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Technology and MRV in Forest Carbon Finance

Contents

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Cover Photo: Canva

Technology and MRV in Forest Carbon Finance

Introduction

Carbon credits have emerged as a powerful tool to fund forest conservation and restoration, with more than 150 million forestry credits issued in 2021 and in excess of $500 million in revenue[1] generated by these projects just this year. The backbone of this funding mechanism is a system of monitoring, reporting, and verification (MRV) that seeks to precisely quantify, measure, and monitor carbon sequestered and stored by these projects. While there can be many components of project MRV, the core of the MRV process is assessing how much carbon currently is stored in a forest and projecting future carbon storage. This quantification includes inventorying the existing project area to understand the biomass, species, and health of the forest; modeling rates of growth; and enlisting an independent third-party verifier to corroborate findings. Much of this research revolves around on-site sampling—enlisting foresters to measure the size and species of trees and sampling sites across a project area to model the project site. Exact precision in this process will ensure carbon credits reflect real and quantifiable carbon sequestration and avoided emissions; however, such precision comes at a cost. Current MRV approaches are expensive and time-intensive, posing a barrier for many small landowners to enter the market and often comprising a significant percentage of the cost of credits sold. Remote sensing and artificial intelligence technologies have been posited as a valuable solution to this problem. Used in complement with ground measurements, these technologies can maintain or increase the level of exactitude in MRV while reducing the costs and time associated with completing this work. This report will examine the challenges and opportunities in the existing MRV landscape and highlight technologies, technology providers, and market leaders who are working to increase efficiency and rigor in the MRV process.

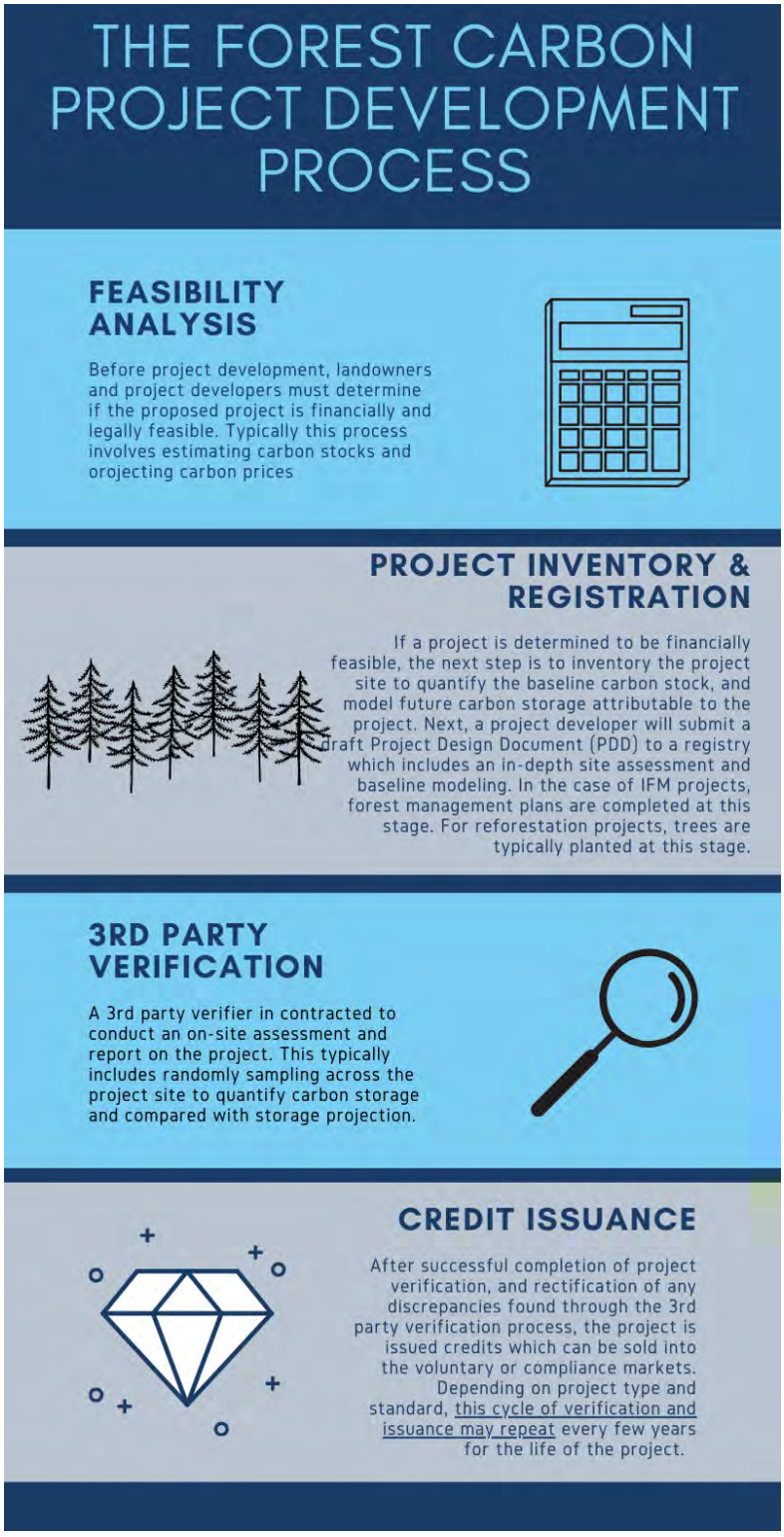
What is MRV?

