

Forest Losses and Gains:

National Removals Systems in Practice: Costa Rica.

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Definition of removals in Costa Rica

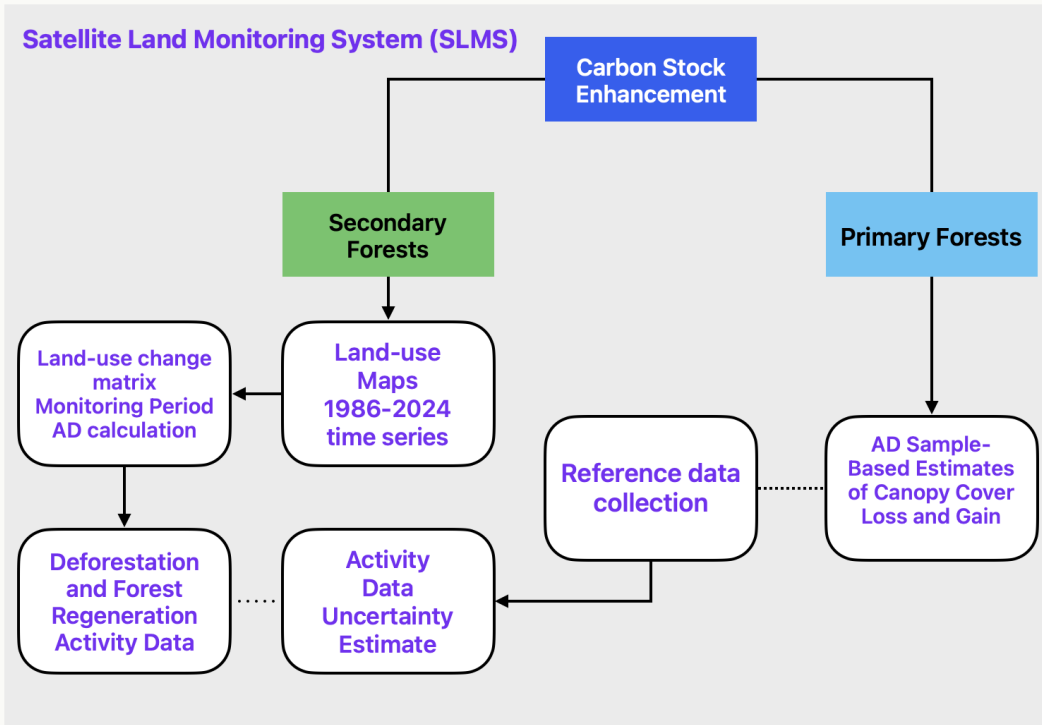
Definition of removals (carbon stock enhancement):

Carbon stock enhancement occurs in secondary forests and in primary forests that remain intact.

- In secondary forests, this carbon stock enhancement is due to stand growth.
- In primary forests that remain as primary forests, enhancement happens when an increase in canopy cover is detected following prior human intervention that caused canopy loss. Carbon flux in forest land that remains forested includes emissions and removals from canopy loss and subsequent recovery, covering all types of human activities, such as selective logging under sustainable primary forest management (SFM).
 - **Definition of Secondary Forests:** Non-forest lands that have been converted to forest are classified as "secondary forests." These forests accumulate carbon until it stabilizes in age classes of 400 years or older. It is important to note that tree plantations are part of the sub-category "secondary forests", which are included in the Forest land category.
 - **Definition of Primary Forests:** Primary forests are areas that have stayed forested without being converted to other land uses since the start of the National Forest Monitoring System in 1986. Throughout this period, they have maintained a canopy cover of over 30% and have never been converted to non-forest land.

