REDD+ Matavén Project addresses misconceptions in media articles

In light of the publication of *"Two Shades of Green: How hot air forest credits are being used to avoid carbon taxes in Colombia"* (2021) by Carbon Market Watch (CMW), triggering a chain reaction of media coverage, including *"Offsets being used in Colombia to dodge carbon taxes – report*" (2021) by The Guardian and *"El mayor proyecto de bonos de carbono de Colombia podría estar vendiendo aire caliente"*(2021) by Mongabay; the technical team of the REDD+ Matavén Project aims to address inaccuracies and provide a comprehensive presentation of the Project baseline fundamentals, ensuring technical-scientific rigor to counter disinformation.

The CMW publication and related media coverage, are grounded in misleading premises and have spurred a negative media frenzy surrounding the REDD+ Matavén Project. Key issues raised include questions about the Project's Baseline validity, the selection of the Reference Region, and comparisons between data and deforestation rates. These concerns stem from speculative assumptions, as Gilles Dufrasne (CMW) employs language that does not commit to the certainty of what it is said; resulting in media reports that have perpetuated these uncertainties.

The document presented below is intended to provide a detailed clarification, employing a methodical and thorough approach. We extend an invitation to journalists, readers, researchers, academics, indigenous communities, and the general public to review the document provided below, as well as the comprehensive and verified documentation of the Project, which is publicly accessible on Verra's website:
https://registry.verra.org/app/projectDetail/VCS/1566

Our aim is to encourage a technical-scientific and social dialogue that promotes constructive discussion based on factual evidence, thereby avoiding inaccuracies and misconceptions propagated in the CMW publication (2021) and subsequent media articles.

We appreciate the opportunity to address these matters and reaffirm our unwavering dedication to advancing effective and sustainable solutions to the world's most pressing environmental challenges.

For further information please contact contacto@reddmataven.com

About the REDD+ Matavén Project: *This initiative is dedicated to stopping deforestation and preserving the tropical forests within the Resguardo Indígena Unificado de la Selva de Matavén in Colombia, while safeguarding its biodiversity and improving their indigenous people quality of life. The REDD+ Matavén Project has received international certification and validation from Verra, meeting the criteria of two worldwide standards: the Verified Carbon Standard (VCS) and the Climate, Community & Biodiversity Standards (CCB). To date, the Project has successfully undergone three verifications in accordance with the VCS and one verification under the CCB standards.*

REDD+

Matavén

REDD+ Matavén

Comprehensive presentation

of the REDD+ Matavén Project Baseline Fundamentals

Ensuring technical-scientific rigor to counter disinformation

selvamatavénredd.org

ACATISEMA

Mediamos

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Glossary

ACATISEMA:	Association of Cabildos and Traditional Indigenous Authorities of the Selva Matavén (Spanish acronym).
CCB:	Climate, Community & Biodiversity Standard by Verra.
CLIP:	Latin American Center for Investigative Journalism (Spanish acronym).
CMW:	Carbon Market Watch.
DNP:	National Planning Department of Colombia (Spanish acronym).
FCC:	Forest Cover Changes.
FREL:	Forest Reference Emission Level.
GHG:	Greenhouse Gases.
HAA:	Heterogeneous Agricultural Areas, locally known as conucos.
HRP:	Historical Reference Period.
ICONTEC:	Colombian Institute of Technical Standards and Certification (Spanish acronym).
IDEAM:	Institute of Hydrology, Meteorology, and Environmental Studies of Colombia (Spanish acronym).
LB:	Leakage Belt.
MADS:	Ministry of Environment and Sustainable Development of Colombia (Spanish acronym).
PA:	Project Area.
PMSTB:	Sustainable Land and Forest Management Plan (Spanish acronym).
REDD+:	Reducing Emissions from Deforestation and forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks.
RENARE:	National Registry for Greenhouse Gas Emissions Reduction of Colombia (Spanish acronym).
RIU-SM:	Resguardo Indígena Unificado Selva Matavén (Spanish acronym).
RRD:	Reference Region for projecting rate of Deforestation.
RRL:	Reference Region for projection of Location of deforestation.
SMByC:	Forest and Carbon Monitoring System.
SUPAF:	Family Agricultural Food Production Units System (Spanish acronym).
UNFCCC:	United Nations Framework Convention on Climate Change.
VERRA:	Certification entity managing the VCS Program and a set of other programs.
VCS:	Verified Carbon Standard.
VVB:	Validation/Verification Body.
VCU:	Verified Carbon Unit.

1. Introduction

The fight for forest protection and climate change mitigation has garnered significant attention in recent years, yet it has also become a focal point for debates and controversies. A pivotal moment arose in June 2021 with the publication of an article by Carbon Market Watch titled “Two Shades of Green: HOW HOT AIR FOREST CREDITS ARE BEING USED TO AVOID CARBON TAXES IN COLOMBIA” triggering a chain reaction. Similarly, Bermúdez (2021) presented an article on the CLIP portal titled “Colombia’s Largest Carbon Bond Project May Be Selling Hot Air,” subsequently echoed in media outlets such as La Silla Vacía and Mongabay. These analyses, though addressing a crucial national issue, are grounded in a false premise and have spurred a media frenzy surrounding the REDD+ Matavén Project.

These publications could be interpreted as a systematic attack on the indigenous communities of the Resguardo Indígena Unificado Selva Matavén (Vichada, Colombia), who are developers of the REDD+ Matavén Project. In this context, this document endeavors to counter these baseless attacks from a technical-scientific perspective. The arguments presented in the articles predominantly center around concerns about the project’s baseline validity, the selection of the Reference Region, and the comparison between data and deforestation rates.

It is essential to highlight that the assertions in the articles rest on assumptions, as Gilles Dufrasne (CMW) employs language that does not commit to the certainty of what is said. Additionally, Andrés Bermúdez (CLIP) echoes the same assertions from CMW regarding distinct deforestation rates for the FREL and the REDD+ Matavén Project.

In response to these concerns, this document aims to provide a comprehensive clarification of each aspect through a rigorous approach. It delves into the meticulous process of creating the baseline, rooted in the transition zone between the Orinoquía and the Colombian Amazon, demonstrating the utilization of 13 similarity criteria in accordance with the VCS standard, the VCS VM0007 methodology, and the VCS VMD0007 module of VERRA. Furthermore, it dispels the misconception that the area is immune to deforestation simply because it is an indigenous Resguardo, undertaking a thorough analysis of its location, significance as a transit route, and its contextual value along the Colombian-Venezuelan border.

In this context, the document not only refute the arguments presented in the articles but also extends an invitation to all concerned parties, including researchers, indigenous communities, academics, journalists and public opinion, to engage in a technical-scientific and social dialogue. This inclusive invitation is offered to foster a constructive discussion grounded in concrete facts, steering clear of the erroneous premises and fallacies presented in the CMW (2021) and Bermúdez (2021) articles.

2. How we built the baseline for the REDD+ Matavén Project

A baseline is associated to the historical deforestation rate in a specific area before the implementation of a project. This baseline acts as a benchmark or reference point for evaluating the impact of a REDD+ project on the reduction of Greenhouse Gas (GHG) emissions caused by unplanned deforestation.

The baseline is established based on two key concepts: the Reference Region and the GHG emissions associated with avoided deforestation.

The Reference Region is a geographic area where the historical deforestation rate is assessed. Criteria for establishing the Reference Region include factors like geographical similarity, accessibility to the Project Area, and the presence of socio-economic factors influencing the risk of unplanned deforestation. Once the Reference Region is defined, GHG emissions associated with deforestation in that area are measured, forming the basis for evaluating the project's effectiveness in emission reduction.

Next, we will illustrate the methodology employed to establish the baseline for the REDD+ Matavén Project, utilizing two distinct approaches: the transition zone and the concept of similarity. Additionally, we will furnish procedural details outlining the process of defining the geographical boundary for the Reference Region.

2.1. Transition zone

The Selva Matavén is located in a transition zone between the Orinoco and the Amazon regions.

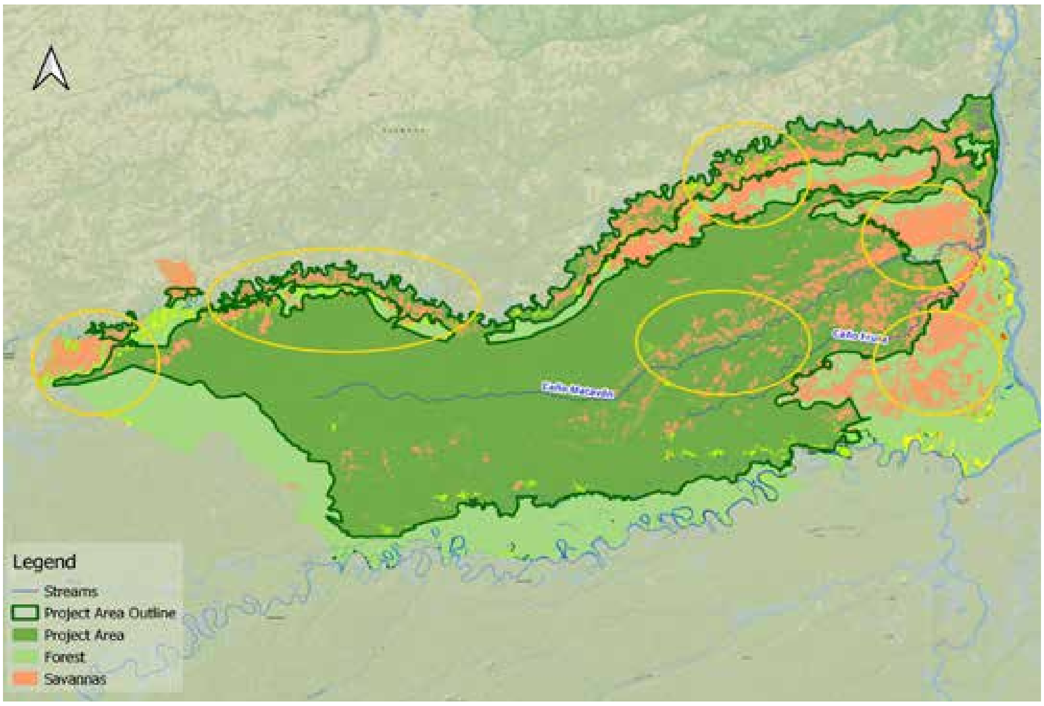
First, the Selva Matavén spans the entire border between the Colombian regions of Orinoco and Amazon, thereby incorporating distinctive characteristics from both regions (Uriel Gonzalo Murcia García et al., 2007). Furthermore, the area's forests are intricately entwined with savannas, rendering it a quintessential transition zone (refer to Map 1).

The Reference Region for projecting rate of Deforestation (RRD) delineates a territorial expanse where historical deforestation quantification and trends are analyzed within the reference scenario. The objective is to project future deforestation and construct the baseline for the REDD+ Matavén Project Area.

The establishment of the Reference Region was based on a specific transition zone between the Orinoco and the Amazon regions.

In Colombia, two primary transition zones towards the Amazon are recognized: one between the Orinoco and Amazon regions and another between the Andes and Amazon regions. The REDD+ Matavén Project focused on defining its Reference Region within the transition zone between the Orinoco and the Amazon regions, characterized by the amalgamation of savanna and Amazon forest features (Villarreal-Leal H et al., 2009). It is noteworthy that within this area, a notable interplay of savanna and forest landscapes exists, as seen in Figure 1.

Map 1 Savannas and REDD + Matavén Project Area



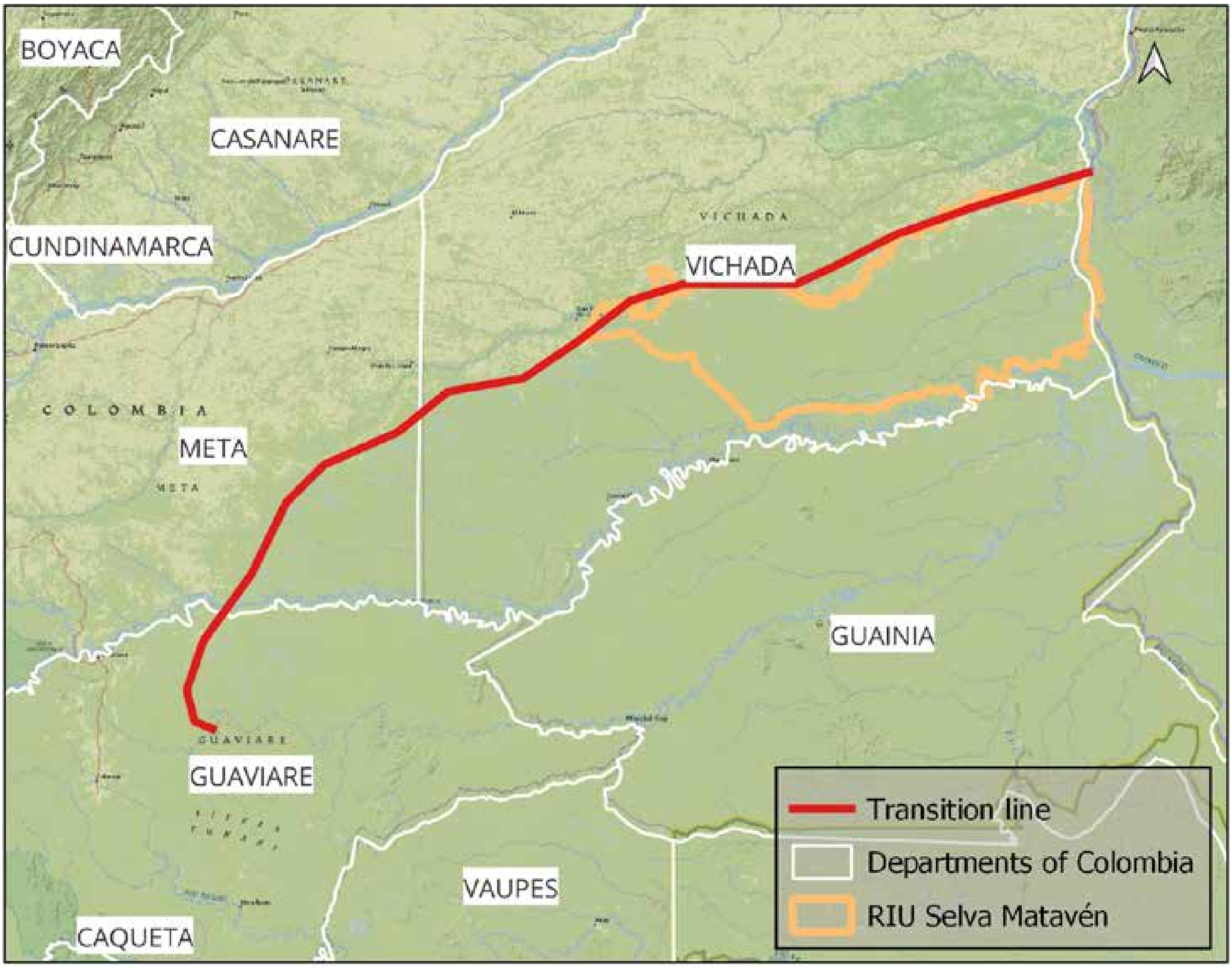
As depicted on the map, the forest encompassing the Project Area is entirely encircled by savannas, highlighted by the yellow ovals. At the core of the Selva Matavén, the Caño Matavén and Caño Fruta streams traverse through areas surrounded by a combination of both forest and savannas. In summary, savannas are present across the northern, eastern, and central sections of the Project Area.

Figure 1 Transition zone between plains and forests

The transition zone between the Colombian regions of Orinoco and Amazon is distinguished by landscapes exhibiting an intricate intermingling of savannas or grasslands with forests, as depicted in this photograph. In contrast to conventional plains where forests constitute a minor proportion and are predominantly located around watercourses, these areas are characterized by the prevalence of savannas as the predominant landscape feature.

The demarcation of the Reference Region was delineated along the red demarcation line illustrated in Map 2, designating the boundary where savannas transition into Amazonian forests. This delineation is of paramount importance for ensuring comparability between the Project Area (Map 1) and a Reference Region with similar characteristics.

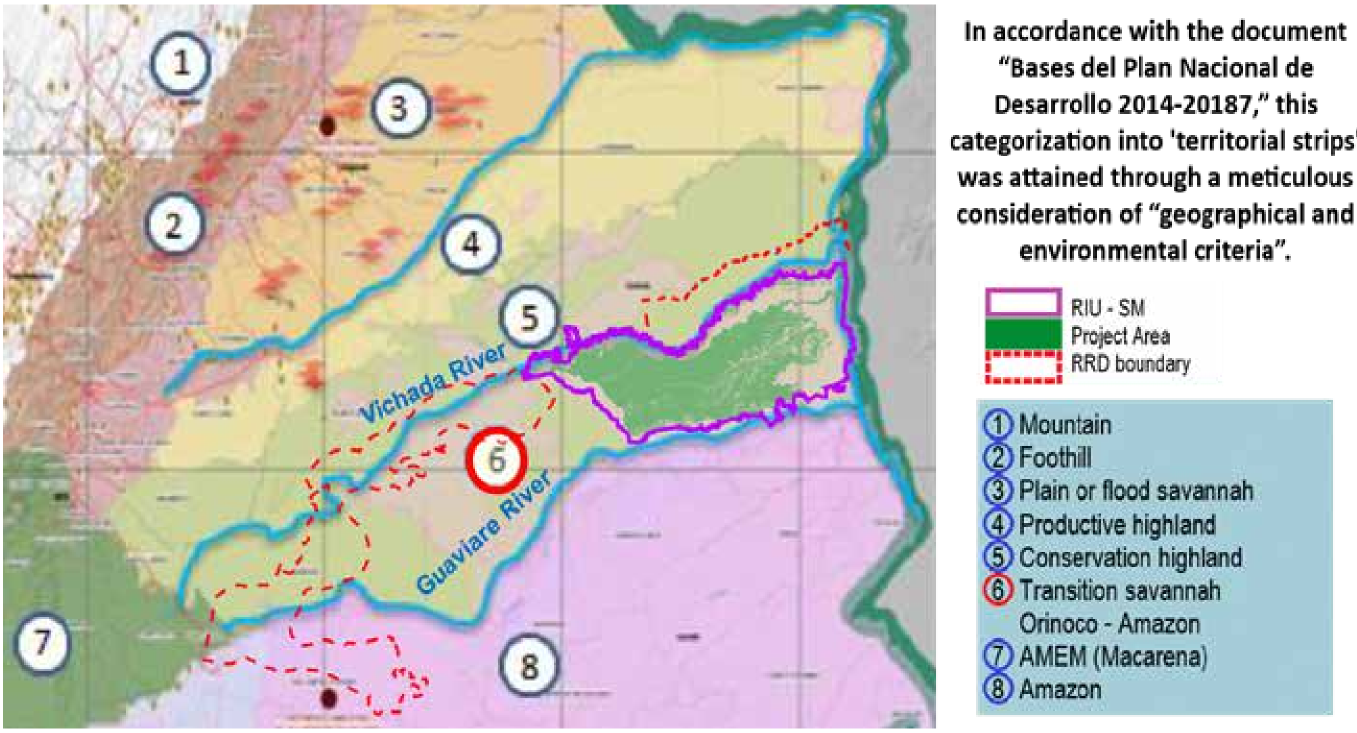
Map 2 Transition line between the Orinoquia and the Colombian Amazon



The map showcases a distinctive red demarcation line, approximately signifying the demarcation between the Eastern Plains and the Colombian Amazon region. This geographical boundary assumes paramount significance in the design of the Reference Region, serving as the delineation of the transitional interface between these two distinct ecosystems. It is imperative to underscore that the design adheres to the 13 similarity requirements stipulated by the VERRA methodology. Additionally, this transition is prominently observable within three specific states in Colombia - Vichada, Meta, and Guaviare - these states assume a pivotal role in both defining and delimiting the Reference Region due to their direct witness to the interface between the Eastern Plains and the Amazon.

Within the transition zone between the Orinoco savannas and Amazonian forests, a distinctive amalgamation of both landscapes gives rise to a singular and ecologically vulnerable ecosystem in Colombia recognized as the ‘Orinoco-Amazon Transition Savanna’ (depicted in strip 6 on Map 3) (DNP, 2015). This particular ecosystem is exclusive to the northern region of the Colombian Amazon—an aspect that, notably, has not been addressed by the authors of the referenced articles.

Map 3. Location of the Matavén Resguardo, the REDD+ Matavén Project Area, and its Reference Region (RRD) within the 'Orinoco-Amazon Transition Savanna' (strip 6)



Source: Derived from the document 'Bases del Plan Nacional de Desarrollo 2014-2018 [Figure E.1. Homogeneous Areas of the Plains]' (DNP, 2015).

It is noteworthy that the Qualitative Assessment section of the CMW article (2021) and Bermúdez's article (2021) both fail to consider this pivotal aspect, thereby leaving a void of true technical-scientific analysis.

Furthermore, the construction of the polygon corresponding to the Reference Region involved more than the mere demarcation of a line around the identified transition zone. It necessitated a meticulous consideration and adherence to 13 similarity requirements stipulated by module VCS VMD0007 of VERRA[1], which will be examined in detail in the following section.

2.2 Concept of similarity level

Similarity pertains to the systematic comparison and quantification of likeness between two or more objects, phenomena, or entities with respect to their inherent characteristics, attributes, or properties. This foundational concept extends across diverse disciplines, including biology, psychology, computer science, statistics, and geography, among others. Fundamentally, similarity allows the establishment of patterns, classification, and the grouping of objects or entities based on the degree of their resemblance.