Monitoring, Reporting, and Verification (MRV) in Carbon Finance is the process through which carbon projects must demonstrate efficacy in order to be issued credits. Most forest carbon projects must follow a multi-stage process in order to be “issued” offset credits that can be sold in the market.

MRV includes more than just quantifying carbon stocks. Depending on protocols, MRV may include an assessment of “leakage” to the surrounding area, an evaluation of potential sources of double counting, a verification of legal rights to credit ownership, and a review of stakeholder comments. However, the site assessment component—

[1] https://www.ecosystemmarketplace.com/articles/voluntary-carbon-markets-top-1-billion-in-2021-with-newly-reported-trades-special-ecosystem-marketplace-cop26-bulletin/

which typically includes on-site sampling to quantify carbon stocks—is a significant and often costly and time-intensive component of the process.



The MRV process fills a critical role in the offset markets by providing independent project assessments grounded in the best available science. A comprehensive and effective MRV process is essential to maintaining and improving the integrity of the carbon market.

Specific MRV requirements vary significantly by standard and project type, but largely follow similar approaches. Third party verifiers will confirm boundaries and acres of a project area in an enrolled forest, review the modeling and assumptions made in the Project Design Documents, and take carbon measurements of sample plots on the project site. These sample plot measurements include randomly selecting sample areas across the project site. The verifier records species in areas of 10-25 ft. radius. Trees in these samples are measured to calculated diameter at breast height (DBH) and total tree height. This allows verifiers to calculate the biomass of each tree; from that computation, the amount of stored carbon can be calculated. The verifier will ensure the project adheres to the specific requirements

and approaches laid out in the methodology documents, such as appropriate quantification of a “buffer pool.”

Third-party verifiers are independent firms that are approved or accredited by registries to conduct this MRV. Major verifiers in the United States include SCS Global Services, Ruby Canyon Engineering, and First Environment. The verification process can take six months or longer depending on verifier capacity and project complexity.

The MRV process includes assessments and considerations beyond site-level carbon storage. The verifier will ensure the project meets the methodological criteria for additionality (i.e., that the project exceeds what is required by law and that it sequesters forest carbon in excess of what would occur in a “business as usual” management scenario). The verifier also will review public comments and ensure the project developer has adequately responded to any stakeholder concerns.

Addressing challenges

Forest Carbon Project MRV is a critical component of credit development and is integral to the integrity of the market. The existing MRV process comes with monetary costs, time costs, and limitations to the types of projects that can easily access the market. These costs are highly variable by project type, location, size, and other characteristics.

Maintaining and improving the level of rigor in MRV processes is essential to the success of the forest carbon market. Several technological innovations and solutions have shown promising potential to maintain or increase accuracy while decreasing time, reducing costs, and improving market access. One study estimated that MRV costs range from $0.15 to $1.4 per ton for forest carbon projects.[2] As much as 20% of the cost of the credit may go to monitoring, reporting, and verification costs. Site sampling plays a large role in these costs. The process of bringing out a third-party verifier to independently and randomly sample the project site is labor-intensive. Much of these verification costs are at least somewhat “fixed” in nature.

While larger projects will be more expensive to monitor and verify, smaller projects spend a disproportionately higher percent of generated revenue in the verification process. This makes forest carbon project development infeasible for many landowners. Historically, for forests less than 1,000 acres (or, in some cases, less than 5,000 acres), forest carbon finance development was financially infeasible due to these high MRV, registration, and development costs. Many registries and project developers are now working to more effectively reach small landowners.