Your response: Max of 2 Slides: 3 minutes

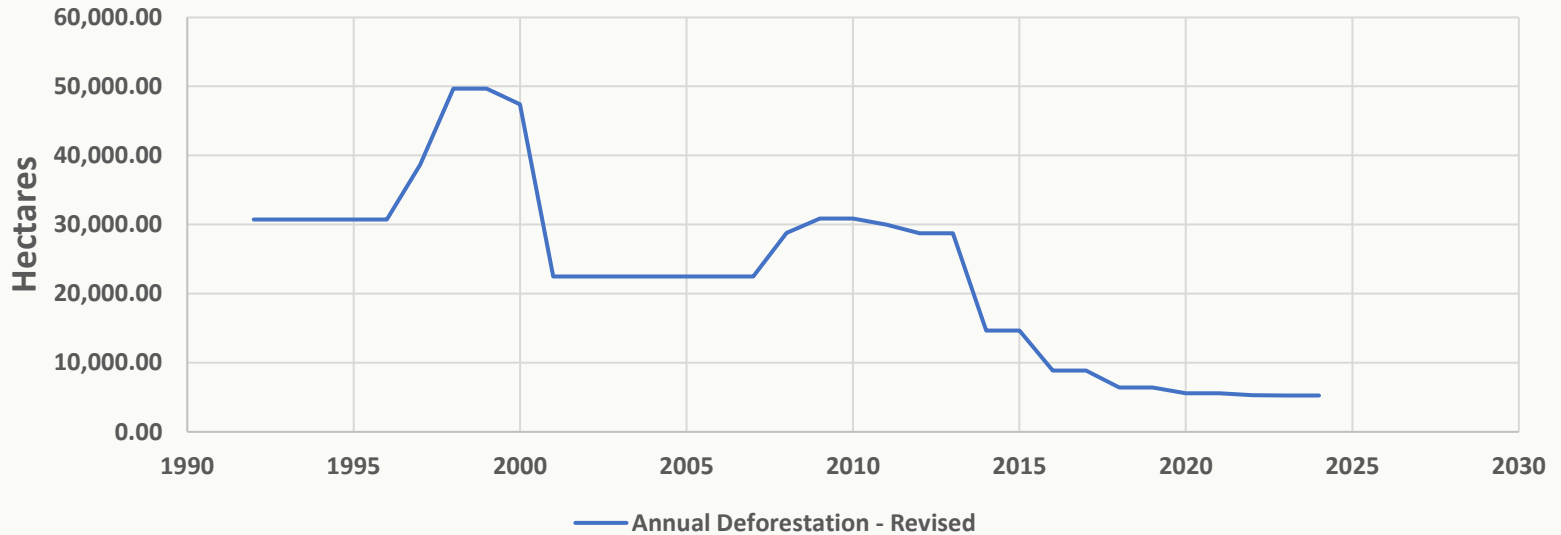
Approach, tools, and datasets used for mapping forest removals in Costa Rica



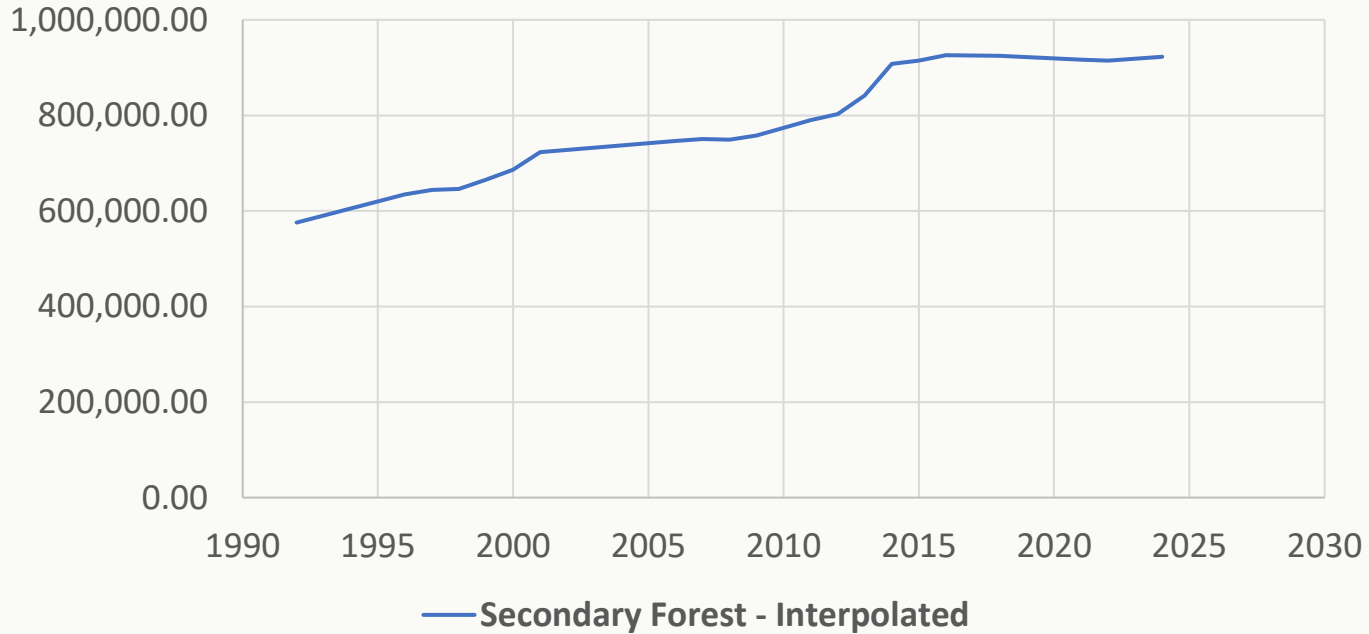
- The activity data for the Costa Rica Emission Reduction Program (ER-P) are derived from land-use cover maps generated through supervised classification of LANDSAT satellite imagery, employing remote sensing techniques such as Random Forests.
- Deforestation and reforestation pixel counts are derived from a land-use conversion matrix comparing maps from 1986 to 2024 that track land-use changes over time.
- Maps created through supervised classification with Random Forests are validated according to Olofsson et al.'s (2014) best practices for assessing changes in remote sensing accuracy.