[1] The project validated its baseline using the version of the standard and methodology available at the time (VCS Standard version 3 2015 and VCS VM0007 version 1.5 2015). However, it's important to note that during subsequent verification events, the most up-to-date versions of both norms are being applicated.

For instance, statistical similarity constitutes a conceptual framework employed to articulate the extent to which two datasets are similar. Statistical similarity is commonly used in data mining

and pattern analysis to find similarities between sets, such as identifying behavior patterns in consumer groups or in patients with certain diseases.

Regarding geographical similarity, it denotes the correspondence between two or more geographic areas concerning their biotic and abiotic composition (biomes), topography, climate, and other biophysical factors. Within the realms of ecology and conservation, geographical similarity serves the purpose of identifying regions that are similar to each other, thereby potentially sharing ecological patterns and/or environmental processes. This identification aids in decision-making processes related to ecosystem conservation and restoration initiatives. Various techniques of geographic data analysis are employed to measure geographical similarity, encompassing approaches such as comparing area proportions in specific variables. In the specific context of a REDD+ project, geographical similarity assumes a pivotal role in contributing to the determination of the Reference Region and extracting the deforestation rate from it. Subsequently, this information is utilized to define the baseline against which the project's effectiveness is evaluated.

The concept of similarity can prove intricate when analyzing geographic data. To elucidate this notion, one can resort to an analogy involving patients with diseases, providing a clearer understanding of how to discern patterns and classify objects or entities based on their degrees of resemblance. For instance, if the objective is to forecast whether a young and healthy individual will develop diabetes (where the young and healthy person symbolizes the Project Area in its original state, i.e., without undergoing changes or interventions in its forests), a reference is sought. This reference could be a population group already afflicted by the disease (deforestation). Analyzing their dietary habits (drivers) and even their genetics (landscape configuration) aids in identifying that reference. It is imperative to seek similar individuals and refrain from attempting predictions based solely on the medical history of the young person (their past) before the onset of the disease.

It is inaccurate to suggest that a healthy young individual will not develop diabetes or a disease based solely on their medical history, which may not show any evidence of the disease. Also, one cannot assert that a geographic area will not undergo deforestation solely because it has not encountered this issue in the past.

Similarity and equality, while frequently used interchangeably, are distinct concepts in practical application.

Equality implies that two entities are precisely identical in every dimension, no differences. On the other hand, similarity entails a degree of resemblance between two or more entities in specific aspects, while disparities may exist in other facets. Consequently, in the determination of a Reference Region, the goal is to find a similar region, not an identical one. For instance, discovering a Reference Region that is entirely identical, encompassing the same geometric configuration, identical forests, a uniform distribution of rivers, or an identical count of hydrographic sub-basins, is an unattainable task. Thus, the pursuit of a similar region necessitates adherence to predefined criteria and proportions, as outlined below.

2.3 Procedures for establishing the Baseline

To define the spatial boundaries of the Reference Region within the REDD+ Matavén Project, we used the VM00007 methodology of VERRA. This methodology incorporates thirteen similarity criteria established in the VCS VMD0007 module of VERRA. Beyond acknowledging the pivotal significance of the transition zone between the Orinoco and Amazon regions, we also considered the similarity of biomes within the Project Area (ACATISEMA & MEDIAMOS F&M, 2017). The coexistence of four distinct forest strata (Helobiome, Peinobiome, Litobiome, and Zonobiome) introduces an additional layer of complexity to the delimitation of an appropriate Reference Region. It is crucial to highlight that these four strata are also present in the transition zone of the Selva Matavén, thereby reinforcing the substantive relevance of its inclusion in our analytical framework.

Incorporating these diverse strata into the delimitation of the Reference Region is crucial to guarantee a precise delineation that authentically reflects the attributes of the transition zone and the biomes existing in the Project Area.

It is noteworthy that in both the article by CMW (2021) within its Qualitative Assessment section and Bermúdez (2021) in his respective article, there is an important oversight of a fundamental aspect such as forest strata (biomes), which is absent in their review of the baseline of the REDD+ Matavén Project. This omission demonstrates a lack of rigor in their analysis, leading to a compromised level of scientific or technical validity.

Considering the various forest types (biomes) in the demarcation of the Reference Region requires heightened precision and rigor to ensure an accurate delineation that aligns with the transition zone and the forest biomes extant in the Project Area.

For instance, floodplain forests (Helobiome) are situated in proximity to large rivers and face deforestation risks primarily due to timber extraction, with agriculture and livestock farming posing minimal threats in this biome. In contrast, riparian or gallery forests (Peinobiome) are intimately linked to savannas, and their incorporation into the Reference Region delineation is imperative to establish similarity between the Project Area and the Reference Region. Additionally, forests associated with rocky soils (Litobioma) are predominantly distributed in the Orinoquía and specific regions of the Amazon, whereas upland forests (Zonobioma) exhibit dense vegetation and are characterized by organic-rich soils.

Module VCS VMD0007 of VERRA, titled "Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation and unplanned wetland degradation (BL-UP)" (VERRA, 2020) establishes a set of requirements for defining the Reference Region, enabling the projection of the deforestation rate. In particular, point 1.1.1.1 of this module focuses on the "Reference region for projecting rate of deforestation (RRD)".

The REDD+ Matavén Project has meticulously adhered to these requirements, guaranteeing a meticulous and coherent delineation in adherence to the directives outlined in VERRA's VCS VMD0007 module. A comprehensive account of how each of these requirements has been satisfied within the Project's framework is presented below.

a) Main drivers of deforestation

This section addresses three pivotal requirements. The first pertains to the evaluation of the proportionality between ranchers and farmers. The second concerns the examination of legal land use rights, which are uniformly presented in both the Reference Region and the Project Area. Lastly, due consideration is given to the ratio between residents and immigrants.

For the REDD+ Matavén Project, the first requirement involves scrutinizing the interactions among settlers/ranchers and farmers/indigenous communities within the transitional zone between the Colombian regions of Orinoco and Amazon. Historically, this region has been inhabited by indigenous communities engaging in subsistence-based agriculture. Extensive ranching has arisen as a consequence of colonization processes and stands out as a primary driver of deforestation, leading to the transformation of forest cover into pastures. These dynamics are substantiated through the examination of land use and land cover transitions at the beginning of the Historical Reference Period (HRP) in 2001, subsequently compared with the initial situation in the Project Area in 2013. The proportionality between ranchers and farmers is similar in both the Reference Region and the Project Area, adhering to the requirements of the Standard (VERRA, 2020).

The Historical Reference Period (HRP) designates a specific temporal span in the past wherein deforestation within a particular region is quantified, serving as a baseline for evaluating potential greenhouse gas emissions in the absence of intervention.
VERRA's methodologies incorporate this concept to ensure the quantifiability and verifiability of climate benefits. The applied methodology (VCS VM0007) stipulates that the HRP should encompass the 9 to 12-year period preceding the Project start date[2]. For the REDD+ Matavén Project the HRP is 2001-2011.

Regarding the second requirement[3], in Colombia, there is no specific regulation that allows indigenous people and settlers to change land use from forest to other land cover types. Although the country has timber concessions, these are not applicable to the transition zone between the Colombian regions of Orinoco and Amazon, where the Project Area is located (Law 99 of 1993).

Finally, it's important to note that in the transition zone between the Colombian regions of Orinoco and Amazon, there were no significant immigration dynamics observed, both in the Project Area region (early 2013) and in the Reference Region (in 2001). This characteristic is relevant to ensure the similarity of demographic conditions and to guarantee comparability between both areas: the Reference Region and the Project Area.

b) Landscape Factors

The biome layer sourced from the Agustín Codazzi Geographic Institute (IGAC) for 2008 served as a spatial information reference to establish the similarity between forest types and soils. Biomes were selected because they explain both the composition of the forest and soil characteristics in the area. Additionally, the biome layer facilitates the identification of areas with congruent biome classifications for both forest and soil, streamlining the analysis of similarity between these variables.

[2] *Verra VCS Module VMD0007 / Temporal boundaries.*
[3] *"Rapid assessment techniques for determination of lack of legal rights to use land is the same in the reference region as in the project area, and" (VERRA, 2020).*

The similarity required according to the Standard is defined with a flexibility of ±20% between the values of the variables.

For example, if a person under study has a height of 180 cm, the reference person should have a height between 164 cm and 196 cm, as follows:

Height of the person under study = 180cm
±20% of 180cm: 180cm - 20% and 180cm + 20%
180cm x 20% = 16cm
180cm - 20% = 180cm - 16cm = 164cm
180cm + 20% = 180cm + 16cm = 196cm

As evidenced in Table 1, the REDD+ Matavén Project complies with the similarity requirement mandated by the standard, allowing the identification of areas with characteristics similar to those of the Project Area.

Table 1: Forest and soil strata in the Project Area and Reference Region (RRD)

Biomes	Project Area (ha)	Project Area %	± 20%	Lower Limit	Upper % Limit	RRD (ha)	RRD %
Helobiomas	174,516	15.2	3.0	12.1	18.2	230,435	15.9
Peinobiomas	326,058	28.3	5.7	22.7	34.0	333,195	23.1
Litobiomas	116,099	10.1	2.0	8.1	12.1	158,752	11.0
Zonobiomas	533,538	46.4	9.3	37.1	55.7	722,424	50.0
Total PA	**1,150,212**	**100**				**1,444,806**	**100**

Table 1 presents the distribution of different biomes in the Project Area. Notably, the Zonobiome exhibits the highest prevalence, representing 46.4% of the total area, followed by the Peinobiome at 28.3%. On the other hand, the Helobiome and the Litobiome have a lower presence, accounting for 15.2% and 10%, respectively. It is important to note that this proportional distribution is consistently maintained in a similar manner in the Reference Region, with variations within the permissible range of ±20%. These results demonstrate that the delineation process is not an arbitrary exercise but it is based on a quantitative demonstration of the similarity between the Project Area and the Reference Region.

Regarding topography, both the Reference Region and the Project Area exhibit predominantly flat terrain with low slopes. As observed in Table 2, the average slope values in both regions do not exceed 15%.

This topographical configuration holds significance in comprehending deforestation processes within the area. The prevalence of flat terrain with gentle slopes enhances the feasibility and expansion of human activities, particularly agriculture and livestock farming, which stand as primary drivers of deforestation in the region.

Table 2: Elevation and slope categories between the Project Area and the Reference Region (RRD)

Elevation m.a.s.l	PA	RRD		Gradient %	PA	RRD
0-500	100%	100%		< 15	100%	100%
> 500				> 15		

Both the Project Area and the Reference Region exhibit similar topographical characteristics. Both areas are characterized by being flat, with no significant slopes, and with altitudes below 500 meters above sea level (m.a.s.l.).

c) Transportation networks and human infrastructure

Within this section, we will address three requirements associated with accessibility, aiming to establish similarities in this regard: navigable rivers, land routes, and human settlements in the region.

Both the Reference Region and the Project Area are characterized by the presence of navigable rivers, which play a fundamental role as primary transportation routes.

As per the Superintendency of Transportation of Colombia, these rivers are the most important means of transportation in the Colombian regions of Orinoco and Amazon, allowing for the transportation of goods, gasoline and people (Y. Paredes M. et al., 2010).

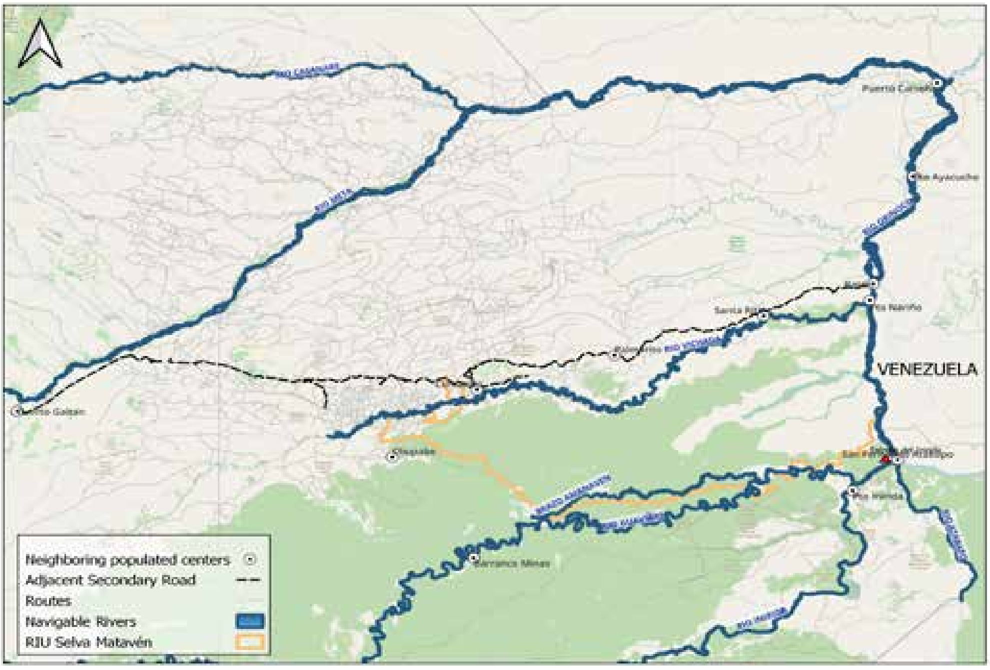
The proportional representation of these rivers is detailed in Table 3, while Map 4 visually illustrates that navigable rivers form a robust and evident transportation network in the region. Within the Project Area, three particularly noteworthy rivers are discernible: the Vichada River, establishing a connection from Puerto Gaitán-Meta to Puerto Inírida via Cumaribo; the Guaviare River, linking San José del Guaviare to Puerto Inírida; and the Orinoco River, a significant binational waterway traversing key cities such as Puerto Inírida, Puerto Carreño, and Puerto Ayacucho (Table 3). Furthermore, the Orinoco River courses through one of the region's principal tourist attractions, the Estrella de Orinoco. These rivers assume a fundamental role in transportation, facilitating the movement of both people and goods throughout the area.

Table 3: Proportion of navigable rivers in the Project Area and Reference Region (RRD)

Spatial Limit	Distance in meters adjacent to navigable rivers	Area in Km2	Proportion (Dist/Km2)
Project Area	625,261	11,502	54
Reference Region (RRD)	619,025	14,448	43
Proportion	**Value**		
Lower Limit	43		
Upper Limit	65		

Table 3 presents data on adjacent distance (in meters) and area (in square kilometers) for the two spatial boundary regions. The proportion (Dist/Km2) is calculated, representing the ratio between the distance in meters adjacent to the forests of each spatial boundary region and the size of the area in square kilometers. In the case of the Project Area, a margin of flexibility is calculated, a value of 20% is calculated as a margin of flexibility for its proportion. It is relevant to highlight that the proportion for the Reference Region is indicated as 43, and upon comparison with the lower limits of the Project Area, this proportion falls within an acceptable range.

Map 4: Navigable rivers and connectivity of RIU - Selva Matavén



The dashed black line on the map represents a secondary route connecting Puerto Gaitán, passing through Cumaribo, to Puerto Nariño. The river network reveal that the Resguardo Indígena Unificado Selva Matavén plays a pivotal role as a dynamic hub connecting the central part of the country to a crucial city in the Colombian Amazon, such as Inírida. Furthermore, its strategic border location and proximity to substantial population centers in Venezuela, including San Fernando de Atabapo and Puerto Ayacucho, are noteworthy. .

The data for the similarity requirement related to Human Infrastructure are presented in Table 4, showing the proportion of human settlements located within 1 kilometer of forests, both in the Reference Region and the Project Area. This dataset indicates a consistent proportionality maintained between the analyzed regions.

Table 4: Proportion of settlement density

Spatial Limit	Number of Settlements	Area in km2	Proportion (total/km2)
Project Area (PA)	195	11,502	0.02
Reference region (RRD)	315	14,448	0.02
Proportion	**Value**		
Lower Limit	0.018		
Upper Limit	0.028		

Table 4 shows data concerning the proportionality between the Project Area and the Reference Region in terms of the number of settlements within 1 kilometer of the forest and the area in square kilometers of the spatial boundaries. The proportion (total/Km2) represents the quotient between the adjacent distance of navigable rivers and the area in square kilometers. In this case, both the Project Area and the Reference Region have a proportion of 0.02, indicating that the relationship between these two variables is close. Additionally, a flexibility range is established with a Lower Limit of 0.018 and an Upper Limit of 0.028 to assess whether the proportionality is adequate.

In the context of accessibility, Bermúdez (2021) presents a crucial argument that requires careful analysis and questioning. He points out that the Reference Region, unlike the Resguardo Indígena Unificado Selva Matavén, has “dozens of roads,” implying that this distinction could impact the deforestation rate.

It is crucial to clarify that the land routes in the Reference Region are comparable in nature to those existing in the vicinity of the Indigenous Resguardo of Selva Matavén, primarily present on the savannas.

These “land routes” cannot be considered as indicative of substantial “road development”[4] in either the Reference Region or the Resguardo Indígena Unificado Selva Matavén. These routes predominantly comprise tracks on the savanna, rendering them practically impassable for a significant portion of the year—approximately 8 months—due to the precipitation conditions characteristic of the Colombian regions of Orinoco and Amazon. Moreover, any comparative analysis should be anchored in the initial phase of the Historical Reference Period (2001), not contingent upon current road conditions or contemporary traffic safety data.

As previously mentioned, the Resguardo Indígena Unificado Selva Matavén is enveloped by three primary navigable rivers, facilitating accessibility and communication with adjacent areas. These rivers not only serve as crucial transportation routes but also play a pivotal role in the economic activities and daily life of the region.

Furthermore, the Resguardo Indígena Unificado Selva Matavén is a border area with Venezuela, fostering continuous interaction and cultural, commercial, and social exchange between the two nations. This border condition introduces a significant dimension to the connectivity and strategic importance of the region.

Despite the absence of major land routes, it is relevant to note that there is a secondary land route within a 5-kilometer proximity, linking the region. This road begins in Villavicencio, passes through Puerto Gaitán, and heads towards the border, ending in Puerto Nariño (see Map 4). This secondary road, although smaller in size, provides a vital connection for the transportation of people and goods (mainly during the dry season), contributing to the integration of the Resguardo Indígena Unificado Selva Matavén with the rest of the country.

An essential aspect to highlight is the strategic positioning of the Resguardo Indígena Unificado Selva Matavén as an indispensable transit point for reaching Inírida, one of the principal cities in the Colombian Amazon.
This advantageous location renders Matavén a key hub for trade, tourism, and economic activities integral to regional development. Similarly, Cumaribo, which is the intermediate city between Villavicencio and Inírida, represents a fundamental connection for the social and economic activities of Matavén and, therefore, the Project Area region.

Contrary to perceptions of remoteness, the Indigenous Resguardo the Selva Matavén and its Project Area region exhibit a range of elements that interconnect and strategically position them within the geographical context.
These attributes underscore its critical importance for the conservation and management of its forests, confirming its relevance both from an environmental and social perspective. Indeed, to dismiss its significance is to disregard the intricate complexity and interdependence of territories

4. In the CMW article (2021), it is stated that in the Reference Region there is a true “road development,” which is not accurate, since many of the roads are not paved, lack any kind of geometric design, and mostly cross savannah areas instead of being asphalt roads. This is similar to the vicinity of the Indigenous Resguardo of Selva Matavén, where a secondary road also passes from Villavicencio to the border with Venezuela along with multiple branches. It is also important to note that the comparison between the Project Area and the Reference Region is made at the beginning of the Reference Historical Period, that is, in 2001, and not at the current time and conditions, as the confusion the author frequently induces in his article.

within the context of the Colombian regions of Orinoco and Amazon, and their consequential implications in defininf the baseline.

In conclusion, the elements presented refute the erroneous assertion made by Bermúdez (2021) and the CMW article (2021) that the Project Area region is an isolated and remote area.

d) Social factors

The transition from forest to other land covers and land uses in both regions, namely the Reference Region and in the Project Area, can be attributed to different conditions.

Firstly, it is observed that indigenous communities engage in subsistence agriculture, leading to landscape transformations to fulfill their food needs.

Subsistence agriculture refers to the cultivation of crops primarily for the farmer's personal consumption and that of their family, without a primary focus on large-scale sales or trade. In the transition zone between the Colombian regions of Orinoco and Amazon, this practice is closely linked to "conucos," small plots of land traditionally cultivated by indigenous communities.

On the other hand, peasants or settlers have played a significant role in the conversion of forested areas into agricultural land and pastures for livestock. This same pattern is observed in the vicinity of the Resguardo Indígena Unificado Selva Matavén.

Moreover, it is relevant to note that both the Reference Region and the Project Area experienced the presence of guerrilla groups during the Historical Reference Period (2001-2011). These armed groups have influenced territorial dynamics and land occupation, impacting patterns of land use change. It is mandatory to consider this social factor in the analysis, given that both spatial boundaries had the presence of FARC[5] during the Historical Reference Period (M. P. Baena Jaramillo, 2017). Therefore, a similarity can be deduced between the conditions in the Reference Region in 2001 and the social conditions in the Project Area at its initial date (2013).

e) Policies and regulations

Concerning policies and regulations in both the Reference Region and the Project Area, it is crucial to acknowledge that the authoritative environmental body in the area is Corpo Orinoquía[6] . By 2012, this entity was implementing identical regulations in both regions, specifically within the transition zone. However, it is noteworthy that specific regulations for REDD+ projects were established five years after the start of the REDD+ Matavén Project with the issuance of Resolution 1447/2018. Also, it is important to emphasize that, in Colombia, there are no distinct subnational laws specifically addressing deforestation.