In addition to monetary costs, the MRV process is often quite time-intensive. Completing the third-party verification process can take six months or more, and typically these verifications must be completed before any credits are issued.

[2] Köhl, M., Neupane, P. R., & Mundhenk, P. (2020). REDD+ measurement, reporting and verification–A cost trap? Implications for financing REDD+ MRV costs by result-based payments. *Ecological Economics*, *168*, 106513.

Depending on buyer arrangements and offtake agreement, this may mean no revenue can be generated on the project until the verification and issuance is complete, which can make project financing difficult and costly.

While MRV costs are significant and the verification process can be lengthy, the integrity of the MRV process is an essential component of the value of these credits and of the market overall.

Figure 1 (below) shows the distribution of forest carbon projects by project size (including both single site and aggregated projects). The average project size for forest carbon projects issued credits in 2021 in the United States was over 50,000 acres. This is reflective (at least in part) of the high fixed costs associated with assessing project feasibility, registering a project, and hiring third-party verifiers. Conversely, only 14% of privately owned forestland in the United States is held in tracts of 1,000 acres or greater.[3] The majority (86%) of privately owned forestland in the United States has traditionally been unable to access forest carbon markets due to these high fixed costs of project feasibility analysis, development, and verification.

Figure 1: Forest Project Size

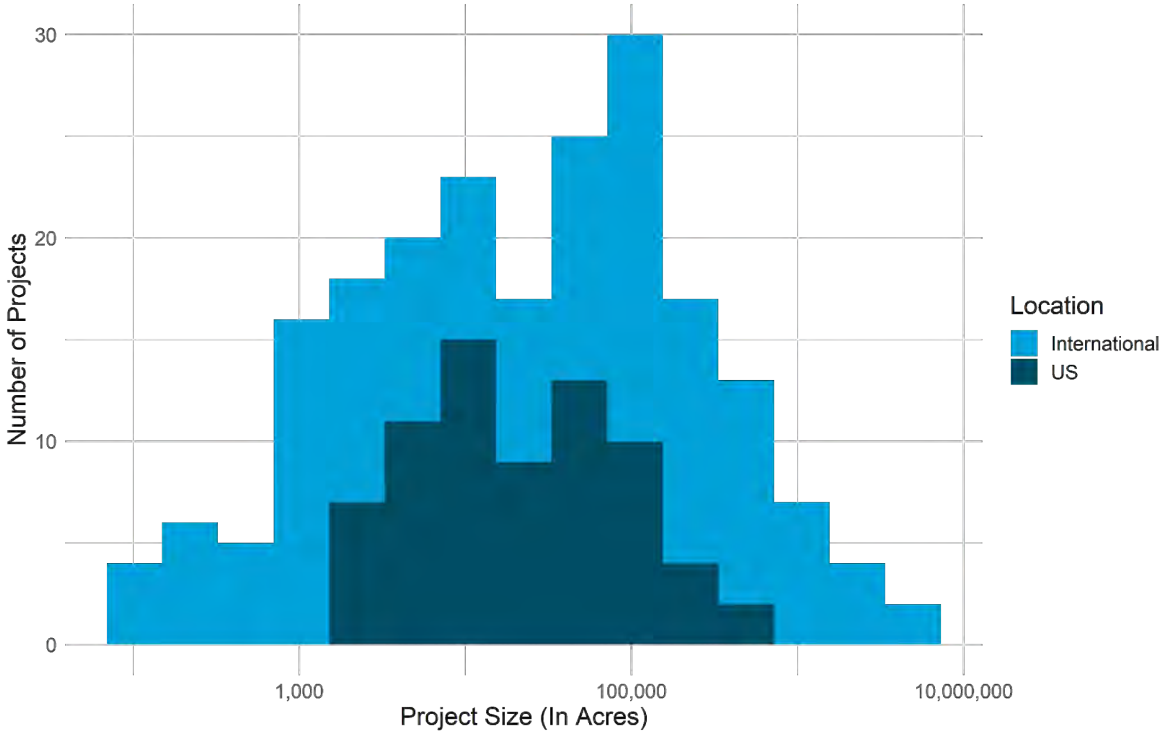


Figure 1. Forest project size (in acreage—logarithmic scale) for projects that were issued credits in 2021 through the Climate Action Reserve, the American Carbon Registry, and Verra

[3] "Who Owns America's Forests? Forest Ownership Patterns and Family Forest Highlights from the National Woodland Owners Survey" (2008) United States Department of Agriculture, U.S. Forest Service, Northern Research Station

Many project developers and registries are seeking to address this barrier to access, largely through approaches to streamline feasibility analysis, aggregate project development, and verification. See Table 1 on page 9 for a list of organizations engaged in this approach.