Deforestation

Annual Deforestation



Regeneration



DISCUSSION QUESTION

Verification that the non-forest condition has persisted for five years prior to planting or restoration.

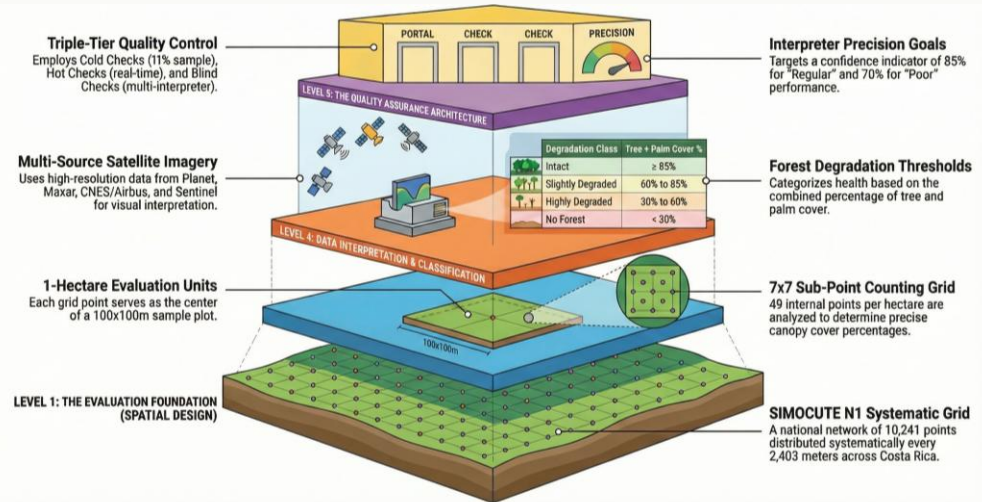
VALUE	DEFORESTACION COHORTS	REGENERACION COHORTS (Ha)							TOTAL ha
		1	2	3	4	5	6	7	
		2001-2007	2008-2011	2012-2013	2014-2015	2016-2017	2018-2019	2020-2021	
0	Before 1986	41,118	32,910	51,074	15,358	4,010	1,559	1,676	
1	1986 -1991	14,901	11,621	14,161	2,286	638	259	466	
2	1992 - 1997	17,701	10,198	10,594	1,514	567	192	1,023	
3	1998 - 2000	12,838	25,832	11,521	1,570	649	256	761	
4	2001 - 2007	0	18,455	25,972	2,138	600	1,084	837	
5	2008 - 2011	22,975	0	18,704	2,225	458	107	591	
6	2012 - 2013	14,611	15,921	0	2,378	628	124	519	
7	2014 - 2015	2,562	3,778	8,053	0	60	11	14	
8	2016 - 2017	1,429	1,419	741	4,368	0	322	6	
9	2018 - 2019	1,321	1,929	3,225	308	78	0	14	
10	2020 - 2021	1,555	2,239	2,170	879	0	259	0	
	Regeneration area deforested during crediting period	44,452	25,287	14,190	5,556	78	259	0	89,821
	Regeneration area present in the crediting period	86,557	99,017	132,027	27,469	7,608	3,915	5,907	362,501
	Total area of the regeneration cohort	131,009	124,303	146,217	33,025	7,686	4,174	5,907	452,322

DISCUSSION QUESTION

Estimate of carbon stock enhancement derived from permanent forest lands.

The methodology uses a Systematic Grid and high-resolution satellite imagery, interpreted using Open Foris Collect Earth. It aims to assess canopy cover changes in permanent forests and validate the land cover map with over 10,000 sampling units. Canopy cover loss/gain is measured specifically within 4,377 points identified as permanent forests.