5. The FARC, Revolutionary Armed Forces of Colombia, are a guerrilla group that has operated in Colombia for over five decades. In the regions of the Colombian Orinoquía and Amazonia, the FARC had a significant presence, exerting control over vast areas and engaging in illicit activities such as illegal mining and narcotics production.

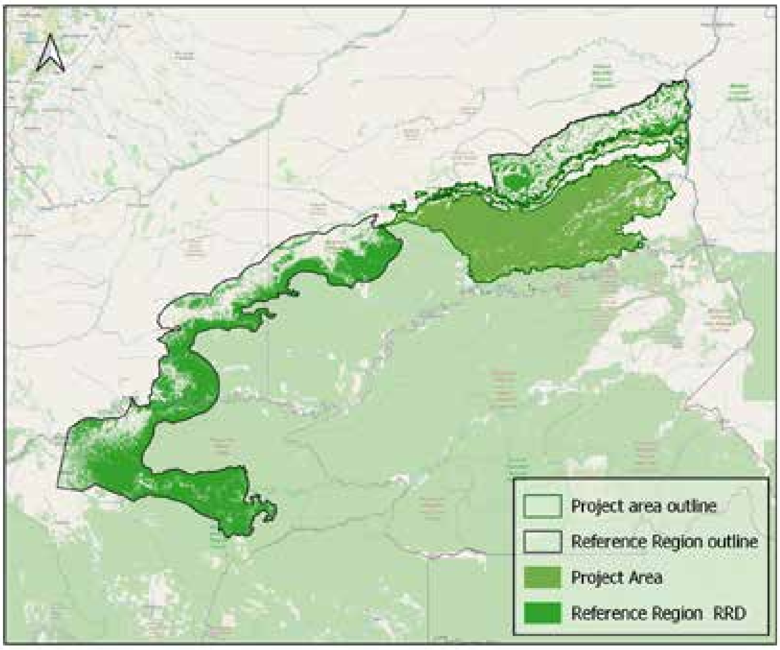
6. Corpo Orinoquía is the Autonomous Regional Corporation of Orinoquía , a public entity responsible for promoting the conservation, sustainable management, and appropriate development of natural resources in the Orinoquía region of Colombia. Through its programs and projects, CorpoOrinoquía aims to ensure a balance between economic growth, social well-being, and environmental protection in this crucial area of the country.

f) Exclusion of planned deforestation

There are no planned deforestation zones in the transitional area between the Colombian regions of Orinoco and Amazon.
In conclusion, the process of establishing the Reference Region for the REDD+ Matavén Project implied meeting the criteria of similarity, ensuring that this region was located in the transition area. Landscape factors, such as biomes, topography, and slopes similarity, were considered. Regarding transportation networks, the importance of navigable rivers as sources of accessibility was considered, refuting the claim made in the CLIP article (Bermúdez Liévano, 2021) that the Project Area region was remote and disconnected. Social factors, policies, and regulations were also taken into account. It is important to note that there is no planned deforestation zone in the Reference Region.

As a result of this comprehensive process, which involved locating the Reference Region in a transition zone between the Orinoco and Amazon regions and fully satisfying all 13 similarity requirements, we obtained the Reference Region shown in Map 5, where the total area is only forest at the beginning of the Historical Reference Period in 2001[7].

Map 5 Project Area and Reference Region



The analysis of the construction of the Reference Region for the REDD+ Matavén Project has revealed its robustness and methodological rigor, grounded in the logic of locating it within a transition zone between the Colombian regions of Orinoco and Amazon. This process is neither ambiguous nor simplistic; instead, it is underpinned by adherence to 13 similarity requirements established in the VERRA VCS VMD0007 module, ensuring the validity and reliability of the delineation.

Moreover, Bermúdez's claim (2021) characterizing the Project Area region as isolated and remote has been strongly refuted. On the contrary, it has been demonstrated that the region is well-

7. The Reference Region covers 1,444,805 hectares of solely forest and reflects the proportions detailed in tables 1, 2, 3, and 4. This expanse exclusively comprises forested lands at the beginning of the Historical Reference Period, i.e., in January 2001. It's important to highlight that areas that are not of a forested nature, such as savannahs, bodies of water, transportation routes, lakes, cultivated lands, regenerating vegetation, and other types of land use different from forests, are not incorporated.

connected and constitutes a crucial corridor between the country's interior and the significant city of Inírida in the Amazon.The presence of navigable rivers and its border location with Venezuela are evidence of its importance and vulnerability.

In contrast, the CMW article (2021) presents comparisons lacking in rigor and a solid technical and scientific foundation. These simplistic comparisons rely solely on rules of three, without taking into consideration the Historical Reference Periods or geographical structures, thereby undermining their capacity to provide an accurate assessment of deforestation rates.

Furthermore, it is important to highlight that the defined Reference Region exhibits no indications suggesting an exaggeration of the Project's baseline, contrary to the insinuations made by the authors of the CMW (2021) and Bermúdez (2021) articles.

VERRA addresses this matter in response to a CLIP questionnaire, affirming that "A Reference Region is selected according to the criteria established by a given methodology and is verified by an external auditor. In this case, the Reference Region shares the same geophysical characteristics as the project. According to our methodological requirements, this region is also 'similar to the project area in terms of deforestation and/or degradation drivers and agents, landscape configuration, and socioeconomic and cultural conditions' ..." and "the selection of the project's reference area complies with the requirements of methodology VM0007 under the VCS framework. The project's reference area reflects the greatest threats and deforestation factors for the project (livestock, illegal crops, illegal mining, and illegal logging)"[8].

8. https://recursos.elclip.org/madera-sin-rastro/Cuestionario_Matavén_Verra.pdf

3. Why we do not use other Reference Regions

An inquiry often arises concerning the selection of a specific Reference Region in REDD+ projects, prompting the question, “Why opt for a particular Reference Region when there are potentially other alternatives?”

The “other possible options for Reference Regions” for the REDD+ Matavén Project do not meet the criteria established by Verra to be considered as a viable Reference Region.

a) It is not feasible with the state limit of Vichada.

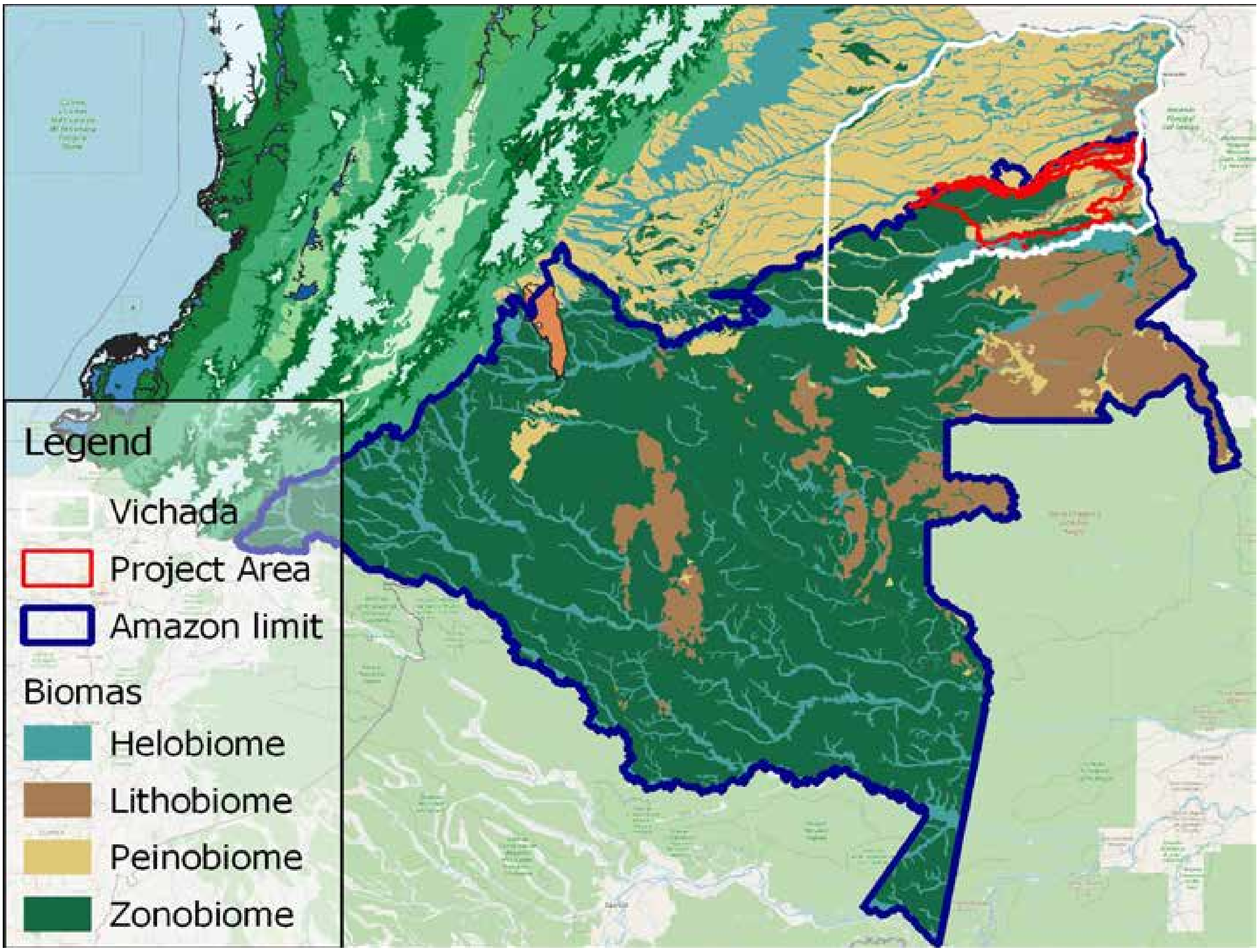
The viability of the state of Vichada is constrained by several factors. The state’s geographic composition encompasses two distinct landscapes: a northern Orinoquía zone situated above the Vichada river and a transition zone characterized by a prominent presence of forests and savannas to the south of the same river, adjacent to the Orinoco river. Furthermore, the delineation of the state follows political-administrative boundaries rather than adhering to biogeographic similarities (refer to Map 6 - State of Vichada). REDD+ Matavén Project Area is part of the transition zone (forest and savannas), significantly differing from the Orinoquía zone in the north of the state.

This confirms that the state of Vichada is not a viable Reference Region for the REDD+ Matavén Project Area.

b) It is not feasible with the Colombian Amazon

The designation of the Amazon biome by the Colombian Ministry of Environment is not suitable as a Reference Region for REDD+ Matavén Project Area, due to multiple factors. The Project Area is surrounded by three navigable rivers, enhancing accessibility from the north, east, and south in a proportionally greater manner. Furthermore, in comparison to the Amazon biome, the Selva Matavén area displays a heightened proportion of savannas, leading to an extended forest edge and, consequently, an elevated deforestation risk attributed to increased accessibility. Lastly, the Amazon biome exhibits a significantly larger proportion of zonobiome forest (dense forest of solid ground) and Lithobiomes (refer to Map 6), indicating a substantial difference in the composition of forest types.

Map 6. Biomes in the Orinoquía and Colombian Amazon



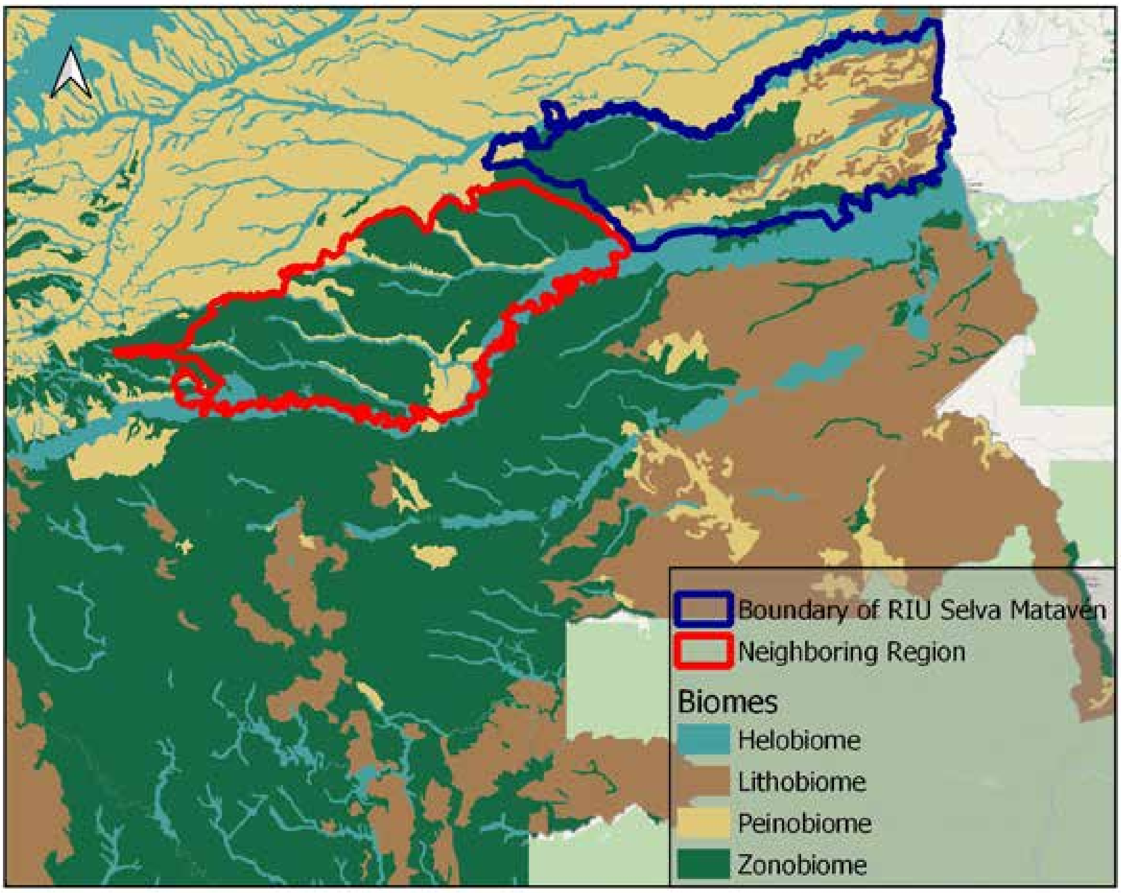
The delineation of the Colombian Amazon Biome boundary (indicated by the blue line) reveals a substantial portion of the forest characterized as Zonobiome (depicted in green). While, at the Project Area boundary (depicted in red), there is a predominant proportion of Peinobiomes at 28%, Zonobiome at 46%, and to a lesser extent, Lithobiome and Helobiome (refer to Table 1).On the other hand, the white line represents the political-administrative boundary of the Vichada department. In the northern part of the Vichada River, Peinobiomes predominantly occur, which are exclusively associated with savannas..

This confirms that the Amazon biome is not an appropriate Reference Region for the REDD+ Matavén Project Area.

c) It is not feasible with the neighboring region

The neighboring region, denoted by the boundary delineated in black immediately adjacent to the Resguardo Indígena Unificado Selva Matavén (as illustrated in Map 7), presents notable disparities, particularly evident in the uneven distribution of biomes (refer to Table 5). This region fails to meet the stipulated requirement of ±20% proportionality, as indicated in the table 5, where the predominant forest type is Zonobiome. Moreover, it lacks Lithobiome, a biome associated with forests on rocky soils typically found in the Orinoco River bed.

Map 7. Biomes in the neighboring region



The delineation of the boundary of RIU Selva Matavén is demarcated by the red line, as illustrated, whereas the adjacent region, depicted by the red line, exhibits an absence of Lithobiomes and a higher prevalence of Zonobiomes.

Due to the absence of proportionality between various forest and soil types, this area does not qualify as a suitable Reference Region for the REDD+ Matavén Project.

Table 5 Proportion of forest strata between the Project Area and the neighboring region Data extracted from the Forest and Carbon Monitoring System SMByC

Stratum	***Biome***	***PA(has)***	***%***	***Neighboring Region (has)***	***%***
i=1	*Helobiome*	*174.516*	*15,2%*	*354.686*	*18%*
i=2	*Peinobiomes*	*326.058*	*28,3%*	*184.932*	*9%*
i=3	*Lithobiome*	*116.099*	*10,1%*	*-*	*0%*
i=4	*Zonobiome*	*533.538*	*46,4%*	*1.465.756*	*73%*
	Total	*1.150.212*	*100%*	*2.005.373*	*100%*

The delineation of a Reference Region in a REDD+ project is a complex process that involves criteria defined by a methodology that is widely used and validated at a global level.

Conclusions of this chapter

In this chapter, three possible Reference Region options were examined, including the state of Vichada, the Amazon biome, and a neighboring region.

The “qualitative analysis” conducted by CMW (2021) lacks appropriateness. The selected areas for comparison by the authors do not exhibit biophysical similarity, rendering their conclusions invalid.

- The state of Vichada diverges significantly in biogeographic aspects. Attempting to equate it with REDD+ Matavén Project Area disregards the notable differences in their biophysical, physiographic, and landscape characteristics.

- The Amazon biome exhibits a higher proportion of Zonobiome forest, establishing a substantial difference and disproportionality in terms of forest type compared to the REDD+ Matavén Project Area.

Comparing the deforestation rate between these two biophysically dissimilar areas is not valid, as the dynamics and factors of deforestation vary drastically due to differences in forest composition and structure (forest edge, accessibility, among others).

- The neighboring region also failed to meet the minimum requirement of biome proportionality, having more Zonobiomes and lacking Peinobiomes and Lithobiomas.

When drawing comparisons with areas that do not adequately capture the context and characteristics of Matavén, a genuine understanding of the situation is distorted, leading to erroneous conclusions. This was exemplified in the case of CMW (2021) and all subsequent articles derived from it.

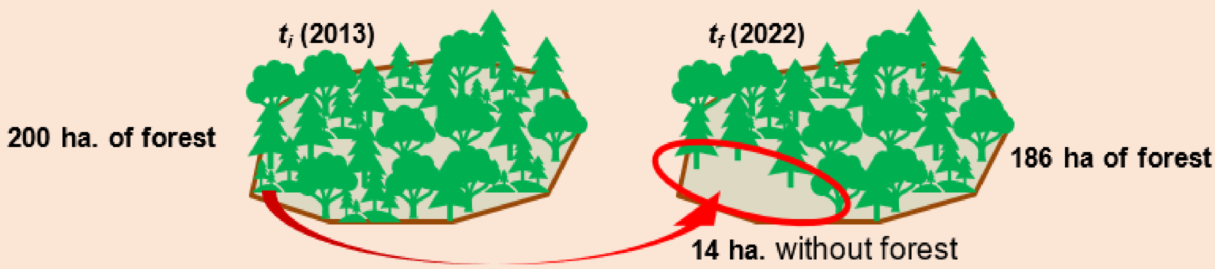
In conclusion, the selection of an appropriate Reference Region for the REDD+ Matavén Project necessitates adherence to biophysical proportionality and positioning within a transition zone between the Orinoquía and the Colombian Amazon. The comparisons presented by CMW (2021) lack scientific and technical rigor, as they do not consider the importance of evaluating similar regions to make relevant comparisons in any analysis of a REDD+ project.

4. Deforestation Rate

The claims made by CMW and CLIP are related to different deforestation rates for the REDD+ Matavén Project and for the FREL (National Reference Emission Factor). These rates are derived from distinct geographical and social contexts and are computed using different methodologies. Consequently, it constitutes a conceptual and methodological error to extrapolate the deforestation rate of the Amazon biome to the emission reduction calculations for the REDD+ Matavén Project. Aclaración conceptual y metodológica sobre qué es una tasa de deforestación:

Conceptual and methodological clarification on what a deforestation rate is:

For example: at the beginning of the year 2013 (t_i) 200 hectares of forest were quantified on a property.



At the end of the year 2022 (t_f) 14 hectares of that forest were lost.
The deforestation rate is:

$$r = \frac{Forest\ lost\ in\ t_f}{Total\ forest\ in\ t_i} = \frac{14\ ha.\ of\ forest}{200\ ha.\ of\ forest} = 0{,}07$$

The CMW article mentions that the REDD+ Matavén Project has reported more results than it should, by wrongly pretending or suggesting that if the holders of this initiative had applied the rate managed by the FREL 2013-2017 (IDEAM, 2014) to determine the Project's baseline, a lower number of carbon credits should have been allocated to the Project.

The REDD+ Matavén Project is not overestimating the deforestation rate used to determine its baseline.

On the contrary, this deforestation rate corresponds to a result derived from the strict application of procedures with technical and scientific support outlined in the VCS Standard and the VCS VM0007 methodology used; an it reflects the theoretical-practical understanding of the territory by a multidisciplinary team from ACATISEMA and Mediamos, collaborating in the Indigenous Territory for the past 12 years.

Se The authors limit themselves to highlighting and drawing attention to the differences in the data presented by the REDD+ Matavén Project and the FREL, presenting incomplete information and drawing inaccurate conclusions. This approach results in misinformation and misconstrued representations in media outlets.

The authors fail to delve into the underlying reasons for these differences, disregarding the unique circumstances of the Matavén Project, the varying levels of deforestation threats in different areas covered by the FREL, and the evolving legislative landscape of Colombia. Notably, the regulatory framework that has been in place only since 2018 (five years after the Project started in 2013), with rules that the Project is complying with, especially outlined in Decree 926 of 2017 by the Ministry of Finance and Public Credit and Resolution 1447 of 2018 by the Ministry of Environment and Sustainable Development (MADS).

