring in the **Andean Amazon**

SilvaCarbon Five-Year Report, 2011-2016

The Amazon rainforest is widely recognized as one of the world's greatest natural resources, yet efforts to conserve and protect this global treasure have had mixed results. While deforestation has been drastically reduced in the Brazilian portion of the Amazon, forests continue to decline throughout the region – particularly in the Andean Amazon. This is largely due to a lack of information about ongoing forest changes, including changes in forest carbon. Without accurate forest baseline data and up-to-date information on forest dynamics over time, forest managers, policymakers, and other stakeholders are ill-equipped to take effective action to address forest loss, or assess the results of different interventions.

Colombia, **Ecuador**, and **Peru** together contain nearly 1.4 million square kilometers of forest land but are experiencing rapid forest loss due to agricultural expansion, mining, illegal logging, and other activities. Carbon emissions from forest loss make up a large share of the countries' total emissions and are a major contributor to global climate change. Improved information on forest dynamics and associated carbon dynamics is urgently needed to strengthen forest management and policy, implement Reducing Emissions from Deforestation and Forest Degradation (**REDD+**) programs, and meet emissions reduction pledges under the United Nations Framework Convention on Climate Change (**UNFCCC**).

To address this need, the **SilvaCarbon Andean Amazon Program** has been providing technical support to Colombia, Ecuador, and Peru since 2011 to enhance in-country capacities for quantifying forest carbon stocks and dynamics. SilvaCarbon has played a key role in increasing understanding and adoption of key tools and methods for tracking forest change in the region and strengthening the relevant institutions in each country.



Pilot project on community-based forest monitoring using mobile devices. Satipo, Peru, 2015.

What is SilvaCarbon?

SilvaCarbon is an interagency initiative of the US Government to assist partner countries in the production and application of improved information related to forest and terrestrial carbon.

Drawing on the strengths of multiple US agencies and a global network of experts, SilvaCarbon provides **targeted technical assistance** to build capacities in measuring, monitoring, and reporting forest and terrestrial carbon. In doing so, the program supports the development of transparent national forest monitoring systems and greenhouse gas (GHG) inventories needed for REDD+, emissions reporting, and other purposes.

The program promotes **sustainable landscapes** and **low-emission** development in 21 countries in accordance with the **US Climate Action Plan**.

SilvaCarbon agencies include the US Department of State, US Agency for International Development (USAID), US Forest Service (USFS), US Geological Survey (USGS), US Environmental Protection Agency (EPA), and National Aeronautics and Space Administration (NASA).

SilvaCarbon partners with the Global Forest Observations Initiative (**GFOI**) to increase the availability and use of Earth observation data for forest monitoring. SilvaCarbon co-leads the GFOI capacity-building component together with the Food and Agriculture Organization of the United Nations (**FAO**).

Overview – SilvaCarbon Andean Amazon Program

The SilvaCarbon Andean Amazon Program has worked with in-country technical teams in Colombia, Ecuador, and Peru, in close collaboration with US and international partners, to support the design and implementation of national measurement, reporting, and verification (MRV) systems for REDD+ and improve the monitoring and reporting of GHG emissions from the agriculture, forest, and other land use sectors.

Peru, Ecuador, and Colombia face similar challenges in the development of their MRV systems and are able to leverage similar methodologies and techniques in forest monitoring. To capitalize on those similarities, SilvaCarbon has adopted a regional capacity-building approach that facilitates **cooperation and technical exchange** between the three countries as well as counterparts in other countries and regions.

For example, with SilvaCarbon support, Peru shared lessons from its national forest inventory development

processes with counterparts in Mexico, Colombia, and Ecuador, and Colombia shared its forest mapping protocols with Ecuador and Peru.

Together with GFOI, SilvaCarbon has familiarized country partners with the latest technologies, methodologies, and international guidance related to REDD+ and forest carbon monitoring, and has connected in-country technical teams with international experts, data-providing space agencies, research institutions, and other donors to advance capacity-building progress.

GFOI regional workshops have been instrumental in assisting country partners to identify capacity gaps and needs, determine which forest monitoring approaches best suit their circumstances, and develop long-term strategies for acquiring the necessary Earth observation data. GFOI regional workshops have also played an important role in strengthening the regional community of REDD+ and forest monitoring professionals and promoting South-South cooperation.

Results Indicators

Between 2011 and 2015, the SilvaCarbon Andean Amazon Program:

- Conducted more than **27,500** person-hours of training in climate change.
- Trained **1,021** people, including **560** men and **461** women.
- Strengthened more than **20** different institutions.
- Supported more than **40** workshops and/or regional exchanges.
- Catalyzed **\$217,000** of additional investment in climate change capacity-building from other sources.
- Provided more than **1,600** hours of technical assistance from the SilvaCarbon Technical Coordinator, in addition to technical assistance from other experts.