- **Counting Points:** Within each one-hectare parcel, a 7x7 grid of 49 internal points is used to count specific cover types, including trees, shrubs, palms, and bromeliads
- **Canopy Cover Categories:** The level of degradation is determined by the percentage of "trees and palms" counted within the 49 points
 - Intact: 85% or higher canopy cover
 - Lightly Degraded: Between 60% and 85% cover
 - Very Degraded: Between 30% and 60% cover
 - Non-Forest: Less than 30% cover
- **Anthropogenic vs. Natural:** The system further classifies degradation as anthropogenic or natural based on the parcel's distance from roads (more or less than 500m) and whether it is located within a protected area.



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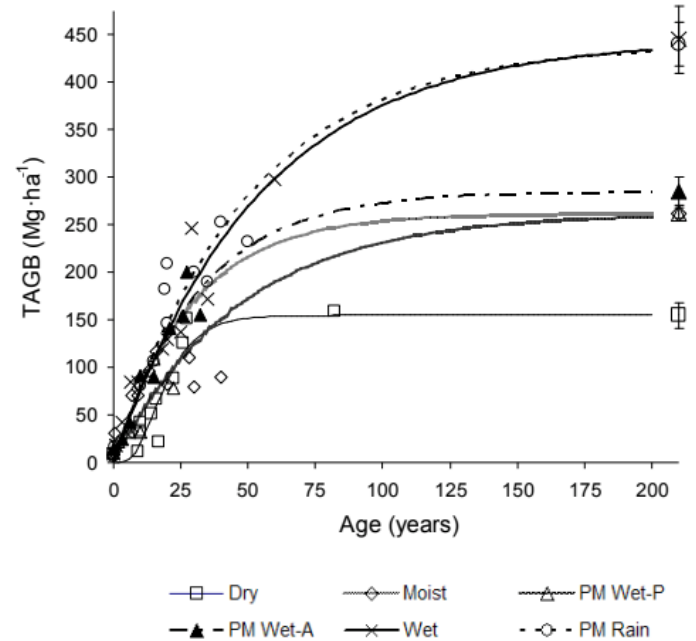
Frameworks utilized in Costa Rica for estimating removals in secondary forests

Feature	FCPF Methodological Framework (v2.0)	ART TREES Standard (v2.1 / 2025 Guidance)
Land History & Eligibility for Removals	Focuses on "Enhancement" within existing regenerated forests.	<p>Forest Transition: Removals are only eligible in areas moving from non-forest to forest; growth in intact or degraded forests is excluded.</p> <p>5-year rule: Areas must have been non-forest for 5 years prior to activity.</p> <p>Historical forest rule: Must prove the land was forest before it was non-forest (prevents ecosystem conversion).</p> <p>Natural restoration: new areas and growth from areas started up to 10 years prior are eligible.</p>
Baseline / Crediting Level for Removals	Historical Average: Based on the average annual removals during a 10-year Reference Period.	Performance Benchmark: For natural restoration, the baseline is zero . For commercial/planted forests, it is based on a historical 5-year planting average.
Accounting Method	Netting Approach: Removals are typically netted against emissions within the same jurisdictional boundary.	Segregated Approach: Removals are accounted for in a distinct "Removals Module" separate from REDD+ emission reductions.
Activity Data Primary Data Source	Remote sensing combined with sample-based area estimation (IPCC Good Practice).	High-resolution remote sensing or georeferenced polygons/vector files.
Monitoring	<p>Regeneration and Deforestation monitoring is required</p> <p>Annual area-based data: it is not required</p> <p>Stratification: Required by forest type, climate zone, or management practice.</p>	<p>Annual Area-based: Must use an "Initial Removals" stratum (new areas) and an "Ongoing Removals" stratum (growth in existing areas).</p> <p>Deforestation monitoring: Losses must be reported as emissions in the year they occur.</p> <p>Commercial vs. Natural Distinction: Participants must categorize areas into Natural Forest Restoration and Commercial Forest.</p>
Removal Factors	Derived from IPCC guidelines or local data; consistency required with the Reference Level.	Removal Factor Stability: ART now explicitly requires the re-evaluation of removal factors (the rate at which trees grow/sequester carbon) every 5 years to account for changing climatic conditions or aging stands.