For many project types, the Taskforce on Scaling Voluntary Carbon (TSVCM) recommends increasing the length of monitoring for as long as 100 years after development to guard against potential reversals and to increase the integrity of issued credits. The TSVCM also recommends increasing the monitoring and transparency of project "leakage" (emissions from outside the project site that would have otherwise occurred within the project site had the project not been developed). The TSVCM recommendations specifically seek to evaluate and encourage digital MRV approaches.[4]

Many different technology solutions and approaches have been applied to reduce costs and increase precision in the MRV process. By and large, there is no single technology solution or approach that is sufficient. The majority of project developers and technology providers in the market (see Table 1) use a combination of the solutions described below.

Types of MRV Technologies and Approaches

Satellite Imagery. Satellite Imagery is the most ubiquitous and easily accessible tool for project monitoring, reporting, and verification. Satellite data is readily—and often freely—available and can provide valuable information on land characteristics. For the purposes of carbon quantification at the level of detail needed to monitor and verify carbon credits, satellite imagery may be a component of a digitized MRV approach, but is not a complete solution. Satellite data provides an aerial image, typically at a 30 x 30 meter resolution (approximately 1000 sq. ft). Satellite imagery is well suited to identify changes in general ecosystem types (e.g. identifying the acres of forest within a project site), as well as changes in land cover over time. It can be used in conjunction with other field and remotely sensed data to provide precise carbon storage estimates at the level of rigor required in the carbon market.

LiDAR. LiDAR (which stands for light detection and ranging) is a method of remote sensing that can generate three-dimensional information about a project site using laser scanning. LiDAR information is collected aerially (via drone or helicopter), terrestrially, or by satellites (e.g. the NASA GEDI ecosystem LiDAR mission). International agencies have proposed additional forthcoming spaceborne LiDAR systems. When collected aerially or terrestrially, LiDAR provides information from a much smaller area of study. With some exceptions[5], LiDAR data is not publicly available and is typically collected on an as-needed basis. LiDAR data can be used to estimate biomass, tree density, and

[4] "Taskforce on Scaling Voluntary Carbon Markets: Phase II Report" (2021) Taskforce on Scaling Voluntary Carbon Markets.

[5] "3DEP LidarExplorer" (n.d.) U.S. Geologic Survey (USGS)

merchantable cubic feet of timber to a comparable level of accuracy as the industry standard site sampling, although the cost of LiDAR data collection and processing is also comparable to site sampling on a per acre basis.[6] In the processing phase, LiDAR data is often integrated with satellite imagery to corroborate and extrapolate data across a landscape.

Photogrammetry. Photogrammetry is similar to LiDAR in it aerially captures information (in this case, via drone) about a project site at much finer resolution than can be achieved with satellite imagery. As the name suggests, photogrammetry relies on photographs taken from different angels and vantage points to capture information at a site. Photogrammetry typically costs less than LiDAR or site sampling, although there is some evidence to show that photogrammetry's accuracy is significantly less than LiDAR, especially in high canopy forests.[7]

Machine Learning. Machine learning is a broad term that encompasses different approaches to "train" technology to identify or estimate information based on an incomplete dataset. Machine learning approaches require precise and robust underlying data to accurately estimate or infer new information. Machine learning approaches are used by many technology providers (see Table 1) to create a robust inventory of trees across a landscape, often based on a combination of site sampling and/or LiDAR data and satellite imagery.

Streamlined Site Sampling. Site sampling deploys individuals to sample numerous plots across a forest . It remains a critical component of project development and verification, and is a factor in nearly all of the technology solutions listed in Table 1. Site sampling is typically conducted by measuring a large number of sample plots (usually a fraction on an acre) across a project area. These measurements include measuring diameter at breast height (DBH) and tree height to estimate total biomass for each tree within a sampling plot, and then converting this biomass value to CO_2. While on-site sampling remains an integral component of both the project inventorying and project verification processes, some technology providers are working to make this process more efficient. Taking Root's software platform (discussed in depth later in this paper) aims to lower costs and increase efficiency in the site sampling component of the project inventorying process. Through a mobile app that makes the sampling and measurement process possible for landowners without technical forestry knowledge, Taking Root uses the machine learning model to project-scale carbon estimates based on a limited number of samples (see Table 1).