Additionally, the authors do not provide any study on the territory, the dynamics within the management of the Project by the local communities of the Indigenous Resguardo, nor any fieldwork that supports their claims.

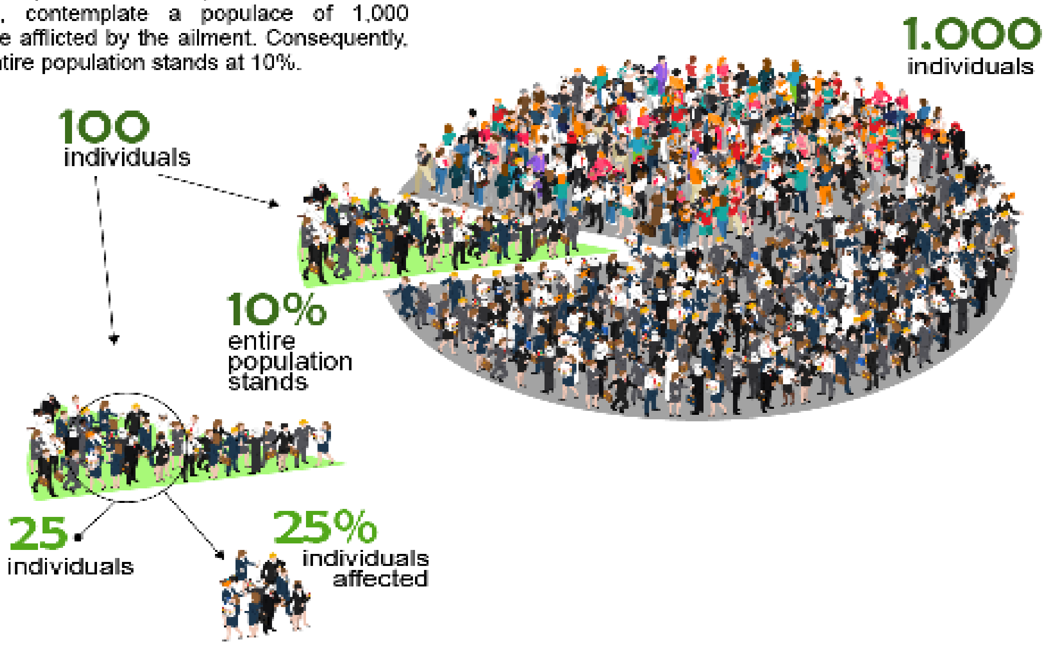
The deforestation rate used by the REDD+ Matavén Project is an average referred to its Region or Reference Area, while the deforestation rate of the Amazon biome is an average of the Amazon biome total extension. There are countless examples of this difference in averages between a part or sub-population and the total or population that indicate distinct characteristics.

Different indicators for a population and a sub-population

Consider a population in which the prevalence of a particular disease is ascertained. As an illustration, contemplate a populace of 1,000 individuals, among whom 100 are afflicted by the ailment. Consequently, the overall disease rate for the entire population stands at 10%.

Now, if we examine a subset of this population comprising 100 individuals, and within this subset, 25 individuals are affected by the disease, the sickness rate within this sub-population is 25%. It's crucial to acknowledge that the proportion of individuals suffering from the disease in the sub-population may deviate from the overall population indicator due to distinctive characteristics inherent to the sub-population.

In this specific sub-population, the prevalence of the disease is higher (25%) compared to the total population indicator (10%).



Employing the 10% indicator from the total population to make inferences about the sub-population would result in an underestimated count of affected individuals (10 individuals), failing to accurately gauge the extent of the issue and the treatment.

Consequently, it is important to recognize that the average or indicator derived from the entire population should not be indiscriminately applied to generalize about a sub-population. This principle is a fundamental tenet in statistics when dealing with both overarching and specific averages.

Using the average deforestation rate of the Amazon biome for generalizations regarding any sub-population is inappropriate; this average is strictly applicable to the entire population of the biome, and its interpretation should be confined to that context.

Similarly, the average deforestation rate of the Amazon biome (representing the total population) cannot be extrapolated to draw conclusions about the REDD+ Matavén Project Area and its Reference Region (sub-population).

In the case of the REDD+ Matavén Project and the Amazon biome, the sub-population and the total population exhibit distinct characteristics in terms of their deforestation rates.

The FREL, derived from the deforestation rate of the Colombian Amazon biome, offers a generalized reference scenario in contrast to the specific Reference Region of the REDD+ Matavén Project, where the deforestation rate is defined to establish its baseline. Consequently, attempting to apply results from the FREL without considering the distinct characteristics of these different contexts is inappropriate.

This constitutes one of the primary errors made by the authors of the CMW and CLIP articles: trying to use the deforestation rate of the Amazon biome in the context of the REDD+ Matavén Project with the purpose of diffusing inaccurate and sensationalized information. Unfortunately, certain media have shared this misinformation, replicating the mistake.

4.1 Deforestation as a spatio-temporal phenomenon

The comparison of deforestation rates may encounter challenges stemming from inaccuracies in dates, regions, and temporal methodologies adopted in some publications. By exclusively focusing on the trend of a region or area, both external and internal threats in a non-project scenario may be overlooked. While this approach could be suitable for isolated areas, such as an island (refer to Map 8), it fails to capture the reality of most regions. Matavén, for instance, faces multiple deforestation threats even during the implementation of the REDD+ Project. To address this issue properly, it is essential to consider both the temporal and spatial dimensions of deforestation, which will be explored in this section.

Understanding deforestation requires a holistic perspective that considers its development in a specific geographic space over time.

An exclusively temporal approach may neglect valuable information about the evolution and underlying causes of deforestation. Therefore, it is vital to adopt a perspective that integrates both dimensions to fully understand the threats and establish a realistic baseline for projects such as REDD+.

Map 8: Deforestation threat on an island - hypothetical case

In a hypothetical scenario wherein the goal is to forecast the deforestation rate of an island, an appropriate approach might involve utilizing time series techniques. This is because, in such cases, there would be no external threats coming from neighboring territories. However, in continental lands, the interaction with adjacent areas makes the phenomenon of deforestation much more complex.

4.2 Spatial autocorrelation of deforestation

The analysis of deforestation should extend beyond temporal considerations and include spatial dimensions.

Spatial autocorrelation serves as a metric facilitating the understanding of the interrelatedness of variable values within geographic space[11]. By examining the spatial autocorrelation of deforestation, significant insights can be gained into the geographic patterns and processes that explain variability in deforestation patterns. This approach provides a deeper understanding of the dynamics of deforestation and helps identify areas where changes in forest cover will most likely occur.

The first law of geography, as stated by Waldo Tobler in 1970, establishes that “everything is related to everything else, but near things are more related than distant things” (Waters, 2017).

In the context of deforestation, this law applies, processes occurring in neighboring areas can affect forests in a specific zone. For example, extensive cattle ranching, cultivation of coca leaves in neighboring areas, and mining-energy requests, make the Resguardo Indígena Unificado Selva Matavén susceptible to vulnerability.

The threats to Matavén primarily stem not so much from internal factors, though they are not entirely dismissed, but rather from the infiltration of external elements. Without adequate financial resources, the region would be devoid of effective governance, resulting in the potential for unbridled and uncontrollable deforestation.

The analysis of deforestation in the Resguardo Indígena Unificado Selva Matavén requires a comprehensive approach that extends beyond a sole reliance on time series models, which primarily address internal threats. It is imperative to acknowledge that deforestation exhibits mobility and spatial dynamics, emphasizing the need for a spatial approach to encompass external threats as well.

5. Differences between FREL and the Baseline of the REDD+ Matavén Project

Data plays a crucial role in the implementation of forest conservation initiatives, such as REDD+ projects or programs. In Colombia, two key sources of data on deforestation and forest degradation are the National FREL and REDD+ projects. While both share the goal of reducing deforestation, they exhibit significant differences in their methodologies and scopes, leading to variations in the reported figures. Therefore, it is important to meticulously analyze and comprehend these disparities for a thorough assessment and, more importantly, to enable accurate comparisons. Failing to do so may result in inaccurate comparisons, exemplified by the CMW article, which erroneously compared deforestation rates using the Amazon biome from the National FREL as a reference region for such comparisons.

A National Forest Reference Emission Level (FREL) indicates the amount of Greenhouse Gas (GHG) emissions expected in the absence of REDD+ initiatives, calculated for either a national scale, encompassing the entire country, or a subnational area, such as the FREL 2013-2017, specifically focused on the Colombian Amazon Biome and excluding other natural regions of Colombia

Meanwhile, a Baseline of a REDD+ project is a scenario in which the amount of GHG emissions expected in the absence of the REDD+ initiative is forecasted, covering a geographically specific and narrowly defined area at a subnational level[9].

The differences between the methodological process carried out by the Colombian FREL and the REDD+ Matavén Project are presented, as well as in the results, abruptly extrapolate in terms of the values of carbon credits and applying a simple rule of three, as has occurred in the case of journalistic articles by CMW (2021) and (Bermúdez Liévano, 2021).

5.1 Scale and Coverage

Both the FREL and the REDD+ Matavén Project operate at the same geographical scale: 1:100,000[10] and use the same satellite data source: Landsat 5, 7, and 8.

The entity processing and providing the satellite information for the Colombian FREL is the Forest and Carbon Monitoring System (SMByC). A significant difference is that the SMByC classifies satellite data only into 2 coverages: Forest and Non-Forest, while the REDD+ Matavén Project data is classified into 9 coverages: upland primary forest, secondary forest, floodplain forest, savannas, floodplain savannas, bodies of water, regenerating vegetation, sandy areas, and Heterogeneous Agricultural Areas (AAH).

In the context of deforestation, the transition from forest cover to other coverages is crucial. However, for the transition zone, a critical emphasis must be placed on estimating the change from Forest to Heterogeneous Agricultural Areas (HAA).

[9] Based on definitions from Resolution 1447 of 2018 issued by the Ministry of Environment and Sustainable Development (MADS).
[10] The geographical scale refers to the proportional relationship between the dimensions represented on a map and the actual dimensions of the territory being depicted. It indicates how much the size of the area on the map has been reduced or enlarged compared to reality. For example, a scale of 1:100,000 means that one unit of measurement on the map (like a centimeter) represents 100,000 equivalent units in reality (like meters). The geographical scale is crucial for understanding and visualizing the spatial relationship and proportions of objects and phenomena represented on a map.

Heterogeneous Agricultural Areas, locally known as “conucos,” are traditional crops used by indigenous communities in this region.

Cultivation of these crops commonly spans from 0.3 to 3 hectares, exhibiting a dynamic pattern prevalent throughout significant portions of the Orinoco and Amazon regions. The practice of crop rotation is executed within a vicinity extending up to 5 kilometers around the indigenous communities.

It is important to recognize that understanding the dynamics of conucos is pivotal for grasping the structure and spatial distribution of deforestation in these regions. Consequently, conducting a cartographic process within the transition zone of Orinoco-Amazonia without incorporating the spatial dynamics of conucos and their minimum area is inaccurate (refer to Illustration 2).

A key difference to highlight is the minimum mapping unit (which will be detailed in section 6.1). If this unit fails to consider the dynamics of the conucos or the change in coverage from forest to Heterogeneous Agricultural Areas (HAA), a phenomenon also observed in the Reference Region (a dynamic prevalent across a substantial portion of the transition zone between the Orinoco and Amazonia), the extent of forest loss is significantly underestimated. This discrepancy stands as a primary factor contributing to divergence in deforestation data.

5.2 Reference and Projection Periods

There is a significant difference between the reference and projection periods of the Colombian FREL and the REDD+ Matavén Project.
The first Colombian FREL establishes the period of reference as 2000-2012, based on deforestation data provided by the SMByC, and a projection period of five years: from 2013 to 2017. The second FREL establishes the reference period as 2008-2017 and a projection period of five years: from 2018 to 2022. In contrast, the REDD+ Matavén Project has a Historical Reference Period from 2001 to 2011, and a projection period of 30 years, from 2013 to 2042 (in accordance with the VM0007 methodology of VERRA).

None of the historical reference periods, nor the reference area employed in the Colombian FREL, align with those utilized by the REDD+ Matavén Project. Therefore, they are not comparable.

5.3. Activity Data

To conduct image processing, both preprocessing tasks (such as downloading, stacking bands, geometric correction, cloud masking, radiometric correction, image composition) and actual processing tasks (including change detection, verification and quality control), we adhered to the “Digital Image Processing Protocol for Quantifying Deforestation in Colombia at the National Level of 2010 (E. Cabrera et al., 2011)”. This protocol was the governing document at the time of establishing the baseline for the REDD+ Matavén Project.

[11] Spatial autocorrelation refers to the degree to which values of a variable at one geographical location are related to or similar to the values of that same variable at nearby locations. In other words, it involves analyzing whether there are spatial patterns in the data, that is, whether similar values tend to cluster or disperse in space.
When there is positive spatial autocorrelation, it means that similar observations tend to be geographically grouped. On the other hand, negative spatial autocorrelation indicates that similar observations are spread out in space. The absence of spatial autocorrelation implies that there is no spatial relationship between the values of the variable at different locations.
Spatial autocorrelation is an important tool in geospatial analysis, as it allows us to understand the spatial patterns of data and detect possible spatial influences on the phenomena being studied. This can be useful for identifying areas of concentration or dispersion of certain events, or for understanding the interactions between variables in a geographical context.

In this step, there are no significant differences between the Colombian FREL and the processes carried out by the REDD+ Matavén Project.

Additionally, to guarantee the quality of the classification, REDD+ Matavén Project has implemented field sampling (as established by the protocol). Also, aerial surveys have been conducted using both drones and manned aircraft to obtain more reliable and precise results regarding changes in land use and cover. Please refer to the monitoring reports for further details (ACATISEMA & MEDIAMOS F&M, 2017, 2018, 2020).

5.4. Emission Factors

The analysis of emission factors in different periods and contexts shows notable differences between the Colombian FREL for the period 2013-2017 and the Colombian FREL for the period 2018-2022.

In the Amazon biome, the 2013-2017 FREL presented an Emission Factor (= DCBT) of 566.1 tCO_2-e/ha, while the 2018-2022 FREL presented an Emission Factor of 556.08 tCO_2-e/ha. Meanwhile, the REDD+ Matavén Project demonstrated greater accuracy and application of stratified sampling techniques by calculating a weighted Emission Factor of 379.55 tCO_2-e/ha[12] for four forest strata, based on a sample of 131 plots in the Project Area.

This level of detail and conservatism in emission estimation contrasts with the imprecise simplifications made by CMW (2021); which analysis lacked due consideration for the specificities of the territory and the diverse forest strata within the transition zone of the Colombian regions of Orinoco and Amazon, thereby rendering invalid their extrapolations regarding the quantity of greenhouse gas (GHG) tons avoided by the Project.

5.5 Territorial extension of the Amazon biome and the REDD+ Matavén Project

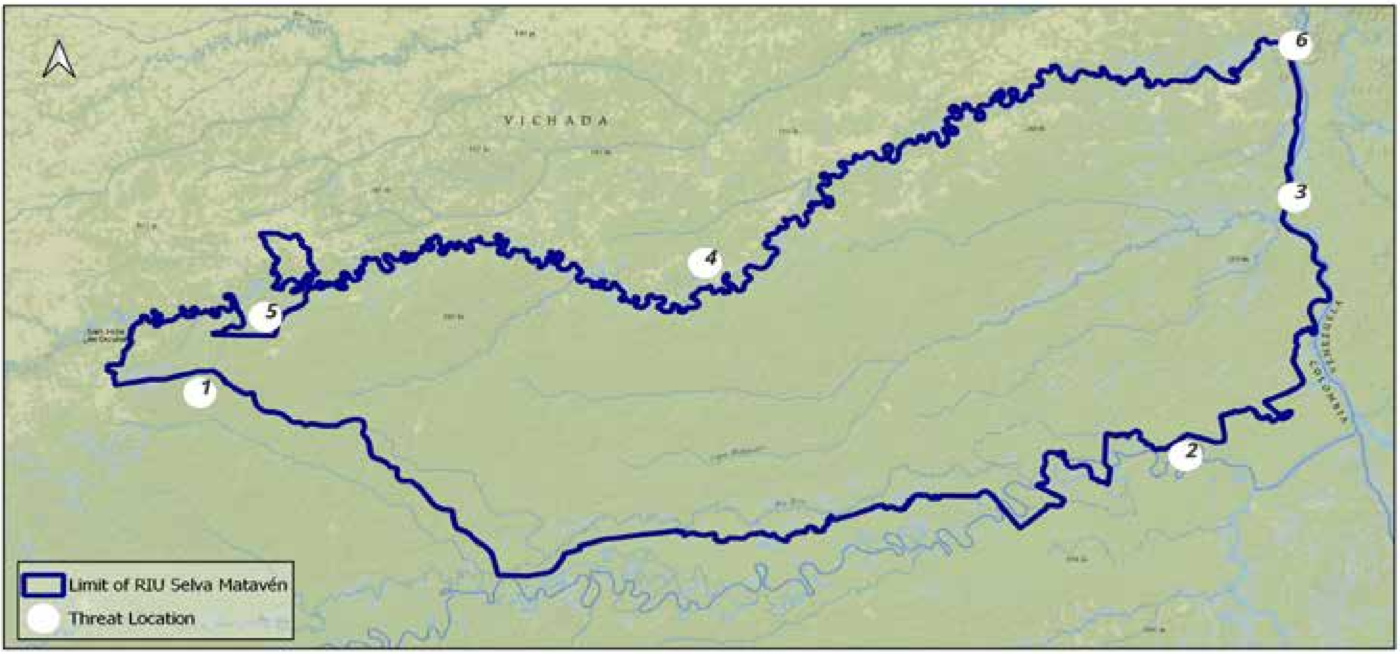
Another aspect to consider is the difference in the extent of the forests being compared (see Illustration 1).

The biome constitutes the entire statistical population, while the Resguardo Indígena Unificado Selva Matavén represents a statistical sub-population (refer to Section 4 of this document and Map 9). The characteristics of the sub-population differ from those of the total population; consequently, in terms of forest loss, the deforestation rate within the Resguardo is different from that of the overall statistical population.

The Colombian Amazon biome covers an area of 45,896,100 hectares, which includes 39,973,700 hectares of forests (IDEAM, 2014), a much larger amount (34.8 times more) than the REDD+ Matavén Project Area with 1,150,212 hectares of forest (ACATISEMA & MEDIAMOS F&M, 2017). Therefore, the characteristics of this biome are different, even with greater diversity, which should not be applied to any sub-area, including the deforestation rate corresponding to the FREL 2013-2017.

[12] In Annex 1, this calculation of the Emission Factor and its more conservative characteristics compared to the FREL are presented in greater detail.

Map 9. Differences between the extent of the Colombian Amazon Biome and the Area of the REDD+ Matavén Project



Source: IGAC 2008[13] *and Amazon Information Network* [14]

5.6 Assessment of historical deforestation in the Amazon biome to determine the FREL

The deforestation patterns across various regions within the Colombian Amazon biome during the FREL reference period (2000-2012) are illustrated in Map 10. There are areas characterized by higher deforestation, indicated by darker shades, primarily align with the transition zones between the Amazon rainforest and the Andes mountains (to the west) and between the Amazon rainforest and the savannas of the Orinoquía (to the north).

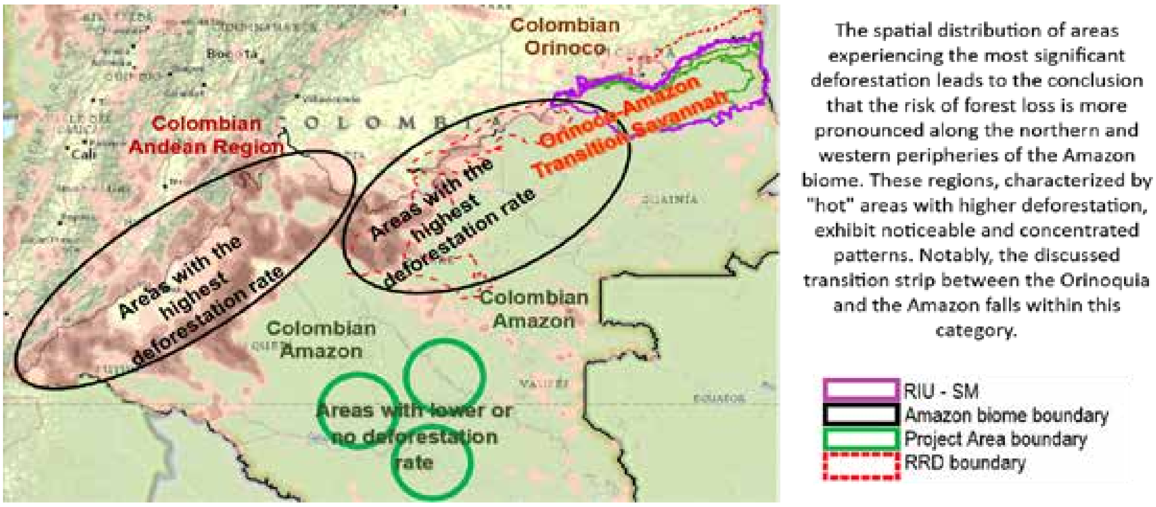
The CMW (2021) article states the following: ‘However, there are several characteristic factors of the reference area that are unlikely to occur in the Project Area and, therefore, it is not a good comparison for measuring the project’s impact. ‘

Considering this statement, if we refer to Illustration 3, it is evident that all transition zones towards the Colombian Amazon are critical points, ‘hot zones or hotspots’, as can be seen from the Andean region towards the Amazon and from the Orinoquia region towards the Amazon.