Program Objectives

The SilvaCarbon Andean Amazon Program has sought to build capacities in Colombia, Ecuador, and Peru related to:

1. Generating accurate estimates of forest carbon stock and other forest resource data through the process of designing and implementing national forest inventories.
2. Using remotely sensed data for forest monitoring and creating national data and mapping products from remotely sensed data to be integrated in national forest monitoring systems.
3. Developing consistent data products over time that are necessary for establishing national GHG inventories for the land sector.
4. Advancing in-country and regional research related to forest and terrestrial carbon measurement and monitoring.



Regional workshop on early warning systems for deforestation. Sao Jose Dos Campos, Brazil, 2015.



SilvaCarbon invests in science to improve understanding of not only changes in land cover over time, but also of the effectiveness of different efforts to reduce GHG emissions from land use change. This investment promotes transparency in national and international reporting – a goal emphasized in the **Paris Agreement** of the UNFCCC – and advances country-led and multilateral climate action by facilitating the implementation of optimal approaches for quantifying forest and terrestrial carbon. With this in mind, SilvaCarbon activities in the Andean Amazon region has focused on the following **five program areas**:

➤ Remote sensing and spatial data analysis

Activities in this area focused on creating spatial data products to address country needs for detailed and accurate information on forest cover and land use changes over time. This work helped the countries generate historic information for use in their national **Reference Levels**, and advanced the development of land cover/land use systems that can provide vital data at biennial time or more frequent time scales for use in planning and UNFCCC reporting.

An ongoing SilvaCarbon grant with the **University of Maryland (UMD)**, focused on 30-meter resolution mapping of forest change, has enabled UMD to work with the technicians in Peru on the creation of annual mosaics. UMD is also working with specialists in Colombia the on developing land cover change indicators for Intergovernmental Panel on Climate Change (IPCC) classes and other classes such as natural shrubs and grasslands; developing biomass change map estimators; and generating new metrics for non-forest ecosystems, such as páramos and savannas.



Country partners explore possibilities for using Unmanned Aerial Vehicles to track forest change.

➤ Strengthening National Forest Inventories

Through both regional and country-specific activities, SilvaCarbon has advanced the development of **national forest inventories** in the region. These activities have included training on software tools for inventory design such as the USFS-supported DTIM and FRIED tools, data analysis, and quality assurance/quality control systems for data collection.

Experts from SilvaCarbon agencies have travelled frequently to the region to work alongside host country partners, and have established ongoing professional relationships that have resulted in numerous hours of remote follow-on support through conference calls, e-mail exchanges, and document transfer. Host country technicians have also travelled to the US to partake in study tours to learn about the US inventory system first-hand and collaborate with US experts. All countries in the region are implementing their inventories, with Ecuador working on a second inventory cycle that was redesigned with the help of technical assistance from SilvaCarbon experts to meet evolving national needs.



Forestry technicians learn about methods for quantifying forest degradation. Mexico, 2016.

➤ National GHG Inventory Tools and Applications

In conjunction with US EPA, SilvaCarbon has worked with Colombia, Ecuador, and Peru to improve GHG inventories for the land sector to meet UNFCCC and other reporting commitments. These activities involved a mix of workshops (see ALU workshop, for example: <https://sites.google.com/site/epaaluworkshop/>) and direct assistance by US experts.

The regional SilvaCarbon technical advisor has worked directly with all countries on GHG accounting for the forest sector and linking REDD+ MRV efforts with GHG inventory efforts. Work still continues in this area, especially in implementing policies to help the countries meet their **Nationally Determined Contributions** under the UNFCCC process.



GFOI workshop on national forest inventory design. Tarapoto, Peru, 2016.



GFOI workshop on assessing the accuracy of activity data. Bogota, Colombia, 2014.

➤ GFOI Regional Capacity-Building Workshops

Over the course of the 5-year program and in conjunction with other international partners, SilvaCarbon has organized and implemented 14 regional capacity-building workshops. These workshops brought together hundreds of host country partners and international experts from around the world to demonstrate, discuss, and apply technologies and methodologies related to a wide variety of forest monitoring topics, including map accuracy assessment, integrating remotely sensed imagery with ground data, and time series analysis. These workshops also provided the basis for direct, country-specific capacity-building support tailored to each country in the region. For a comprehensive list of workshops see the GFOI Regional Workshops website (in Spanish: <https://sites.google.com/site/talleresgeofct/>).