Forestry Inventory Analysis (FIA) data. The U.S. Forest Service's Forestry Inventory and Analysis Program deploys staff-trained technicians to conduct site sampling across

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[6] Hummel, S., Hudak, A. T., Uebler, E. H., Falkowski, M. J., & Megown, K. A. (2011). A comparison of accuracy and cost of LiDAR versus stand exam data for landscape management on the Malheur National Forest. *Journal of forestry*, *109*(5), 267-273.

[7] Lamping, J. E. (2021). Comparison of low-cost commercial unpiloted digital aerial photogrammetry to airborne laser scanning across multiple forest types in California.

forest land in the United States. Through an annual survey, these technicians collect biomass, forest health, and species information, which is used to generate a series of publicly available datasets that estimate forest carbon storage and numerous other forest attributes across the country. FIA data is a unique and highly useful data asset that is being integrated in methodologies developed by the American Carbon Registry[8] and Verra[9] (in collaboration with the American Forest Foundation and NCX programs described in Table 1). Please note that FIA data on its own is not an MRV tool, and it's U.S. specific.

Many organizations have developed and are developing solutions and innovations that make use of one or more of the solutions described above to reduce costs and/or increase precision in the MRV process.

Photo: Canva

[8] "IFM on Small Non-Industrial Private Forestlands 1.0" (2021) American Carbon Registry

[9] Pond, N. (2021) "Additionality in NCX Carbon Accounting." NCX

Table 1. Forest Carbon MRV Providers and Innovators

Organization	Project Feasibility	Project Development, and Inventorying	Post Credit Issuance Assessment and Analysis	Data Sources and Analytics
Technology Providers				
Taking Root		App-based software to improve efficiency and ease in project inventorying.		On site measurement, satellite imagery, machine learning
Sylvera			Independently assesses carbon stocks, additionality, and permanence for carbon credits already issued	LiDAR, on site sampling
Pachama			Independently evaluates forest carbon projects after credit issuance to provide buyer assurance of credit quality	LiDAR, machine learning, satellite imagery
Developers[10]				
American Forest Foundation's (AFF) Family Forest Carbon Program		Aggregated Project Development		On site sampling, FIA data
Finite Carbon's CORE Carbon Program		Aggregated Project Development		
NCX (the NCX marketplace may be classified as a technology provider as well as project developer])	Streamlined project feasibility analysis	Aggregated Project Development open to landowners of all sizes in 48 states, with zero fees, no minimum acreage, and annual contract terms.	Carbon benefit is paid for on delivery, eliminating the need for long term monitoring. Monitoring occurs during the one-year project period, and credits are not issued until verification of carbon benefit is complete and benefit is realized.	LiDAR, on-site sampling, FIA data, satellite imagery, machine learning, application of their proprietary "Basemap" forest dataset at 30m resolution

[10] Most, if not all, project developers use remote sensing technologies as part of the project feasibility and development process. The small selection of developers listed in this table are specifically working on approaches to improve efficiencies in the development and MRV processes in order to increase market access for small forestland owners.

Organization	Project Feasibility	Project Development, and Inventorying	Post Credit Issuance Assessment and Analysis	Data Sources and Analytics
Registries				
American Carbon Registry		Developed a methodology geared towards small U.S. Landowners, in collaboration with AFF and TNC which allows for project baseline establishment using FIA data, and third-party verification for a subset of small forest plots enrolled in an aggregated carbon project		
Climate Action Reserve		Mexico Forestry protocol allows for streamlined project aggregation. The majority of small land area projects in the carbon market have been developed in line with this protocol		
Gold Standard		Working to digitize project design and monitoring with an aim towards increasing efficiency and reducing costs		
Plan Vivo		Reviewing Taking Root's software platform for endorsement as an "Approved Approach"		
Verra		Developing U.S. IFM methodology in collaboration with NCX. Verra has also approved an approach for aboveground biomass with remote sensing.[11]		

[11] https://verra.org/methodology/vt0005-tool-for-measuring-aboveground-live-forest-biomass-using-remote-sensing-v1-0/

Areas of Opportunity

Research on specific MRV costs. While MRV (broadly inclusive of project feasibility, inventorying, registration, and third-party verification and monitoring) costs are well established as a significant part of the total cost of carbon projects, there is limited information on the specific costs of each of these MRV components and how these project costs differ by project size, location, and type. An improved understanding on MRV costs will allow technology providers, registries, and other market actors to better target and invest in innovations that reduce costs and increase efficiency.