[13] https://datos.siatac.co/datasets/sinchi::l%C3%ADmite-de-la-amazonia-colombiana-escala-1100-000-1/about
[14] https://ecosistemas.ovacen.com/wp-content/uploads/2018/03/superficie-bioma-amazonico.jpg.webp

This same map highlights that the only transition zone towards the Colombian Amazon that is not yet a hotspot is the one located in the state of Vichada.

Map 10. Deforestation is greater at the edges of the Amazon biome (2010-2018)



Deforestation is a spatiotemporal phenomenon, gradually advancing and eroding the edges of forests. In this map, it is evident that the transition areas are the most affected within the Colombian Amazon biome. The areas with the highest deforestation were identified using data from the Forest and Carbon Monitoring System (SMByC).
Source: Own elaboration, based on official IDEAM deforestation data (www.ideam.gov.co/capas-geo)

The method employed for determining the FREL fails to account for the varied nature of the threat to the forest within different regions of the Amazon biome. It establishes a singular deforestation rate without differentiation among areas with distinct susceptibilities. The approach neither considers their geographical locations nor acknowledges differences in accessibility through waterways, various extractive interests, and the dynamics of actors contributing to forest loss. Consequently, it overlooks the varying degrees of threat to which different sub-areas within the biome are exposed. Thus, it could be considered that there are at least two sub-areas exhibit markedly different trends. One corresponds to the transition strips with the Andean region and the Orinoquía, characterized by deforestation rates indicative of greater threats. The other pertains to the forest with a lower deforestation rate, suggesting a lesser degree of threat.

Indeed, VERRA's approaches are oriented when it mentions that '... The reason why the estimated emission reductions differ widely is that an FREL represents an average across an entire country or region and is not specific to a particular site, whereas a baseline accounts for a more accurate estimate of the expected deforestation in the project area...'.

VERRA continues by mentioning that *'... If we follow the logic of the CMW report (that is, using average regional baselines in all areas for all projects), developers could set up their projects in areas with low deforestation because they would achieve the same emission reductions with less effort'*[15].

For example, referring to Illustration 3, between the borders of the states of Caquetá and Vaupés, where little or no deforestation occurs, a REDD+ project could claim good results for reducing forest loss with little effort, since the deforestation rate of that area would be lower than the general rate of the Amazon biome.

[15] https://verra.org/carbon-market-watch-report-on-colombian-redd-projects-contains-flawed-allegations/
[16] *'Two Shades of Green: How hot air forest credits are being used to avoid carbon taxes in Colombia'", page 9.*
[17] *'Two Shades of Green: How hot air forest credits are being used to avoid carbon taxes in Colombia'", page 5.*

This is an aspect that is recognized by CMW when it explains that '... However, it is possible that specific areas within a jurisdiction are at higher risk of deforestation than the jurisdictional average, and hence taking other, more local, factors into account is relevant'[16] (without giving further detail or explanation about these 'more local factors'), so CMW would be presenting disqualifying statements against the REDD+ Matavén Project and then contradicting itself by accepting the possibility that its initial assertions may not be correct.

It should also be considered that when CMW indicates that '... CMW does not make any judgement over the adequacy of the Colombian government's jurisdictional REDD+ programme, nor its associated baseline, but relies on its data because it is used as a reference in the carbon tax regulation. Should this government baseline itself be inflated, this would make the (already conservative) estimates of hot air credits presented in this briefing lower than the real scale of the problem...'[17] , it is casting doubt even on the Government's own baseline (FREL), with which it intends

On the other hand, it has been observed that the FREL determined the average annual rate of historical deforestation for the entire Amazon biome of the country (as the Reference Area) and, simultaneously, used that same area to estimate future expected results in GHG emission reductions, that is, the area where deforestation is projected is the same area that was taken as reference. This is another aspect in which it differs from the REDD+ Matavén Project, as this initiative uses different areas to assess the threat of deforestation (in the Reference Region RRD) and to project future deforestation (in the Project Area), as previously explained, which constitutes another differentiating aspect.

Regarding the data presented by CMW:

The 2013-2017 FREL explains that the Amazon biome has 399,737 km² (39,973,700 ha) of forest in the year 2012 and the Forest Cover Change (FCC), which would equate to deforestation, was as follows: siguiente:

Analyzed period	FFC (ha./year)	Fraction of the Amazon Biome without information
2000 – 2002	-77.042	0,07
2002 – 2004	-95.846	0,06
2004 – 2006	-82.448	0,10
2006 – 2008	-78.998	0,12
2008 – 2010	-69.355	0,13
2010 – 2012	-93.604	0,27
Average 2000 - 2012	**-82.883**	

Source: FREL 2013-2017, Table 1 Deforestation data for constructing the Reference Level

With the above data, which corresponds to annual averages for each biennial period, the amount of forest in the Amazon biome for each annual period can be approximately calculated (data are not presented in the FREL, and data available in the SMByC differ from the above) as follows:

Analyzed period	Deforestation (ha./year)	Forest at the beginning of each period (ha.)*	
2000 – 2001	77.042	40.891.244 + 77.042	40.968.286
2001 – 2002	77.042	40.814.202 + 77.042	40.891.244
2002 – 2003	95.846	40.718.356 + 95.846	40.814.202
2003 – 2004	95.846	40.622.510 + 95.846	40.718.356
2004 – 2005	82.448	40.540.062 + 82.448	40.622.510
2005 – 2006	82.448	40.457.614 + 82.448	40.540.062
2006 – 2007	78.998	40.378.616 + 78.998	40.457.614
2007 – 2008	78.998	40.299.618 + 78.998	40.378.616
2008 – 2009	69.355	40.230.263 + 69.355	40.299.618
2009 – 2010	69.355	40.160.908 + 69.355	40.230.263
2010 – 2011	93.604	40.067.304 + 93.604	40.160.908
2011 – 2012	93.604	39.973.700 + 93.604	40.067.304*
Total 2000 - 2012	**994.586**		
Average 2000 - 2012	**82.883**		

** The forest in 2012 (at the end of the last analyzed period: 2011-2012) is 39,973,700 ha, to which deforestation for that period is added: 93,604 ha, resulting in an estimated total of 40,067,304 ha of forest in 2011 (at the beginning of the last analyzed period 2011-2012).*
For the preceding periods, the deforestation in each period is added to the estimated total forest of the next period, until reaching year 2000 with 40,968,286 ha.

The total forest lost from 2000 to 2012 is 994,586 ha.

Deforestation rate can be calculated:

$$\text{Deforestation rate } r = \frac{Forest\ lost\ at\ t_f}{Total\ forest\ at\ t_i} = \frac{994.586\ ha.}{40.968.286\ ha.} = 0{,}0243 = 2{,}43\%$$

$$\text{Annual deforestation rate } r_A = \frac{r}{T} = \frac{0{,}0243}{12\ years} = 0{,}00243/year = 0{,}243\%\ annually$$

The annual deforestation rate calculated differs from the deforestation rate proposed by CMW for the FREL 2013-2017, considering that it is unknown how the author of the report obtained the value of 0.18% (procedures for the called 'Quantitative Reconstruction of the Baseline' are not found).

5.7 Assessment of historical deforestation in the ReferenceRegion to determine the Baseline of the REDD+ Matavén Project

Causes of Deforestation in the Reference Region RRD during the Historical Reference Period (HRP)

In the course of establishing the Baseline (2012) for the REDD+ Matavén Project, a thorough investigation was conducted to identify the principal threats, causes, and agents of deforestation.

As described in the Project Design Document (PDD) (ACATISEMA & MEDIAMOS F&M, 2017), the transition strip between the savannas of the Orinoquía and the forests of the Amazon, forms a barrier at the edge of the forest, making it more accessible to various threats emanating from neighboring areas, such as:

- **Agricultural activities**

Agricultural activity has been one of the most significant causes of deforestation, which not only threatens but has already affected the interior of the Resguardo. This was mentioned in the study by the Alexander von Humboldt Institute and ACATISEMA in 2009 (prior to the start of the REDD+ Matavén Project), which noted that: ‘Currently there are various production systems that are endangering the socio-environmental diversity of the Matavén area. Among these are cattle ranching, illicit crops, among others. These anthropic activities have a great impact on all elements of the landscape (for example, deforestation, savannization, contamination of water resources, loss of soil nutrients, displacement of fauna), since they involve the implementation of techniques and/or practices of using the territory that are alien and go against the natural dynamics of the ecosystems distributed in this area’ (Villarreal Leal, et al., 2009).

Also, a study by the University of Los Llanos in 2002 (prior to the start of the REDD+ Matavén Project) found that ‘...Colombian cattle ranching has been expanding throughout the country, as part of agricultural development policies, including among the beneficiaries of such policies the indigenous communities (Reserves and Indigenous Reserves). These policies have considered cattle ranching important, not only as a nutritional alternative by providing meat, milk, and their derivatives, but also to maintain land tenure, to ‘justify’ the requests to expand the reserves by the INCORA…’ (Falla Molano & Galvis Salcedo, 2002).

Additionally, high activity in the cultivation of coca leaves was documented in an area immediately adjacent (Chupabe), and the navigable rivers surrounding the entire Matavén area serve as a pivotal transit route (refer to Map 9).

However, these were not the only deforestation threats looming over Matavén. At the beginning of the Project, the Resguardo also faced pressure from invasions by settler ranchers and coca leaves cultivation.

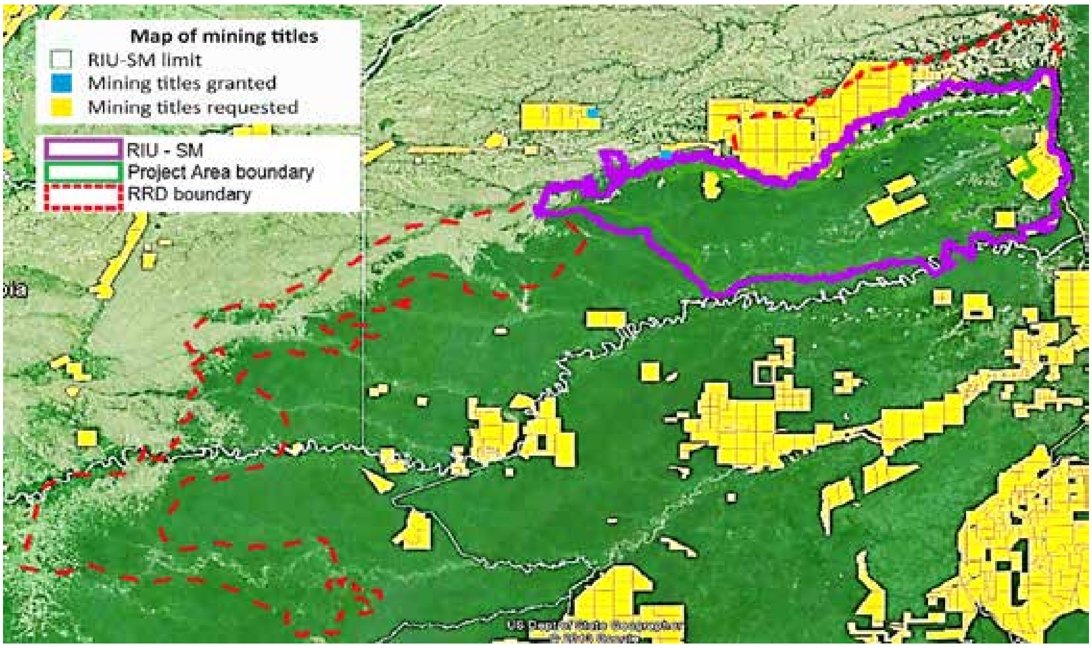
- **Oil / Mining interest minero**

During the presidential terms of Álvaro Uribe Vélez (2006-2010) and Juan Manuel Santos (2010-2014), multiple requests for mining and energy exploration were documented both within the Resguardo Indígena Unificado Selva Matavén and its neighboring areas. These requests, which included the extraction of resources such as oil, coal, and gold, could have generated greater pressure on the ecosystems of the region, as happened in the transition zone of the Colombian regions of Orinoco and Amazon.

> Fortunately, Matavén avoided a situation of massive deforestation thanks to the REDD+ Project that started in 2013.

Owing to its substantial mineral wealth, including oil, coal, gold and other non-renewable natural resources, there was a significant economic attraction for the area (mainly in the course of the Vichada and Orinoco rivers); and a complex situation around some exploitation processes that had been developing within the limits of the Matavén and in adjacent areas, before the start of the REDD+ Matavén Project (during the years 2006 to 2010) and even during the implementation of this project (years 2010 to 2014). Throughout these periods, there were multiple requests for mining and energy exploration, alongside instances of illegal mining driven by economic booms, such as the coltan boom. These circumstances could have intensified pressure on the region's ecosystems, potentially escalating the deforestation rate in the area.

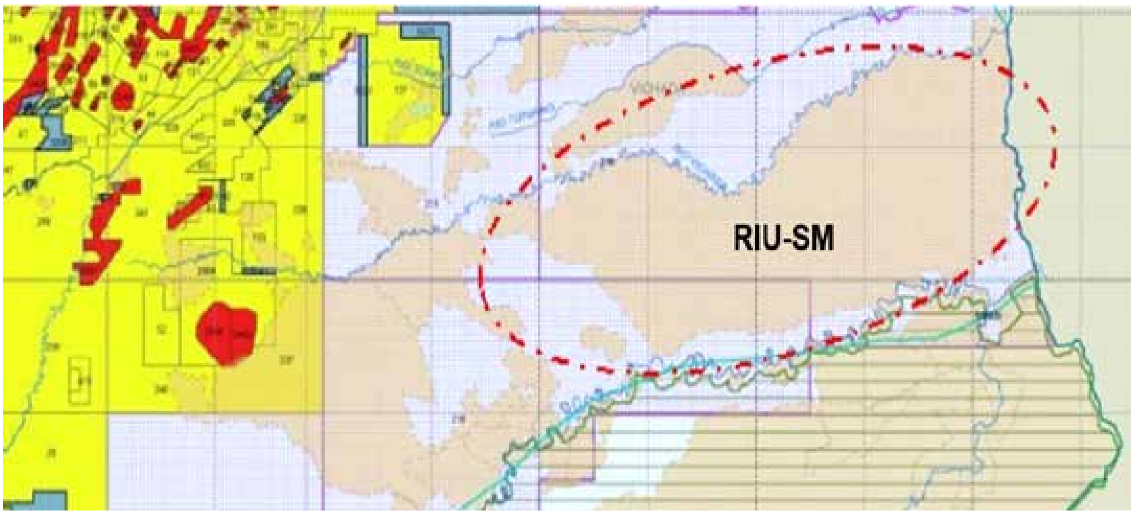
Map 11. Mining requests in the RRD Reference Region and in the Resguardo Indígena Unificado Selva Matavén prior to the start of the Project (2011)



Source: Environmental Justice Colombia

As shown in Map 11, during the Historical Reference Period, a sub-area of the Reference Region bordering Matavén to the north, was notably marked by a concerning number of mining requests. This situation was already being replicated in areas within the Resguardo: along the Vichada River (to the north), in the heart of the Matavén Caño basin (internally), along the Orinoco River and towards the city of Inírida, on the Guaviare River, constituting latent threats against the conservation of its natural resources and biodiversity.

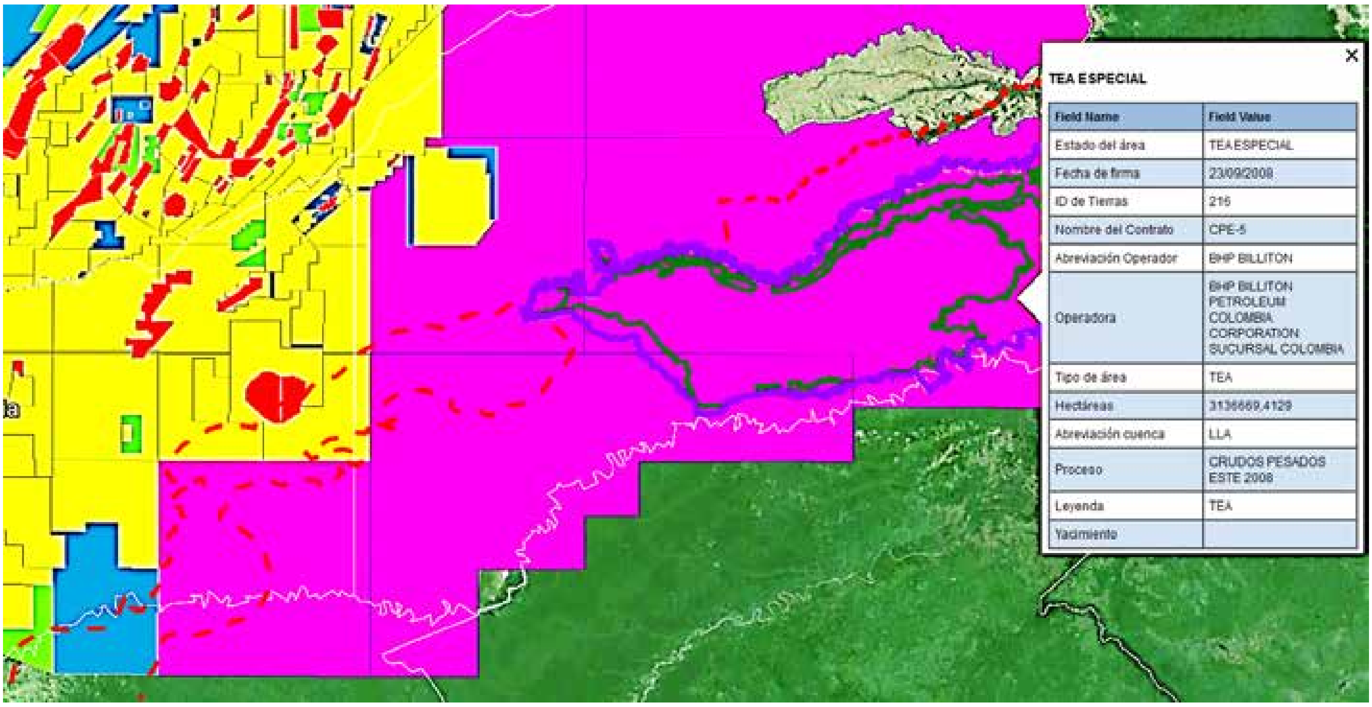
Map 12. The Reference Region and the Resguardo Indígena Unificado Selva Matavén areas of oil interest (2010 - before the Project)



Source: REDD+ Matavén Project Design Document (PDD), section 1.10.10.

[18] https://justiciaambientalcolombia.org/mapa-titulos-y-solicitudes-para-actividades-mineras-en-colombia/ y https://sites.google.com/site/tierraminada/

Map 13. The Reference Region and the Resguardo Indígena Unificado Selva Matavén within a broad area under a Technical Evaluation Contract (TEA) granted since 2008



Fuente: Justicia Ambiental Colombia[19]

As seen in Maps 12 and 13, both the Reference Region and the Resguardo Indígena Unificado Selva Matavén have garnered attention for oil exploration, particularly within the delineated area identified as strip 6, the 'Orinoquia - Amazon Transition Savanna,' as explained earlier. This reinforces the similarity between the Reference Region selected and the REDD+ Matavén Project Area in terms of the nature of a threat that could potentially impact them.

- **Immigration**

On the other hand, despite being a situation evaluated during the REDD+ Matavén Project implementation, the Resguardo Indígena Unificado Selva Matavén, located in a unique and particularly vulnerable ecosystem, has experienced considerable impact due to the influx of indigenous people originally from the Resguardo returning from Venezuela, and primarily settlers, during the years 2016 and 2017. According to the residents of the Resguardo, driven by increased economic opportunities in the vicinity of the city of Inírida (in contrast to the recent social and economic conditions in the neighboring country), they aspire to engage in economic activities and, in some instances, participate in the extraction of natural resources (wood, minerals) prevalent and expanding in the area.

Determination of the Deforestation Rate in the Reference Region during the Historical Reference Period (HRP)

In contrast to the methodology employed to formulate the FREL (where the anticipated deforestation area coincides with the reference area), the approach of the REDD+ Matavén Project utilizes the Reference Region independently of the Project Area (PA). This method determines a deforestation

[19] https://justiciaambientalcolombia.org/mapa-titulos-y-solicitudes-para-actividades-mineras-en-colombia/ y https://sites.google.com/site/tierraminada/

rate grounded in external threats rather than relying on an analysis conducted within the confines of the Project Area itself (please refer to Map 11, Main Threats to the Selva Matavén), where the assessment of forest cover loss cannot be determined.

In the case of the REDD+ Matavén Project, deforestation was 138,565 hectares during the Historical Reference Period (HRP) 2001–2011, the Reference Region had 1,444,805 hectares of forest in 2001 (at the beginning of the HRP). The reference deforestation rate was calculated as follows:

$$\text{Deforestation rate } r = \frac{Forest\ lost\ at\ t_f}{Total\ forest\ at\ t_i} = \frac{138.565\ ha.}{1.444.805\ ha.} = 0{,}0959 = 9{,}59\%$$

$$\text{Annual deforestation rate } r_A = \frac{r}{T} = \frac{0{,}0959}{10\ years} = 0{,}00959/year = 0{,}959\%\ annually$$

Source: The calculation of this deforestation rate is based on the procedures, data, and operations presented in the PDD of the REDD+ Matavén Project (ACATISEMA & MEDIAMOS F&M, 2017), Section '3.1.2.5 Calculation of the historical deforestation rate' (page 202) [Annex 1 of this document provides a summary of the data, procedures, and calculations that support the value of this deforestation rate, and Annex 2 presents the estimation of the projected emission reductions for the life cycle of the REDD+ Matavén Project]

This corresponds to the deforestation rate with which emissions were subsequently projected in the REDD+ Matavén Project Area in the baseline scenario.