➤ Research on Forest Carbon Monitoring

While Colombia, Peru, and Ecuador must establish forest monitoring systems in order to meet near-term objectives, they must also be prepared to respond to future forest monitoring needs, as well as contribute to greater global understanding of forest carbon dynamics. To that end, the SilvaCarbon Andean Amazon Program has supported research on forest carbon monitoring by funding host country scientists and technicians to participate in **global conferences** (e.g. the International Union of Forest Research Organizers) and partially supporting **higher education training** such as Masters, Doctorate, and Certificate Programs on priority areas identified by host country agencies. Workshops on forest carbon monitoring science, such as tree allometric equations, were also organized, with one such workshop resulting in the publication of 5 articles in a special issue of the *Annals of Forest Science*. (See <http://link.springer.com/journal/13595/72/6/page/1>). To date, these articles have been viewed nearly 5,000 times, collectively.

SilvaCarbon has also supported the establishment of landscape-scale **intensive carbon monitoring sites** in Colombia, Peru, and Ecuador to build scientific capacity and stimulate further research and collaboration. The intensive monitoring sites are centers of technology transfer and training, and provide data needed to perform many of the functions required for improved (i.e. Tier 2 and Tier 3) GHG monitoring and reporting. These sites are also valuable in cross-validating research performed by other groups that utilize other MRV methods at different levels/tiers (e.g. GEO-FCT). Finally, these sites inform the design and implementation of complementary state-level climate change programs. Colombia has recently proposed establishing 3 more intensive sites along an altitudinal gradient, and Ecuador is considering establishing 5 more sites.



Specialists receive training on flux towers for intensive carbon monitoring. Tiputini, Ecuador, 2015.



Colombia



Colombia has become a regional leader in forest carbon monitoring, and now employs state-of-the-art mapping and statistical methodologies to generate accurate, up-to-date information about changes in land cover. The country has established the core components of an MRV system and is beginning to shift its primary focus to other areas, such as the further development of **Reference Emissions Levels**, social and environmental safeguards, and intensive monitoring sites to improve the accuracy of GHG estimation.

According to partners at the **Colombia Institute of Hydrology, Meteorology and Environmental Studies (IDEAM)**, SilvaCarbon has been instrumental in advancing national REDD+ efforts, and further support from SilvaCarbon will be critical as the country takes on new challenges in REDD+ implementation.

One important outcome of Colombia's partnership with SilvaCarbon was the finalization of the **design for the national forest inventory**, which was approved in 2014 and now is now being implemented. The achievement marks a major milestone on the path to REDD-readiness and is also crucial for improving overall forest management at the national level. A

previous design was deemed too costly to implement, and for years the government relied on forest inventory data that was collected using inconsistent protocols from field plots scattered around the country. In 2014, SilvaCarbon sent a USFS expert on a two-month technical detail to Colombia to work directly with IDEAM to revamp the design. Through daily, hands-on collaboration, IDEAM and the SilvaCarbon expert modified the design to increase its cost-efficiency and ensure integration with the national MRV system.

Colombian partners have also worked with SilvaCarbon in a number of other technical areas. For example, SilvaCarbon experts provided decision support to the government regarding the selection of an official mapping methodology, and supported the development of a GHG inventory for the agriculture and land use sectors that is now used to inform the country's **National Communications** to the UNFCCC. Colombia was recently chosen as a testbed for a new approach to spatial data storage and analysis referred to as the **Data Cube**, and is currently working with SilvaCarbon and NASA on the implementation of the approach. If successful, the approach could be useful in many other SilvaCarbon countries around the world.



Technicians from Colombia and across the region learn about cutting-edge and operational approaches for mapping forest cover and biomass. Leticia and Bogota, Colombia, 2013.

Partner Perspective



"Without SilvaCarbon we would be two years behind. SilvaCarbon has been like a bridge, helping us find the right experts. Without it we would only have research papers to guide us, and those aren't enough to implement anything."

In general, international cooperation comes with a very specific agenda – normally we have to adapt, whereas SilvaCarbon adapts to us. The SilvaCarbon model has been very useful in Latin America. I wish other international cooperation could be more similar."

– **Gustavo Galindo**,
Remote Sensing
Coordinator, IDEAM

Photo by Cristian Garavito, El Espectador



Peru



Peru has made impressive progress in forest monitoring in recent years. The **Peru Ministry of Environment (MINAM)** has greatly improved its forest mapping and carbon accounting capabilities, due in part to SilvaCarbon support, and has leveraged those capabilities to generate two key products that are essential for REDD+ implementation: a **forest dynamics map** and a **national forest carbon assessment**.