Research on key carbon accounting questions. To strengthen forest carbon methodologies, we need a better understanding of how to measure and account for leakage, permanence, additionality, and the time value of carbon. Increased funding for research into those issues would allow us to raise the bar on the quality of carbon credits, improve the confidence in the real climate impact that they create, and incentivize immediate climate action.

Increased investment in regional or national forest carbon datasets. Many recent innovations in U.S. forest carbon MRV processes leverage FIA datasets as a source of high resolution, freely accessible carbon data. Increased investment in FIA data collection domestically and investment in FIA-like programs internationally will significantly improve precision and confidence in these estimates.

Increased collaborations between technology providers and registries. Advancements in MRV processes have been driven by technology providers and registries collaborating to integrate new approaches into existing methodologies and carbon market processes. These collaborations, and the creation of freely available or publicly reproducible datasets and tools where possible, is essential to advancing MRV processes while also increasing confidence in the forest carbon market.

Case Studies

Taking Root's Software Platform

Creating a pathway for small landowners to participate in the carbon market by simplifying the project recruitment, mapping, and inventorying process

Taking Root, a Canadian-based not-for-profit organization that provides information and resources for saving existing trees and planting new ones, has developed a software platform to unlock access to the carbon market for millions of farmers across the tropics. Their platform makes it simple for farmers to grow trees and create high-quality forest carbon removals that can be sold to brands with climate commitments. Recently recognized as a carbon market innovator by the World Economic Forum, Taking Root has enabled the creation of over 2.5 million forest carbon removals while directing over $7M in payments to thousands of farmers across the tropics.

Taking Root initially focused its efforts on developing the CommuniTree Carbon Program. CommuniTree is a large scale Plan Vivo-certified carbon project reforesting land with smallholder farmers in Nicaragua. Founded in 2010, CommuniTree began with a handful of farmers. As it grew from tens to hundreds to thousands of farmers, Taking Root began to face challenges that have been a barrier to so many seeking to scale forest restoration projects in the tropics.

There were two challenges in particular: 1) how to effectively manage and track project operations to ensure the land was reforested effectively and 2) how to monitor and report in a way that didn't rely on prohibitively expensive third-party expertise. Taking Root's solution to both challenges was to build their own software platform.

Figure 2

Figure 2. A landowner establishing a sampling plot to record tree count, species, and size information in the platform

The platform acts as a management tool for project developers, facilitating every step of operating and scaling a successful forest restoration project. From farmer recruitment to monitoring and farmer payments, the platform provides project developers with the tools and information they need to ensure their projects are on track. As a first step, the mobile app allows field staff to register farmers and map land areas to facilitate and track recruitment efforts, as well as monitor land areas to ensure tree planting and growth targets are met over time. With the web app, project developers can then assess which parcels of land may need additional planting or if a farmer has achieved certain outcomes and can be delivered payment.

The platform also automates the quantification and reporting of carbon removals. For project developers, this improves the ease of forest carbon inventory and certification while also dramatically reducing the cost.

Taking Root quantifies carbon by combining field data collected via their mobile application with remote sensing data to estimate the carbon stored in the trees on each parcel within a project. Harnessing these two data types achieves two main benefits. First, it means trees and carbon can be cost-effectively measured through field monitoring in the early years of tree growth when they are hard to detect from remote sensing. Second, as the trees mature, the platform's machine learning algorithms use field data gathered through the app as training data to deliver carbon estimates with higher precision and accuracy than can be achieved using remote sensing data alone. The carbon assessments generated are reported in the platform, which can then be delivered as fully traceable carbon removals to brands.

A core part of Taking Root's platform is its approach to making field forest carbon inventories simple for project developers. Working with local project partners, the platform's users are often field staff who have limited forestry expertise. Taking Root's goal is to remove the complexity of inventorying so when equipped with their platform, these staff can be as effective at field data collection as any trained forestry expert. Taking Root removes the complexity by:

> **Generating Automatic Sampling Plots:** Once a land area is mapped using Taking Root's mobile application, sampling plots are automatically generated across the mapped area. The quantity and size of the sampling plots generated will reflect the needs and design of the program to maximize precision while minimizing the area and thus resources needed for monitoring.
>
> **Facilitating Field Inventory:** Guided by a built-in map in the mobile application, field staff visit each monitoring plot in turn. They take a picture of each monitoring plot and then measure every tree, identify its species, and calculate its diameter at breast height (DBH).
>
> **Quantifying trees and carbon:** With the field inventory data, the platform automatically calculates the total trees and carbon stored within the mapped area. The stored carbon is calculated by applying the tree data to species growth models from an in-house tropical forest allometry database. These individual tree calculations are then extrapolated to the mapped area. For all the data entered, Taking Root performs multiple data validations and quality checks to ensure the precision of the data. For example, the data collected within a monitoring plot is geo-tagged to ensure information gathered is within the monitoring plot.