Again, differences are observed with the deforestation rate for the REDD+ Matavén Project that was presented in the CMW article.

Annex 1 of this document contains a description of how the REDD+ Matavén Project has met the requirements of the applied methodology in relation to:

- Temporal boundaries: Historical Reference Period (HRP) and accreditation period.
- Spatial boundaries: Project Area (PA), Leakage Belt (LB), Reference Region for projecting the Deforestation rate (RRD), and Reference Region for Locating projected deforestation (RRL).
- Similarity criteria.
- Selection and processing of satellite images (evaluation of data and deforestation patterns in the Reference Region and its source, changes in Forest, Non-Forest and other covers, image processing method).
- Modeling of deforestation prospects (spatial model, IDRISI Selva software, factors, calibration, deforestation probability map, risk map, prediction scheme, maps for locating future deforestation, model validation).

Annex 2 of this document contains a description of how the REDD+ Matavén Project has met the requirements, once the Reference Region was defined, to estimate GHG emission reductions, consisting of determining:

- Forest stratification (in biomes).
- Pre-deforestation carbon stocks and contents by stratum (above and below-ground biomass as a result of fieldwork on plots and the application of allometric equations, soil organic carbon and conversion to CO2; conservatism: Above-ground biomass of the Project lower than the biomass in the same deposit of IDEAM 2011).

- Land use change (post-deforestation carbon stocks; conservatism: the Project analyzes net Carbon contents, unlike the FREL that analyzes gross Carbon contents -higher-).
- Projection of deforestation in Project Area and Leakage Belt, changes in Carbon stock in baseline (conservatism: The Project's emission factor is lower than that handled by the FREL).
- Ex-ante emissions in the scenario with-project (conservatism: the Project deducts from gross emissions those it considers would occur in a scenario with a project).
- Emissions due to leakage by displacement of deforestation due to Project activities (conservatism: the Project deducts from gross emissions those it considers would occur due to leakages outside the Project Area and outside the Leakage Belt).
- GHG emission reduction estimations with uncertainty analysis (conservatism: the Project conducts an uncertainty analysis, which is not done in the construction of the FREL).
- Calculation of reductions that are deposited in a "Buffer" account (conservatism: the Project deducts a proportion from net emissions for the buffer account, which is not applied in the use of the FREL).
- Calculation of Verified Carbon Units (VCUs).

[Conservatism is a VCS quality assurance principle that consists of using conservative assumptions, values, and procedures to ensure that emission reductions are not overstated.]

The REDD+ Matavén Project determined the deforestation rate defined in the Reference Region to project future forest loss in the Project Area (PA) during the readiness or feasibility phase (at the end of 2012 and the beginning of 2013). This occurred before Colombia submitted the National Forest Reference Emission Level (FREL) to the United Nations Framework Convention on Climate Change (UNFCCC), receiving approval in October 2015, and preceding the issuance of Decree 926 of 2017. The Project concluded its validation and initial verification in 2017, preceding the issuance of Resolution 1447 of 2018[20] .

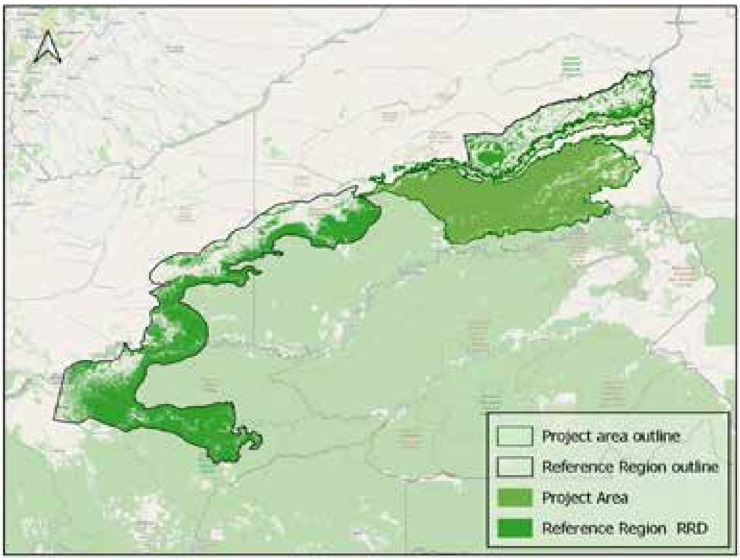
Consequently, the Project established its reference parameters in accordance with the procedures specified and mandated by a widely adopted and recognized methodology at both the national and international levels, such as the VCS VM0007 from VERRA; and based on the climate change policy in effect in the country until 2013. Therefore, when establishing its baseline, the REDD+ Matavén Project adhered to all regulations, law, decree, resolution; and continues to comply with them.

5.8 Inadequate comparisons to evaluate the REDD+ Matavén Project

The CMW article (2021), in its section on ‘Quantitative Reconstruction of the Baseline,’ draws a comparison between the deforestation rates of the Reference Region as presented by the REDD+ Matavén Project and those of the Colombian National Forest Reference Emission Level (FREL) and the state of Vichada. However, this direct comparison lacks a robust foundation and fails to provide an accurate assessment of the data. Firstly, both areas are not representative from a biophysical perspective. Secondly, the comparison is made between dissimilar regions and across different historical periods[21]. It is crucial to consider these aspects to prevent drawing erroneous conclusions without ensuring an adequate analysis of the data.

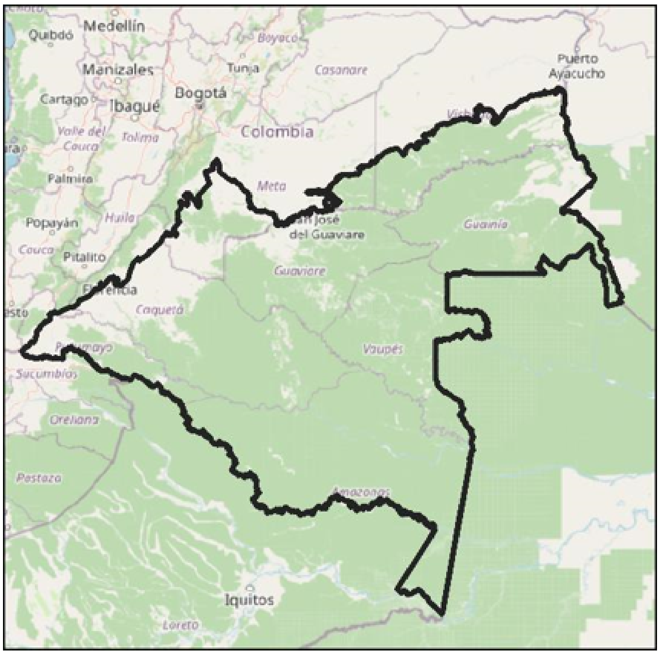
Even more delicate is the comparison of the deforestation rate between the boundaries of Matavén during periods after the initiation of the REDD+ Matavén Project in 2013 (which already includes the Project Area, where activities are specifically undertaken to prevent deforestation) and the deforestation rate of the Reference Region of the REDD+ Matavén Project. This approach is inadequate and should not serve as a basis for comparison. In Table 10 below, we present a case-by-case analysis.

Table 10 List of dates and regions compared in various journalistic articles

Matavén REDD+ Project	Comparison
	Reference Region of the Matavén REDD+ Project HRP: 2001-2012 Deforestation Rate: 0.959% / Year

[21] *A historical reference period in terms of deforestation refers to a specific time interval chosen as a basis for assessing changes in forest cover. For example, from 2000 to 2010 or 2008 to 2012. During this period, data are collected, and measurements are established on deforestation and forest pResguardo. It is important to highlight that comparing different historical periods implies analyzing social, economic, and environmental conditions that may have changed significantly between those times. Factors such as government policies, population growth, economic development, and other historical events can influence deforestation patterns at different times. Therefore, when comparing deforestation rates in different historical periods, these contextual and socioeconomic differences must be taken into account to obtain appropriate conclusions and avoid erroneous interpretations.*

Case 1: Amazon Biome
National NREF
HRP: 2013-2017
Deforestation Rate: 0.243% / year



In the CMW (2021) article, a comparison is exclusively made on deforestation rates without adequately emphasizing the use of historical reference periods, which pertain to different decades.

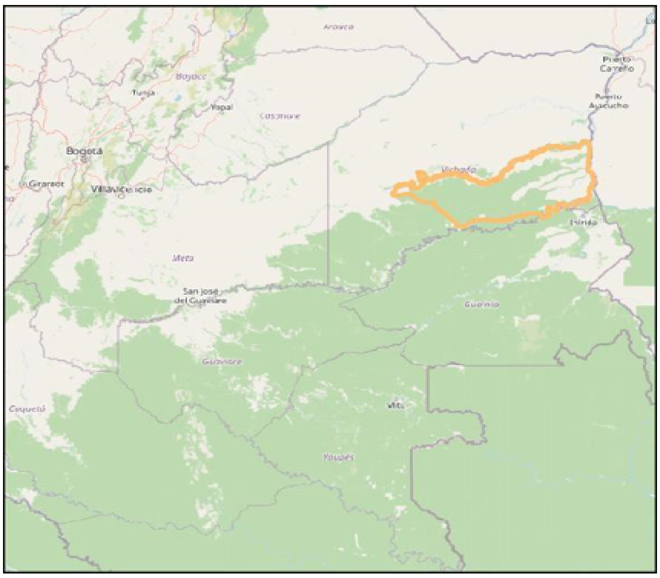
The omission of clear specification regarding historical reference periods in the comparative does not allow the interpretation of the results accurately and comprehend the temporal context within which changes in forest cover occurred.
In addition, the Amazon biome is not biophysically representative of the Matavén REDD+ Project.

Note: Throughout the 2013-2017 period, activities of the Matavén REDD+ Project to prevent deforestation in the Project Area were already underway. Hence, any data extracted during this Historical Reference Period is not suitable for comparisons.

Case 2: Boundary of the state of Vichada
HRP: Not specified in the CMW article
Deforestation Rate: 0.143% / year

The CMW article establishes a comparison between territories with different biophysical conditions and includes a region primarily corresponding to the Orinoquía, which falls outside the designated transition zone. It is crucial to emphasize that the absence of specification regarding the Historical Reference Period used to derive the deforestation rate does not allow a proper understanding of the presented results, making it even more challenging to draw valid conclusions.

Case 3: Boundary of the Indigenous Reservation of the Matavén Forest
HRP: Post-2013
Deforestation Rate: 0.06% / year



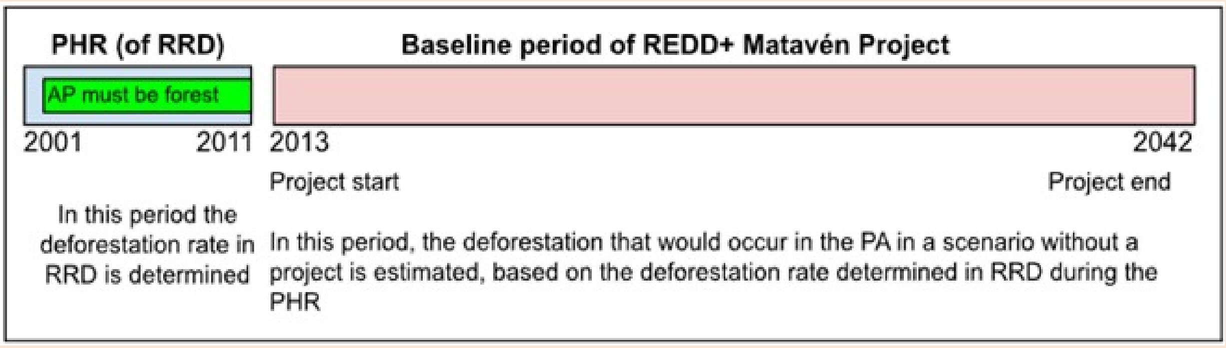
CMW and CLIP have calculated a deforestation rate for Matavén over the last 10 years (2012-2022) and compared it with the deforestation rate of the Reference Region in the period (2001-2011) to demonstrate an alleged inconsistency. However, this comparison lacks validity, given that the deforestation rate in the Indigenous Reservation of the Matavén Forest has been significantly low, thanks to the activities of the Matavén REDD+ Project since its initiation in 2013.

The determination of the deforestation rate in the same Project Area (PA) is not feasible

Due to the provisions of the applied methodology, VCS VM0007, the REDD+ Matavén Project refrains from calculating its average annual deforestation rate during the HRP based on the analysis of activity data in the same Project Area (PA), because, among other requirements, the PA must be forest at the beginning of the Project and also 10 years prior. Therefore, it would not be possible to find differences in its forest cover during those years (PA was 100% forest in 2011 and also was 10 years earlier, in 2001), and thus, a deforestation rate r = 0% would be found.

Considering the above, the analysis of forest loss is required to be conducted in the Reference Region, which is the similar region to accurately determine the deforestation rate, and not in the Project Area (PA) where the deforestation rate would be 0%.

Historical Reference Period and Baseline Period
Case: REDD+ Matavén Project



Note: The period in which the Project Area (PA) must be forest, HRP, before the start of the Project.
Source: Own elaboration

Por According to provisions of the applied methodology, this Reference Region must be defined at the beginning of the HRP (in 2001) and must have only forest cover. So, at the end of the HRP (in 2011), this Reference Region has already lost forest cover, whose quantification is the basis for calculating the annual deforestation rate (r) of the REDD+ Matavén Project.

The CMW (2021) article states the following: 'the fact that it includes a much wider deforestation frontier than what could realistically happen in the project area is very important. Logically, logging is much easier starting at the edge of a forest. '

This becomes particularly relevant as logging is more accessible along the edges of forests, a variable termed as "forest edge" in spatial modeling. Both the Reference Region and the Project Area exhibit extensive forest edge characteristics, attributed to the already deforested areas and the features of the transition landscape between the Colombian Orinoquia and the Amazon. In this region, savannas intermingle with forests, facilitating more direct access compared to areas situated in the central part of the Amazon.

Another erroneous assertion in the CMW (2021) article is as follows: 'If the reference area is supposed to represent a likely scenario for the future project area, this assumes that Indigenous Peoples' tenure in the project area would be rolled back in the absence of the project

implementation. This is highly unlikely given that Indigenous Peoples' tenure is regulated through national measures, and any changes would be politically sensitive.
At no point in any of our documents have we asserted that in a scenario without the Project, the territorial rights of indigenous peoples would be lost. While the titling of communal indigenous reserves has been pivotal in safeguarding these communities, their territorial boundaries are not necessarily impermeable to deforestation. In the case of the REDD+ Matavén Project Area, the territories are extensive relative to the population, amounting to approximately 120 hectares per inhabitant.

The absence of governance, the lack of financial resources for the indigenous guard and their leaders, and the scarcity of productive projects would leave Matavén vulnerable to the fluctuations in governmental policies and incentives, rendering it fully exposed to illegal economic activities such as mining and illicit agriculture, among other potential threats.

In conclusion, inadequate comparisons have been made to evaluate the REDD+ Matavén Project by using dissimilar reference regions and more recent or post-2013 historical periods.

A particularly out-of-place case is case 3, presented in Table 10.

Firstly, the Resguardo Indígena Unificado Selva Matavén includes the REDD+ Matavén Project Area, which represents 84% of the forests within the Reserve at the start of the Project in 2013. Therefore, using the historical deforestation rate of the Resguardo as a basis for projections is inadequate.

This approach does not consider the governmental policies and incentives promoted by the Colombian Government between 2010 and 2014, which included the '5 engines of development'. Nor does it address the need to confront illicit economic activities.

The decision of the Matavén communities to embrace a REDD+ project played a pivotal role in shaping their development and life plans. The deforestation rate before the initiation of the Project and the rate recorded after its start cannot be considered as suitable references for comparing the effectiveness of the Project.

A low deforestation rate from 2012 to the present does not mean that Matavén is not constantly threatened by external deforestation agents. There is ongoing pressure on the forests Matavén, as evidenced in Map 9.

Using time series models and/or trends to predict deforestation underestimates the true threat and does not consider the spatiotemporal nature of the deforestation phenomenon. Furthermore, employing a simple rule of three, as demonstrated in the CMW (2021) article, for comparisons is not a rigorous approach and fails to adequately capture the complexity inherent in deforestation dynamics.

After reviewing the differences between the Colombian FREL and the REDD+ Matavén Project in terms of geographical scale and coverage, reference and projection period, activity data, emission factors, territorial extent, and the determination of deforestation, some important points can be noted:

- While the FREL uses Forest to Non-Forest changes, the REDD+ Matavén Project considers changes from forest to Heterogeneous Agricultural Areas and other covers, even in areas smaller than 1 hectare. This difference is significant as it enables greater precision in identifying changes, leading to a more detailed estimation of deforestation dynamics.

- The first FREL sets a 12-year reference period (2000-2012), with a 5-year projection period (2013-2017); the second FREL presents a 9-year reference period (2008-2017) and a 5-year projection period (2018-2022). In contrast, the REDD+ Matavén Project sets a 10-year reference period (2001-2011) and a 30-year projection period (2013-2043), making them non-comparable.

- Regarding activity data, it is observed that the FREL is based on monitoring results generated by Colombia's Forest and Carbon Monitoring System (SMByC), procedures that we also apply in the REDD+ Matavén Project, specifically following the IDEAM protocol (E. Cabrera et al., 2011).

- Differences are also observed in the emission factors used by the FREL and the REDD+ Matavén Project. While the FREL uses an emission factor for the entire Amazon biome, the REDD+ Matavén Project stratifies different emission factors for above-ground biomass, below-ground biomass, and soil organic carbon in four specific biomes. This stratification is based on data from 131 forest plots in the Project Area, enhancing the precision of biomass values in this transition zone.

- There is significant differences between the REDD+ Matavén Project Area and the Amazon biome, where the transition edges from the Andes and from the Orinoquia towards the Amazon have a much more accelerated deforestation than the center of the Amazon. The Resguardo Indígena Unificado Selva Matavén is well preserved attributable to the implementation of the Project, despite its heightened vulnerability due to its location within the transition zone between the Orinoquía and Amazon biogeographical regions.

- Simplistic comparisons lack rigor as they concentrate on distinct regions, disparate emission factors, and divergent historical reference periods, without considering the methodologies employed in their construction.

6. Differences between Deforestation Data Sources

In this chapter, we will explore the divergences that arise when using different data sources to quantify and analyze deforestation. It will underscore how the comparisons made in some media articles have not only been superficial in terms of combining non-similar historical reference periods and reference regions but have also employed different data sources[22].

The main objective of this chapter is to explain the various satellite data sources available and the associated cartographic generalization processes, which can significantly influence the results obtained. Additionally, official deforestation data in Colombia will be examined, underlining the inappropriateness of using global data as a reference for direct comparisons.

Through this section, a more accurate insight will be provided on the differences between deforestation data sources, and the importance of carefully considering the consistency of sources, the Reference Region and the spatial resolution when conducting studies and comparisons related to deforestation.

6.1 Minimum Mapping Unit (MMU)

The Minimum Mapping Unit (MMU), as defined by 'GOFC-GOLD Global Observation of Forest Cover-Global Observation of Land Dynamics' (2016), refers to the smallest spatial unit used to delineate and classify forest cover on a map.

This unit is defined in a way that allows accurately capturing the details and characteristics of the different types of vegetation present in a specific area.

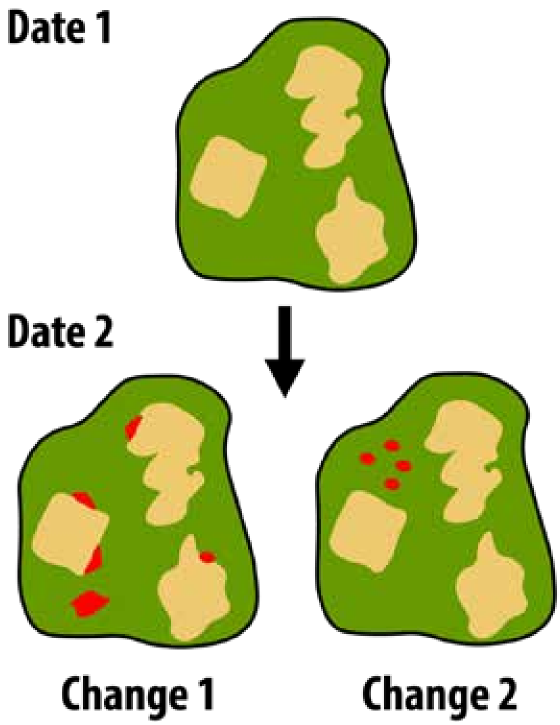
The selection of the MMU depends on several factors, such as the spatial resolution of the available data, the heterogeneity of the landscape, and the specific objectives of the analysis. Typically, the MMU is chosen to be small enough to capture the spatial variability of forest cover, but also large enough to avoid problems of interpretation and misclassification.

Establishing an appropriate MMU is essential to ensure the accuracy and comparability of cartographic data used in monitoring and assessing changes in forest cover at a global scale.