Peru recently completed its first multi-temporal forest dynamics map using a cutting-edge methodology developed by SilvaCarbon partners at UMD. The methodology incorporates **freely available Landsat imagery** to generate high-resolution, cloud-free maps that can be used to quickly and accurately estimate forest extent, loss, and gain. Estimates based on the map indicate an annual deforestation rate of 0.15 percent. While the rate is relatively low compared to countries in other regions, forest loss accounts for nearly half of Peru's total GHG emissions.

MINAM also worked with SilvaCarbon experts to improve the statistical methodology it uses to determine the carbon content of different ecosystems. MINAM then applied the methodology to generate the first national-level estimates

of forest carbon stocks based on field data, resulting in a more comprehensive understanding of forest carbon dynamics than could be achieved solely through satellite imagery or other remotely sensed data.

Partners in Peru recognize the importance of such output products for achieving near-term REDD+ objectives, but also emphasize the need to strengthen and sustain institutional capacity over the long term, including in areas beyond the scope of REDD+. Peruvian partners see SilvaCarbon as particularly valuable in this regard. They note that SilvaCarbon has made it possible for MINAM technicians to benefit from otherwise inaccessible training opportunities, both in Peru and abroad, and they acknowledge that the program has played a vital role in **bridging science and policy** by fostering a holistic understanding of forest carbon monitoring among technicians and policymakers. By investing in the **professional development** of dedicated staff rather than focusing solely on immediate outputs, which are often outsourced to external consultants, SilvaCarbon is helping Peru overcome key institutional challenges that can hinder development progress.

Partner Perspective



"We have funding, but it is not always directed toward our most important needs. Some donors are more focused on delivering products and outputs than on strengthening institutional capacities along the way. SilvaCarbon, in that sense, has been very helpful to the Peruvian MRV team because they have given us the opportunity to strengthen our capabilities and have been flexible enough to respond to our needs."

SilvaCarbon has collaborated in linking the monitoring of forest dynamics with carbon accounting, and we now have a more technical understanding of the entire process."

— Natalia Málaga Durán,
REDD+ Project, MINAM



Technicians gain first-hand experience working with advanced technologies for tracking and quantifying forest resources.

Local community members are trained in the use of mobile devices for forest monitoring. Satipo, Peru, 2015.



➤ Ecuador



Ecuador has overcome a number of institutional and financial challenges to make significant headway toward REDD+ implementation. The country has successfully developed a suite of forest monitoring products, including a robust national forest inventory and high quality forest change maps, and has made great strides in ensuring community involvement and broad stakeholder engagement in REDD+. With assistance from SilvaCarbon, the **Ecuador Ministry of Environment (MAE)** is now working to integrate different products and components into a comprehensive national forest monitoring system.

MAE has worked closely with SilvaCarbon on the design of its **national forest inventory** and the generation of **forest maps**. MAE completed its first national forest inventory design in 2012, and in 2014 produced its first inventory results from the design. Formal and informal training by SilvaCarbon experts in “R,” an open-source statistical software tool, were critical to those efforts, according to Ecuadorian partners. MAE technicians are currently in the process of redesigning the national forest inventory in collaboration

with SilvaCarbon experts, as well as counterparts in Colombia and Peru through SilvaCarbon-supported exchanges.

Ecuador implemented the UMD time-series mapping methodology with assistance from SilvaCarbon, and was then able to apply the methodology to generate a forest dynamics map that can be used for MRV and a variety of other purposes. The map depicts forest change over ten continuous years for an area that previously lacked historical data due to constant cloud cover.

Opportunities for technical exchanges and **South-South cooperation** outside of Ecuador are particularly valuable to partners in Ecuador, who have relatively little domestic funding available for international engagement. Hence, in addition to providing direct technical assistance to Ecuador, SilvaCarbon has helped strengthen the country’s capacity by supporting the integration of Ecuadorian scientists into the global forest carbon community, as well as by catalyzing further support from other donors and partners.

Partner Perspective



“SilvaCarbon support has been very important to us through mechanisms such as internal workshops to enhance technical skills, the exchange of experiences at national and regional levels, study tours, and practical learning activities related to forest monitoring and the measurement of carbon stocks.

This kind of support makes SilvaCarbon a great partner to MAE, and is essential to its capacity to adapt to the country’s needs.”

– **Daniel Segura**,
National Forestry
Evaluation Project,
MAE



Key stakeholders learn about the role of uncertainty in predicting and responding to deforestation. Tena, Ecuador, 2015.



Program Information



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