The result of these features is a simple and cost-effective solution to facilitate field inventories across projects.

The frequency of performing field inventories varies from project to project based on their objectives. Typically, projects will monitor land:

1. before any intervention to create a carbon baseline;
2. within 12 months of any interventions to ensure the initial tree-planting targets have been met, and;
3. periodically to assess progress against growth targets, facilitate farmer payments, and track the carbon being stored over time.

Between field inventories, the platform will use remote sensing data to provide supplementary carbon estimations in addition to running a monthly anomaly detection engine to report on any significant forest disturbances such as deforestation or tree die-offs.

To date, the platform has been successfully adopted in nine countries around the world. In addition, Taking Root's CommuniTree program alone enables the creation of over 650,000 Plan Vivo certified-carbon credits annually.

Moving forward, the organization plans to expand the use of its software by aligning it with carbon market standards to ensure it can create forest carbon removals for farmers, regardless of the type of certification required. As a first step, Taking Root has been working with the Plan Vivo standard to become an "Approved Approach" so any project could adopt the platform to automatically generate Plan Vivo-certified carbon credits. Over the next few years, the hope is that Taking Root's solution will accelerate forest restoration, increase trust and investment in forest restoration projects, and create improved livelihoods for farmers across the tropics.

The Natural Capital Exchange (NCX)

NCX is a data-driven market for forest carbon credits increasing MRV efficiency through methodological innovations and the application of remote sensing data to carbon offsets.

The Natural Capital Exchange (NCX) is a U.S.-based startup headquartered in San Francisco working to increase forest owner access to carbon markets by digitizing and dramatically simplifying the project feasibility and landowner enrollment process. NCX develops aggregated Improved Forest Management (IFM) carbon projects via annual harvest deferrals operating on a quarterly cycle. In 2021, they enrolled over three million acres of land owned by more than 2,000 landowners in the United States, and are now operating in all 48 continental states.

The NCX platform has zero fees, no minimum acreage requirements, and annual contract terms. This means landowners of all sizes can use the NCX platform to quickly assess the potential financial returns of selling carbon credits at no cost to the forest owner. NCX's approach has also eliminated the need for long-term contracts for forests enrolled in the carbon market, opting instead for a one-year harvest deferral commitment for landowners enrolled in their program.

This unique approach gives landowners the option to get paid to defer harvests when they otherwise would not have the opportunity to enroll in carbon markets. As a result, NCX's annual harvest deferral method has the potential to drastically increase participation and accelerate the climate benefit of forests, and thus quickly scale the potential climate impact of IFM projects.

NCX's annual harvest deferral method uses "ton-year accounting" to quantify the climate benefit of delaying harvest-based emissions by one year at a time. Traditional carbon projects say that to offset one ton of CO2 emitted today, a commensurate one ton of CO2 needs to be sequestered and held for the duration of the impact of the initial emission—usually between 40 and 100 years.

Ton-year accounting uses science and economics based on the IPCC to draw an equivalence between the value of this "low-magnitude, long duration" approach and the value of storing a much larger volume of carbon for a shorter period of time.

Projects that use ton-year accounting generate credits and achieve permanence by effectively increasing the storage of carbon year over year across landowners enrolled in the aggregated project, rather than committing one project at a time to hold smaller volumes of carbon decades into the future. This creates an opportunity to accelerate climate mitigation by delivering high-magnitude climate impact bundled into just one year. Another advantage of a ton-year accounting approach is the climate benefit is paid to the landowner on delivery, at the end of the one-year project period, rather than up front. This minimizes the risk of intended or unintended "reversals" like fire, disease, or other removals that often occur in long-term forest carbon projects and that threaten to erode the project's overall climate impact. Since the climate benefit is defined as the one-year delay itself, annualized projects do not need to implement traditional measures like long-term monitoring and carbon buffer pools, which otherwise are needed to safeguard against potential future forest loss.