The relationship between the MMU, pixel size, and geographical scale is fundamental for understanding and analyzing cartographic data. The MMU refers to the smallest spatial unit used to delineate and classify information on a map, while the pixel size refers to the physical dimensions of each image element in a satellite image or raster data set. Both concepts are closely related to the geographical scale, which refers to the relationship between the dimensions of the real world and the representations of those elements on a map.

[22] In this regard, it is important to point out the critical observations made by VERRA in its report of January 31, 2023, where it states that certain data used, such as satellite images with a resolution of 250 meters x 250 meters (6.5 hectares), are inadequate for REDD projects, and significantly deviate from Verra's recommendations for a resolution of 100 meters x 100 meters. Additionally, the Global Forest Watch dataset, widely recognized by scientists as unsuitable for estimating deforestation or for REDD purposes without proper adjustments, was also used without the necessary corrections by the authors of the articles West et al. 2020 and West et al. 2023.

Illustration 2 Transition between two dates establishing the Minimum Mapping Unit (MMU)



On date 1, a coverage of Forest (area in green) and Non-Forest (brown polygons) is observed. Transitioning to date 2, two areas of change are identified. In change-1, red polygons adjacent to the Non-Forest area are found. These polygons, even if they are below the Minimum Mapping Unit (MMU), can be considered as part of the Non-Forest area and quantified as deforestation. On the other hand, the red polygon numbered as 2 does not adjoin Non-Forest areas and is only quantified as deforestation if it meets the criteria of MMU. In the Change-2 area, small red polygons numbered as 3 are observed, which are not considered deforestation because they do not meet the MMU. However, in terms of change detection on satellite images, we can adopt the term Minimum Units of Change Detection (MUCD).

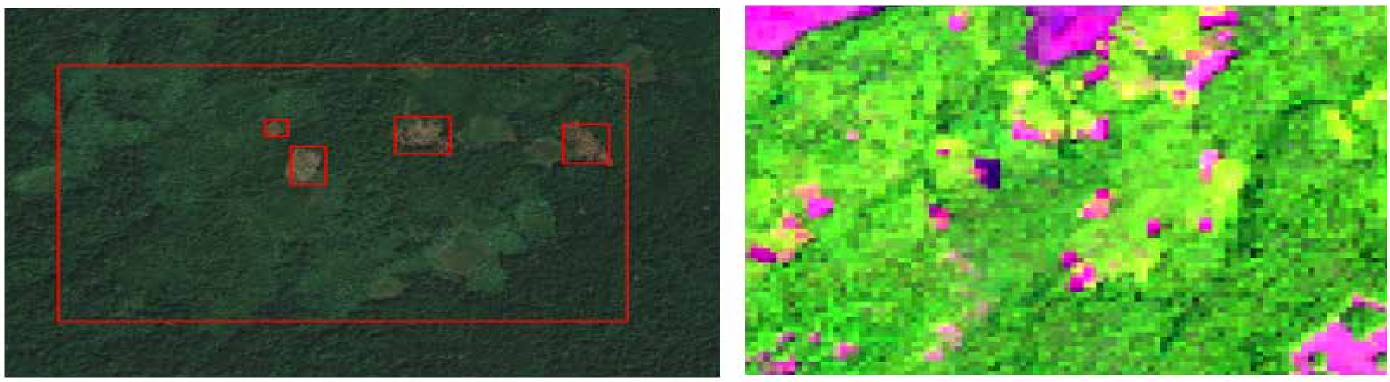
When working with geospatial data, it is important to consider the relationship between the MMU and the pixel size. If the MMU is smaller than the pixel size, there may be a loss of information and detail in the cartographic representation. If the MMU is larger than the pixel size, problems generated by cartographic generalization[23] can arise, and important landscape features may be lost (See Illustration 2).

Geographical scale also plays a crucial role in this relationship. As the geographic scale is enlarged, that is, focusing on smaller and more detailed areas, the MMU and pixel size must be small enough to capture the spatial variability and details of the geographic phenomena. At a broader geographic scale, a larger MMU and pixel size can be used, as it will focus on a more general and comprehensive representation of the landscape features.

23. Cartographic generalization refers to a crucial process in the post-classification of satellite images, aiming to simplify and represent complex information in a more understandable manner. Choosing a too large Minimum Mapping Unit (MMU) poses the risk of losing valuable details and nuances present in the original data. Conversely, if the MMU is not appropriately selected, it can lead to incorrect detections of changes, thereby increasing the total margin of error in the interpretation and analysis of geospatial information.

Illustration 3 Heterogeneous Agricultural Areas (conucos) in the Orinoco and Amazon transition zone

Google Earth screenshot *Sentinel-2 Satellite Image in Swir-Nir-Red Combination*



In the left image, a detailed satellite view of the area is presented, where the forest can be clearly distinguished, as well as areas of regenerating vegetation marked with a large red rectangle and small patches of deforestation enclosed in smaller red rectangles. These latter patches of HAA or conucos each cover an extent of 0.3 hectares. In contrast, the right image offers a wider view of the same landscape using data from the Sentinel-2 satellite. Here, the primary forest is shown in darker shades of green, the regenerating vegetation in lighter green, and the AAH patches in magenta. It is particularly interesting to note how these patches of deforestation, although small in extent and below one hectare, are perfectly visible even at the geometric resolution of the Sentinel-2 and Landsat satellite images.

The REDD+ Matavén Project employs a geographic scale of 1:100000, following the guidelines established by the Digital Image Processing Protocol of IDEAM in 2010 (E. Cabrera et al., 2011).

This geographic scale provides an overview of the study area, allowing detailed capture of information on changes in forest cover. Although the same geographic scale is used, different thematic scales and MMUs are applied in the Project.

The thematic scale used in the REDD+ Matavén Project is based on the Corine Land Cover adapted for Colombia (IDEAM, 2010), which provides a detailed classification of soil cover types. This thematic scale allows the identification and analysis of different patterns of change in forest cover, including the conversion of forests to Heterogeneous Agricultural Areas.

The MMU for the spatial boundaries of the REDD+ Matavén Project was not arbitrarily defined; instead, it was established through careful observation in fieldwork and analysis of satellite images.

The MMU is used to accurately capture deforestation processes, and its size is determined by understanding specific territorial dynamics. In the case of the REDD+ Matavén Project, it was identified that deforestation occurs in a mosaic manner, with the conversion of forests into Heterogeneous Agricultural Areas.

Denying or underestimating this MMU would mean ignoring and underestimating thousands of hectares affected by deforestation in the study area (See Illustration 3); a fundamental aspect that was overlooked by both CMW (2021) and Bermúdez Liévano (2021). Their conclusion that the baseline of the REDD+ Matavén Project is inflated and overestimating certified emissions lacks rigor and oversimplifies the complexities involved.
These conclusions were made public without due consideration for the potential harm caused to the REDD+ Matavén Project, particularly to its indigenous communities.

6.2 Information sources

The primary source used for remotely determining land cover and land use are free satellite images, among which the Landsat program, Sentinel-2, and MODIS stand out.

Landsat images[24] offer a spatial resolution (pixel size) of 30 meters, allowing the detection of detailed features on the Earth's surface. With these images, a geographic scale of up to 1:70000 is achievable, meaning that objects or phenomena of interest at a regional level can be identified and monitored.

On the other hand, Sentinel-2[25] images provide a higher spatial resolution of 10 to 20 meters, allowing for greater precision in identifying and tracking specific areas or at a municipal level (if viewed from this perspective). These images can also reach a geographic scale of up to 1:20000. In addition to these sensors, MODIS data, which offer a spatial resolution of 250 to 1000 meters, are also used. This resolution allows for a continental or global view, with these images having a geographic scale of up to 1:500,000.

Two main sources of information are distinguished. On one hand, there are primary or observed data, represented by satellite images. On the other hand, there are secondary sources, which comprise classified data derived from satellite imagery. That is, each pixel in the image receives a thematic category of land use and cover.

Regarding secondary information, three sources are identified for comparing their differences. Firstly, there is the Forest and Carbon Monitoring System (SMByC) of IDEAM, which uses Landsat satellite images to create a detailed representation of forest cover and changes to non-forest areas. This system provides geographic layers indicating deforested areas, Forest and Non-Forest, which have been freely available since 2018. Additionally, there is the Global Forest Change (GFC) database, a geospatial set that documents change in forest cover worldwide. These data are developed by Matthew Hansen's team at the University of Maryland and are accessible through the Global Forest Watch (GFW) platform or Google Earth Engine, having experienced improvements in precision and methodology over its versions.

t's also crucial to mention a third fundamental source: information derived directly from the REDD+ Matavén Project, in line with national protocols, such as those established by IDEAM (E. Cabrera et al., 2011), and guided by the best practices of image processing promoted by GOFC-GOLD. Specific data layers are generated, which are subjected to rigorous criteria of accuracy and validation, as required by VERRA. Additionally, it is also important to consider the interpretation made by the technical team of the Project of the unique characteristics of the region where it is developed, such as the dynamics of the Heterogeneous Agricultural Areas in the transition zones between the Orinoquia and the Colombian Amazon.

[24] Landsat images emerge as the primary source of information for REDD projects. The methodologies defined by VERRA require, at a minimum, this level of spatial resolution, or even the option to choose an even more precise and detailed one.

[25] Since Sentinel-2 satellite images are only available from 2015 onwards, it was not possible to use this data source to establish the baseline for the REDD+ Selva Matavén project in 2013. However, since then, these images have been used alongside Landsat to conduct annual monitoring of deforestation within the Project Area and the Indigenous Resguardo of Selva Matavén.

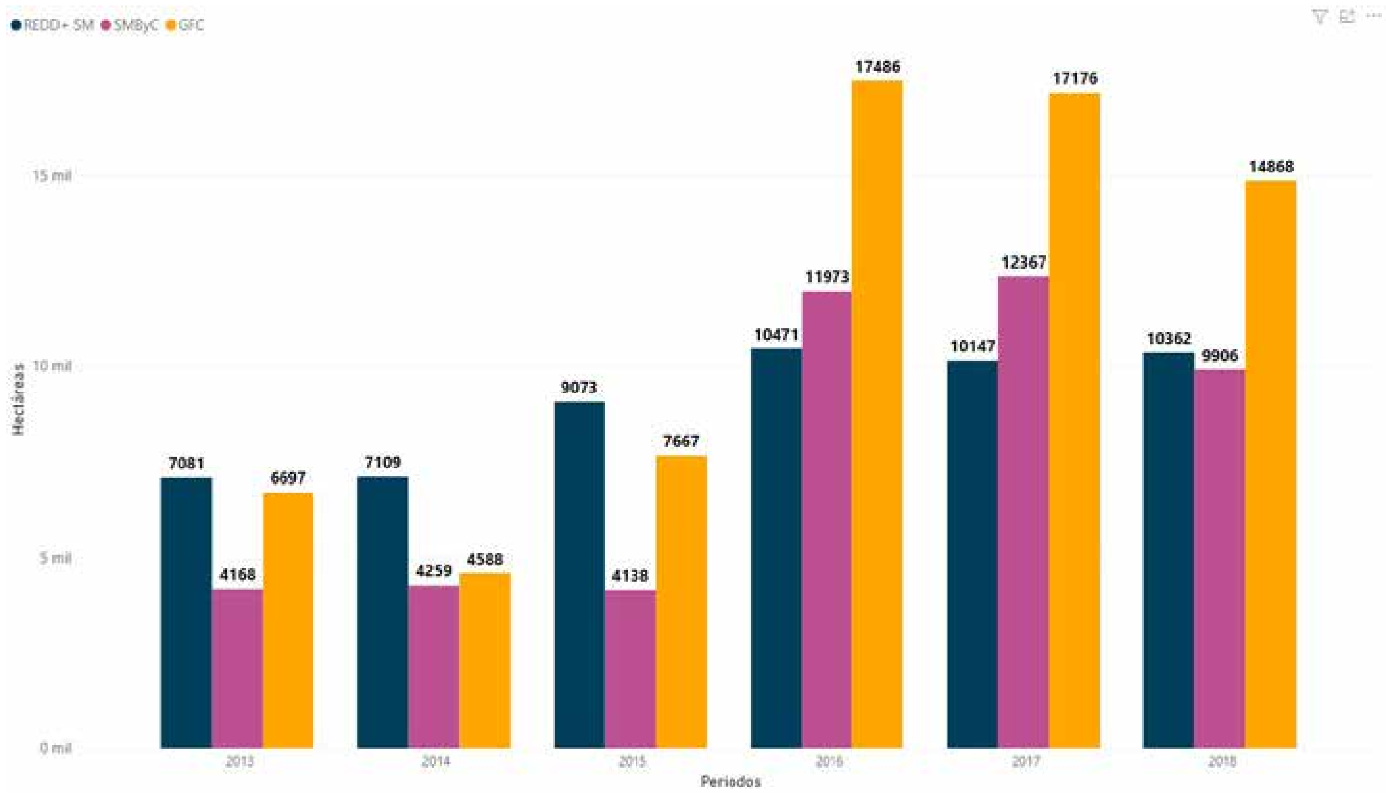
6.3 Comparison of Information Sources

We explore the discrepancies in deforestation data, which, despite sharing the same primary source (Landsat images), show differences in their final results. Our objective is to clarify the underlying causes of these differences.

For this, we initially examine a bar graph (Graph 1) illustrating the total magnitude of deforestation in the transition zone between the Colombian Orinoquia and the Amazon, marked as the Reference Region of the REDD+ Matavén Project. This analysis covers the period between 2013 and 2018, a critical phase with data available from the three mentioned sources: SMByC, GFC, and those generated through our own methods.
There is a noticeable disparity between the different data sources regarding deforestation. However, observing the behavior of the trends in Graph 2, a similar increasing trend can be seen from 2016 onwards.

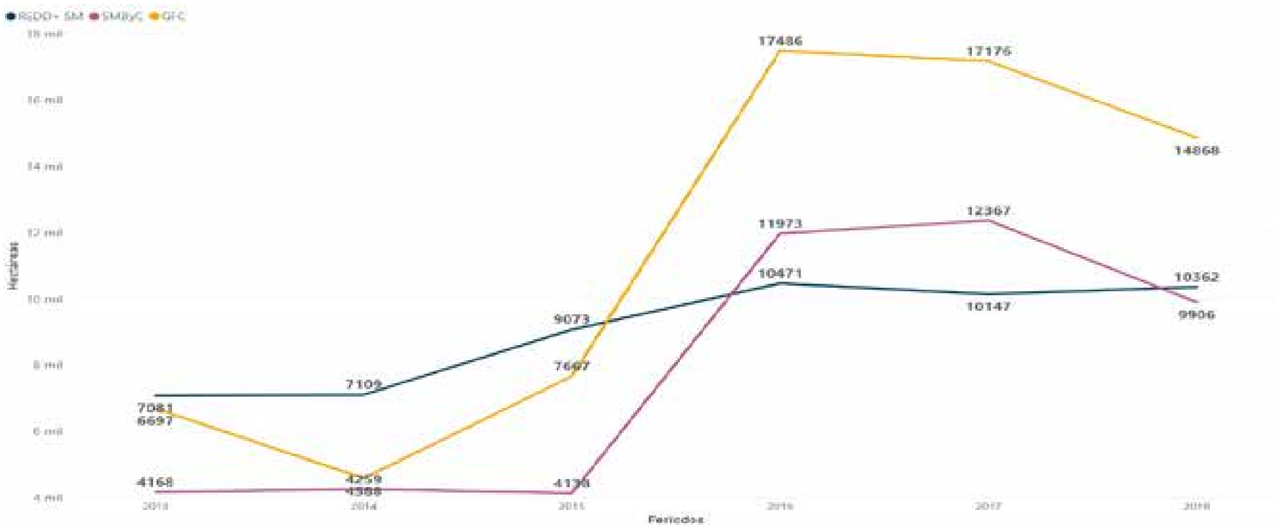
It is relevant to note that, although the data processed by the REDD+ Matavén Project present higher figures in the early years, they exhibit a lower standard deviation (see Table 6), indicating less variability compared to the alternative sources. Additionally, the abrupt increase in deforestation observed between 2015 and 2016 in the SMByC and GFC sources is not as pronounced in the REDD+ Matavén data (See Table 6 – specifically the standard deviation and the coefficient of variation).

Graph 1. Comparison of deforested area values in the Reference Region for 2013-2018 (Hectares/ year)



The dark blue bars represent data obtained through the classification method used in the REDD+ Matavén Project.
The magenta bars reflect national information from the SMByC.
The orange bars represent annual data provided by the global GFC dataset.

Graph 2. Historical trend of deforested area values in the Reference Region for 2013-2018 (Hectares/year)



Generally, an increase in the trend of all-time series is observed from 2016, more pronounced for the national SMByC data and global GFC data.

Table 6. Yearly comparison of deforestation data sources in the Reference Region (2013-2018)

Period	SMByC	REDD+ Matavén	GFC
2013	4167.7	7081	6697.01
2014	4259.0	7109	4587.75
2015	4138.4	9073	7667.26
2016	11973.0	10471	17486.45
2017	12366.8	10147	17175.63
2018	9906.2	10362	14868.13
Average	7802	9040	**11414**
Median	7083	9610	**11268**
Standard deviation	4046	**1586**	5743
Coefficient of variation (%)	52	**18**	50

The table presents annual deforestation data from three distinct sources: IDEAM-SMByC, REDD+ Matavén, and Global Forest Change (GFC). Notable trends can be observed, such as the highest deforestation detection found in GFC data with an average of 11,414, followed by REDD+ Matavén with 9,040, and SMByC with 7,802. This indicates that GFC detected higher deforestation compared to the other two sources. The median, representing the middle value of the ordered data, is 7,083 for SMByC, 9,610 for REDD+ Matavén, and 11,268 for GFC. The median is similar for SMByC and REDD+ Matavén but much higher for GFC. This suggests that GFC values are influenced by periods with significantly higher deforestation detection.
Standard deviation measures the dispersion of data around the average. For SMByC it is 4,046, for REDD+ Matavén it is 1,586, and for GFC it is 5,743. GFC shows the highest dispersion in its data, indicating a wider variability in deforestation across different periods.
For SMByC, the Coefficient of Variation (CV) is 52%, indicating relatively high variability in the data relative to its mean. For REDD+ Matavén data, the CV is 18%, suggesting lower relative variability compared to its mean. Finally, for GFC data, the CV is 50%, also indicating high variability.

GFC data starts with relatively low values at the beginning of the series, then experience a noticeable increase from 2016 onwards, significantly surpassing the other two sources. Similarly, SMByC data show an upward trend in 2016 and 2017.

Data from REDD+ Matavén exhibit lower variability, all sources show a similar trend, though with disparate magnitudes, and the graphs indicate that the increase in deforestation is more pronounced from 2016 onwards in SMByC and GFC data sources.

To elucidate the reasons behind these discrepancies in the data, we proceed to examine the deforestation polygons, their dimensions (Minimum Detection Units), their distribution, and their variability. This analysis is conducted through statistics per polygon (Table 7 and Table 9) and box plots in Figure 3 represent each of the sources per period. To achieve an adequate comparison, we focus on the period from 2013 onwards, as in this interval the data are presented annually and not biannually, as is the case with SMByC (2010-2012) and REDD+ Matavén (2011-2012).

Table 7: Statistics of polygons identified as deforestation using the approach of the REDD+ Matavén Project

Period	Polygon Number	Average Areas	Standard deviation	Min size	25%	Median 50%	75%	Max size
2013	7926	0,89	1,8	6,55E-03	0,22	0,53	0,95	56,15
2014	10788	0,66	1,6	4,65E-02	0,16	0,40	0,69	87,59
2015	9828	0,92	2,3	5,01E-02	0,31	0,48	0,89	77,78
2016	9088	1,15	4,0	4,75E-02	0,33	0,50	0,92	139,86
2017	8300	1,22	3,4	6,67E-03	0,36	0,56	1,08	140,43
2018	8143	1,27	4,0	5,94E+00	0,34	0,51	1,02	157,67

Table 8: Statistics of polygons identified as deforestation using the approach of SMByC

Period	Polygon Number	Average Areas	Standard deviation	Min size	25%	Median 50%	75%	Max size
2013	1765	2,36	4,8	0,09	0,82	1,37	2	114
2014	1644	2,59	5,5	0,09	0,82	1,37	3	132
2015	1415	2,92	4,6	0,09	1,10	1,83	3	71
2016	2635	4,55	12,9	0,09	1,01	1,92	4	290
2017	4086	3,02	7,2	0,09	0,46	1,19	3	146
2018	5473	1,81	6,2	0,09	0,09	0,27	2	262

Table 9: Statistics of polygons identified as deforestation using the approach of the Global Forest Change (GFC)

Period	Polygon Number	Average Areas	Standard deviation	Min size	25%	Median 50%	75%	Max size
2013	6664	0,63	1,80	0,09	0,09	0,09	0,45	47
2014	11090	0,60	1,98	0,09	0,09	0,18	0,36	67
2015	4341	1,06	2,66	0,09	0,18	0,45	0,99	78
2016	7758	0,99	2,74	0,09	0,09	0,27	0,90	84
2017	8812	1,98	8,36	0,09	0,18	0,45	1,53	377
2018	12412	1,38	4,78	0,09	0,09	0,27	0,99	162

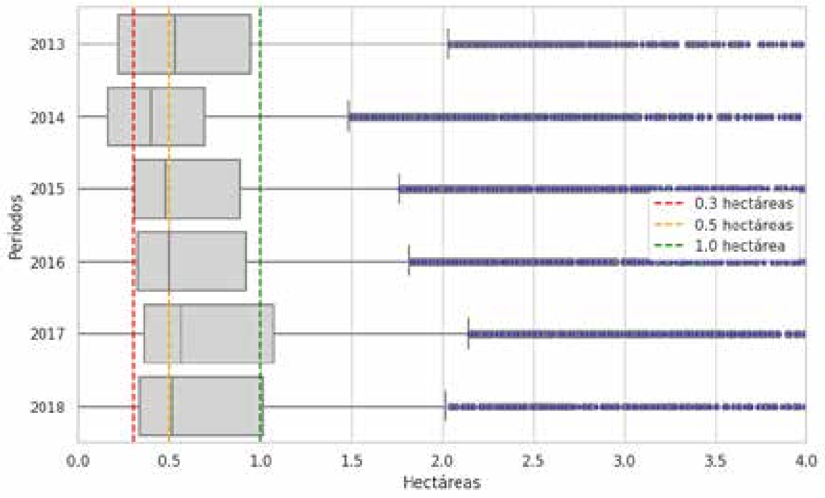
Tables 7, 8, and 9, along with Figure 3, provide a fundamental insight into the deforestation detection methods and approaches used in the REDD+ Matavén Project, SMByC, and GFC.
Table 7 representing the REDD+ Matavén approach highlights a sensitivity towards detecting polygons smaller than 1 hectare. This is seen in the average values ranging from 0.66 to 1.27 hectares, with the majority of polygon detections around the half-hectare mark as evidenced by the median (50%) values. However, the first quartile shows data around 0.3 hectares, consistent with the minimum mapping unit of Heterogeneous Agricultural Areas. This corroborates the classification strategy applied in the transition zone of the Colombian regions of Orinoco and Amazon, focusing on detecting deforestation areas in line with the dynamics of the territory.