Estimate of removals based on secondary forests

Elements for the quantification of removals

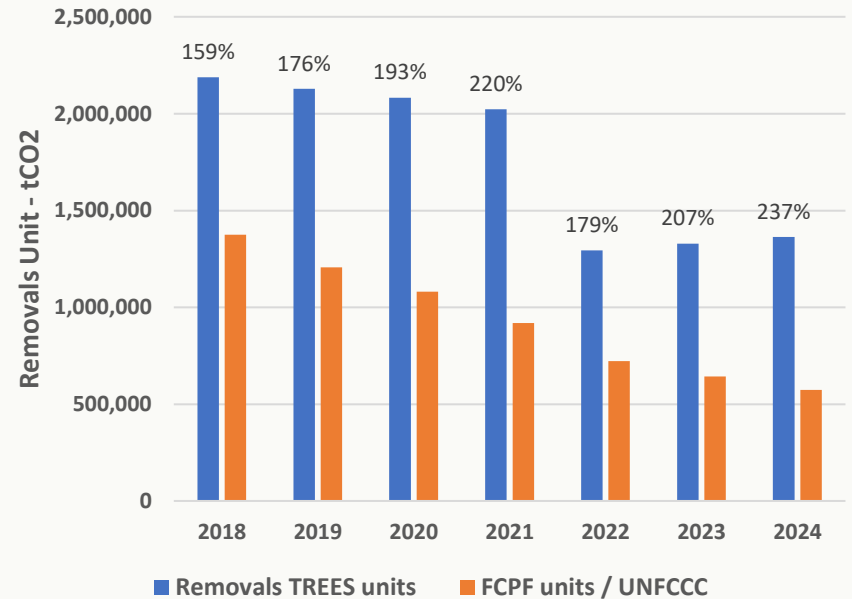
- Stratification of forest land cohorts, monitoring of ongoing forest restoration (considering deforested areas), and determination of forest age.
- Forest restoration areas are derived from the map algebra of historical land-use maps created between 1985 and 2024.
- Biomass growth models for each forest type.



Estimate of removals based on secondary forests

Recovery of forest cover in Costa Rica

- Forest policies: Most forest restoration has been based on natural regeneration of abandoned grasslands.
- Contribution of forest removals to the generation of carbon credits:
 - FCPF units / UNCCC: From 2018 to 2024, 14% of the ERs are derived from carbon stock enhancement (**6,523,223 tCO₂**) – **Crediting Level Approach**.
 - TREES units: From 2017 to 2024, 53% of the ERs are derived from carbon stock enhancement (**14,661,054 tCO₂**) – **Zero baseline, with the naturally regenerated area established 10 years prior to the start of the crediting period**.



Estimate of removals based on secondary forests: Technical Limitations

Technical limitations	Standard requirements
<p><i>Availability of cloud-free imagery:</i> Limited cloud-free imagery hindered annual land-use change evaluations and the mapping of annual regeneration in Costa Rica.</p>	<p>Section 5.3 of TREES V2. Removals from converting non-forest to forest are eligible under TREES if the land was non-forest for five years before planting or restoration. These areas must be labeled and maintained in the “ongoing removals stratum” for monitoring and reporting.</p>
<p><i>Differentiating natural regeneration from commercial plantations via remote sensing mapping:</i> Technical limitations prevent accurate stratification between commercial and natural forests in Costa Rica’s LULUC maps, impacting ART/TREES crediting level calculations</p>	<p>Requirement 5.3. Calculating a TREES crediting level for removals: "Stratification of areas between ' types' of conversion to forest is advised, and at a minimum, stratification between commercial forest and natural forest restoration is recommended.</p> <ul style="list-style-type: none"> • Commercial forest is defined as any homogeneous tree planting or forest regeneration with the purpose of timber, fiber, fruit or tree sap harvest for a commercial local, national or international market. • Natural forest restoration is defined as tree planting or natural regeneration of native species • with the intention of restoring natural forest cover, without a commercial purpose".

Your response: Max of 2 Slides: 3 minutes

DISCUSSION QUESTION

Costa Rica needs assistance to evaluate the following options.

Requirement	Options Evaluation
Annual Regeneration and Deforestation Yearly "Initial Strata" polygons and updated ORS maps with incremental growth and emission from deforestation reporting.	Time-series break-point detection (e.g., LandTrendr) for continuous annual monitoring of spectral recovery
	Sample-based estimation of the yearly distribution of the Ongoing Removal Stratum (ORS) from high-resolution imagery interpretation.
Plantation vs. Natural Stratified map for separate credit calculations	Multimodal Remote Sensing analysis <ul style="list-style-type: none">• SWIR ratios: species/biomass identification• SAR texture: planting rows pattern identification• Lidar height metrics: vertical layering/uniformity identification
	Sample-based estimation of the proportions of natural versus plantation areas from high-resolution imagery interpretation.
Eligible removals areas: Forest transition 5-Year Pre-history Historical Forest Rule Natural reg 10-year prior Crediting period	Landsat/Sentinel archival imagery analysis