NCX's streamlined project feasibility, enrollment, and aggregation process is made possible by their underlying algorithm and dataset of forest carbon storage and sequestration across the United States. Called "Basemap," this dataset is the first-ever high-resolution inventory of the entire country, covering every acre and accounting for almost 92 billion trees. Basemap provides acre-by-acre information on the species and biomass of forests across the continental United States, eliminating the need to collect measurements before setting up each individual carbon project and streamlining data collection for enrolled properties. NCX updates this dataset annually and uses it to predict carbon sequestration on an acre-by-acre basis.

The Basemap dataset is built from multiple data sources including field measurements and FIA data, as well as LiDAR, photogrammetry, and satellite imagery. It uses machine learning to generate a cohesive dataset of carbon at a 30 meter x 30 meter scale (approximately 1/4 of an acre) for the entire continental United States.

NCX is working to develop a new methodology for IFM projects under Verra's Verified Carbon Standard (VCS) Program. In order to make a robust forest carbon model that can also be applied by other market actors, NCX is incorporating measurements from publicly available data sources including FIA data and information from the National Woodland Owner Survey. Verra has stated that it is excited about the potential of remote sensing to improve measurements for baseline setting and project monitoring, to reduce monitoring costs, and to unlock a much larger supply of forest-based carbon credits.

NCX's targeted short-term IFM strategy not only offers equivalence to "permanent tons" of impact, but also does so with greater flexibility to increase landowner participation and provide greater assurance against reversals. If approved by Verra, the methodology will be groundbreaking as the first to employ a ton-year accounting approach for IFM projects and one of the first to explicitly integrate remote sensing data and machine learning methods into carbon quantification and MRV.

Photo: Canva

Glossary of Terms

Additionality. A forest carbon project is “additional” if the activities for which it is receiving credits (conservation, reforestation, or improved management) would not have occurred in the absence of a market for carbon credits and exceeds a “business as usual” scenario for carbon storage on a given project area.

Buffer Pool. A buffer pool is a method of insurance for forest carbon projects against unforeseen reversals or losses in carbon (e.g., due to fire, disease, or illegal harvesting). In a buffer pool system, a registry will withhold a portion (typically 5-20%) of credits that would be issued to each project and place them in a shared “pool.” These credits cannot be traded or retired, and are used to cover any potential future losses for forest carbon projects to which that registry has issued credits.

Credit Issuance. Credits are issued by a registry to a project developer once a project has submitted all necessary documentation and gone through third-party verification. Once issued, these credits can be transferred to brokers and end-buyers to be used.

Credit Retirement. When a credit has been “used” (e.g., purchased for environmental benefit with no intent to resell), it is “retired.” Credit retirements are tracked and reported by registries.

Improved Forest Management. The most common type of forest carbon project in the United States, whereby credits are generated through reducing the intensity or frequency of forest harvests. These changes sequester additional carbon.

Inventorying. The process of quantifying the stored carbon, species, and forested area of project sites prior to registering a forest carbon project

Leakage. Leakage refers to when a forest carbon project displaces rather than prevents forest harvest or loss. For example, if conserving a forest results in the adjacent forest being harvested, then the project would have a high degree of leakage. Carbon credit methodologies include adjustments that seek to account for leakage.

Registry. A carbon credit registry administers the registration and verification of carbon projects. Registries develop methodologies for specific types of carbon projects and issue credits to projects that meet the criteria set forth in the methodology and go through a third-party verification process.

Permanence. Permanence means ensuring the climate impact of a forest carbon project fully makes up for the long-term damages associated with emissions of CO_2 into the atmosphere. Traditionally, permanence criteria take the form of time requirements—commitments that stored carbon will not be re-released for a certain amount of time (usually for several decades or a century). As a result, one “permanent ton” is often defined as the impact of holding one ton of carbon for 100 years. New approaches have proposed creating equivalent climate impact in a way that reflects the time value of

carbon storage by storing a larger quantity of carbon for a shorter duration, rather than one ton for many decades. This approach creates a permanent impact, while also prioritizing sequestration that occurs immediately rather than decades into the future.

Project Design Document (PDD). The Project Design Document is a written document submitted by a project developer to a registry as part of the process to register a new carbon project. These documents include the project concepts, the existing site inventory and baseline, and a monitoring methodology, as well as other details as required by the registry's methodology.

Site Sampling. Forest carbon project site sampling involves a team of foresters visiting a large number of small sites across a project area to measure tree diameter, height, and species to quantify carbon storage and estimate sequestration.

Third-party Verifier. An independent auditor who verifies the accuracy and integrity of forest carbon projects, typically prior to issuance of carbon credits.

Photo: Austin Rempel / American Forests

Learn more about 1t.org US and the Carbon Finance Working Group at us.1t.org.