Table 8 describing the SMByC approach, shows a lower total number of polygons identified, compared to the REDD+ Matavén approach (see “Number of Polygons” column). The average values center around 3 hectares, and the median exceeds 1 hectare, except in the last period (2018), where most polygons are close to 0.3 hectares. This trend is clearly evident in the box plot, specifically in Figure 3-B. There is a wider standard deviation in this data source compared to the other two. We can conclude that the SMByC approach is primarily oriented towards detecting deforestation in areas larger than 1 hectare, except for the last two periods, where it shows greater sensitivity in identifying areas below 1 hectare, evidenced in Figure 5, and relates to wider standard deviations.
Table 9 corresponding to GFC, reveals that the average size of detected polygons ranges from 0.6 to 1 hectare. Moreover, the median, representing the majority of polygons, is between the size of a pixel (0.09 hectares) and 0.4 hectares. This suggests that the algorithm used in this approach is especially sensitive to detecting polygons below 1 hectare. The standard deviation does not show the same variability as the SMByC data. GFC algorithm tends to identify relatively small-sized polygons, with 75% of detected polygons below 1 hectare. The first quartile column shows that 25% of polygons are below 0.3 hectares, even reaching pixel size in some instances, suggesting some disparity in terms of a precise definition of Minimum Mapping Units (MMU).

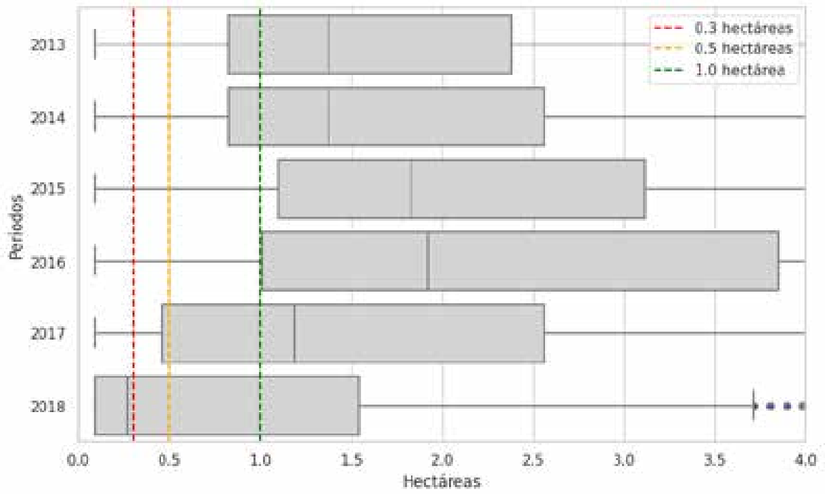
Upon closely examining Figure 3, which includes box plots, a vertical green line represents the one-hectare limit. In Graphs A and C, it is evident that approximately 75% of deforestation detections are in areas less than 1 hectare, whereas in Graph B, the trend is opposite, with 75% of polygons above one hectare, except in the last two periods, 2017 and 2018.

The key difference between Graphs A and C of Figure 3 lies in the fact that, in Graph C, about half of the detected polygons are smaller than 0.3 hectares, while in Graph A, the data from the first quartile are above this figure. Considering that Graph A represents data generated by the REDD+ Matavén, Graph B corresponds to data from SMByC, and Graph C represents data extracted from the GFC dataset.GFC.

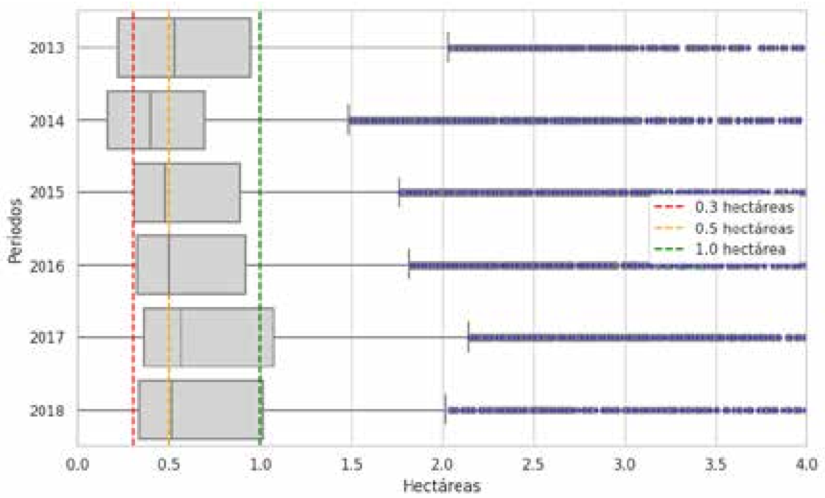
Figure 3: Variability of deforested areas during 2013-2018



A: REDD+ Matavén



B: SMByC

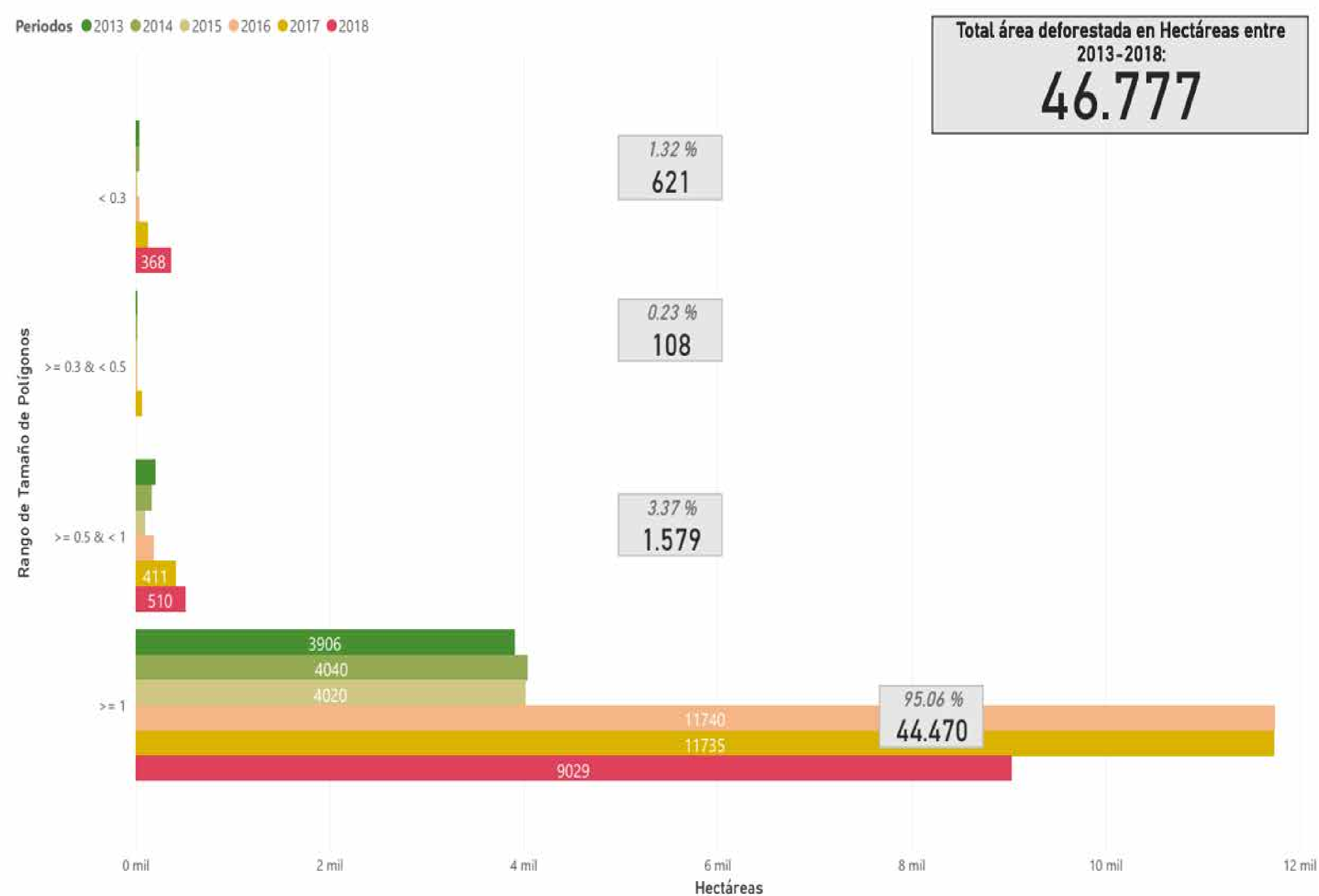


C: GFC

Figure 4: Amount of deforestation by period and by size of polygons with the approach of the REDD+ Matavén Project in the Reference Region between 2013-2018

Figure 4, based on data from REDD+ Matavén, reveals fundamental aspects. In the six periods examined, only a marginal 9 hectares, almost a negligible margin, are located below the threshold of 0.3 hectares, equivalent to an almost null percentage of the total area. Additionally, the range of 0.3 to 0.5 hectares, accounting for 10% of the total deforestation, contributes 5621 hectares, a key factor in the difference compared to the data from SMByC.

Figure 5: Amount of deforestation by period and by polygon size with IDEAM- SBMyC data in the Reference Region between 2013-2018



Regarding Figure 5, which reflects SMByC data, notable observations are revealed. A distinctive pattern in polygon detection is identified, with a clear focus on areas exceeding 1 hectare in size, that is, 95% of the total deforestation. It is observed that there is a change in the detection algorithm in the most recent periods, showing greater sensitivity to detecting polygons smaller than one hectare.

Figure 6: Amount of deforestation by period and polygon size with GFC Data in the Reference Region from 2013-2018

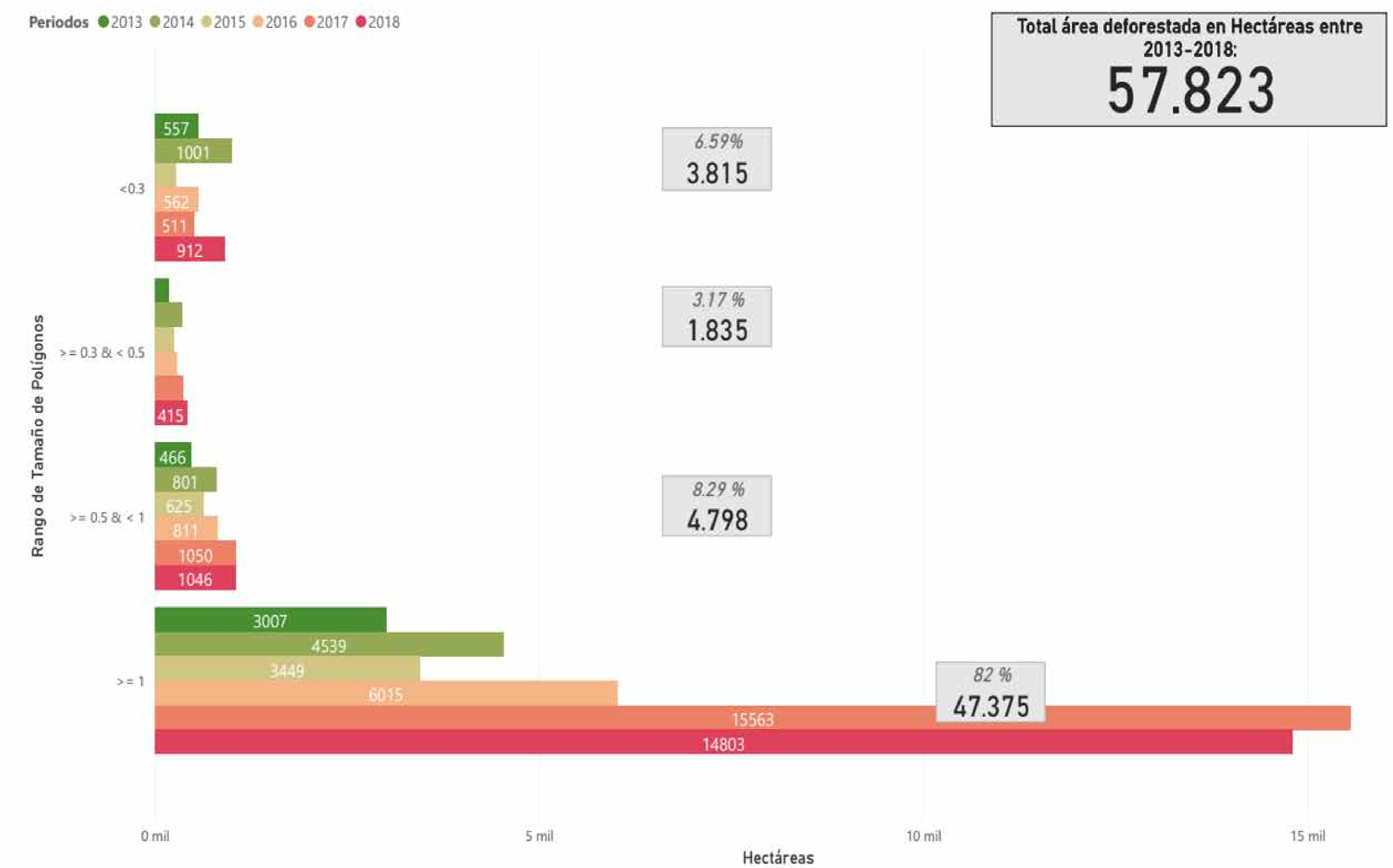


Figure 6, derived from the GFC dataset, also offers a series of significant considerations. The GFC algorithm demonstrates high sensitivity in detecting polygons below 1 hectare, focusing on very small areas, even sensitive to pixel-level change detections. A marked variation in the detection of large polygons is observed in the 2017 and 2018 periods.

These tables and graphs reveal different approaches in deforestation detection result in differences in size and distribution of polygons. This underscores the importance of understanding and contextualizing these differences when interpreting the results of each method. Each deforestation detection technique has its inherent strengths and limitations.

The approach adopted by the REDD+ Matavén Project is specifically tailored to detect deforestation polygons in the transition zone between the Colombian regions of Orinoco and Amazon, sensitive to detecting forest-to-HHA changes with minimum dimensions around 0.3 hectares, as corroborated by our field analyses.

On the other hand, SMByC data demonstrate versatility in detection capacity across various scales, encompassing a national approach that aspires to cover the diverse dynamics present in different geographical areas of the country (Pacific, Andean, Caribbean, and deep Amazon regions). SMByC data show a substantial increase in deforestation from 2016 onwards, in contrast to the REDD+ Matavén Project, where the increase is marginal and even shows a lower value from 2017. Our hypothesis suggests that, from this period, SMByC processes have begun to consider a Minimum Mapping Unit as a determining factor in their analyses, as suggested by the graphs presented here.

Finally, GFC stands out for its ability to identify both small and extensive areas, and that at a global level. However, its deforestation detection algorithm shows some lack of the sensitivity needed to precisely adjust to the unique dynamics of a specific territory, an aspect also shared by N. Harris et al., (2019).

We conclude that all these data sources are valuable, although REDD+ projects possess the ability to perform decentralized analyses and targeted approaches, generating data that range from the particular to the global, which is crucial for comprehensive evaluations. The geographical scale, data sources, their scope, and territorial particularities must be considered to conduct thorough evaluations of the project in question.

The purpose of conducting this analysis is to observe that by not considering deforestation polygons in the transition zone of the Colombian regions of Orinoco and Amazon with areas between 0.3 and less than 0.5 hectares, around 1000 hectares per year would be underestimated. Similarly, if polygons with areas between 0.5 and less than 1 hectare are not included, the underestimation would reach approximately 1500 hectares annually. Together, this represents a total of about 2500 hectares per year. However, when analyzing the detection of polygons larger than 1 hectare, a difference of 900 hectares per year is observed, which is proportionally insignificant. Therefore, it can be concluded that the disparity between the data presented by SMByC and the approach of the REDD+ Matavén Project is especially accentuated in smaller polygons, namely, those less than 1 hectare.

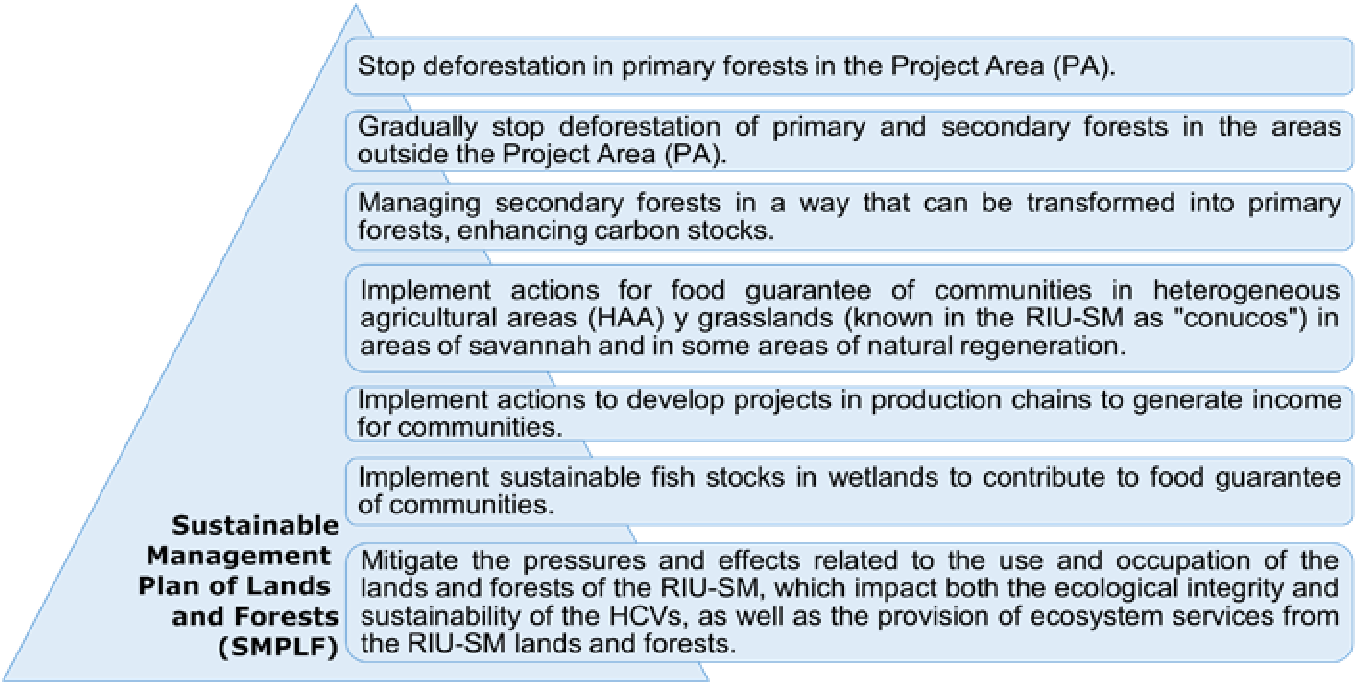
The differences between the deforestation area data detected by SMByC and the approach adopted by the REDD+ Matavén Project widens, especially in the case of smaller polygons, especially those less than 1 hectare. This aspect, not considered by neither the authors of CMW (2021) nor by Bermúdez (2021), is essential for conducting appropriate comparative evaluations and avoiding erroneous conclusions, as the ones expressed in these articles.

7. Additional factors for consideration

7.1 Measures undertaken by the REDD+ Matavén Project to counteract deforestation threats in Matavén

To address the challenges posed by deforestation and mitigate its impacts on Matavén natural resources, the REDD+ Matavén Project has formulated the Sustainable Land and Forest Management Plan (PMSTB) for the Indigenous Resguardo of the Matavéb Forest. The plan comprises seven key strategies, as illustrated in Diagram 1. It underwent scrutiny during validation and verification processes conducted in 2015, 2018, 2020, and 2022. Moreover, the plan has been in active implementation since the beginning of the Project in 2013.

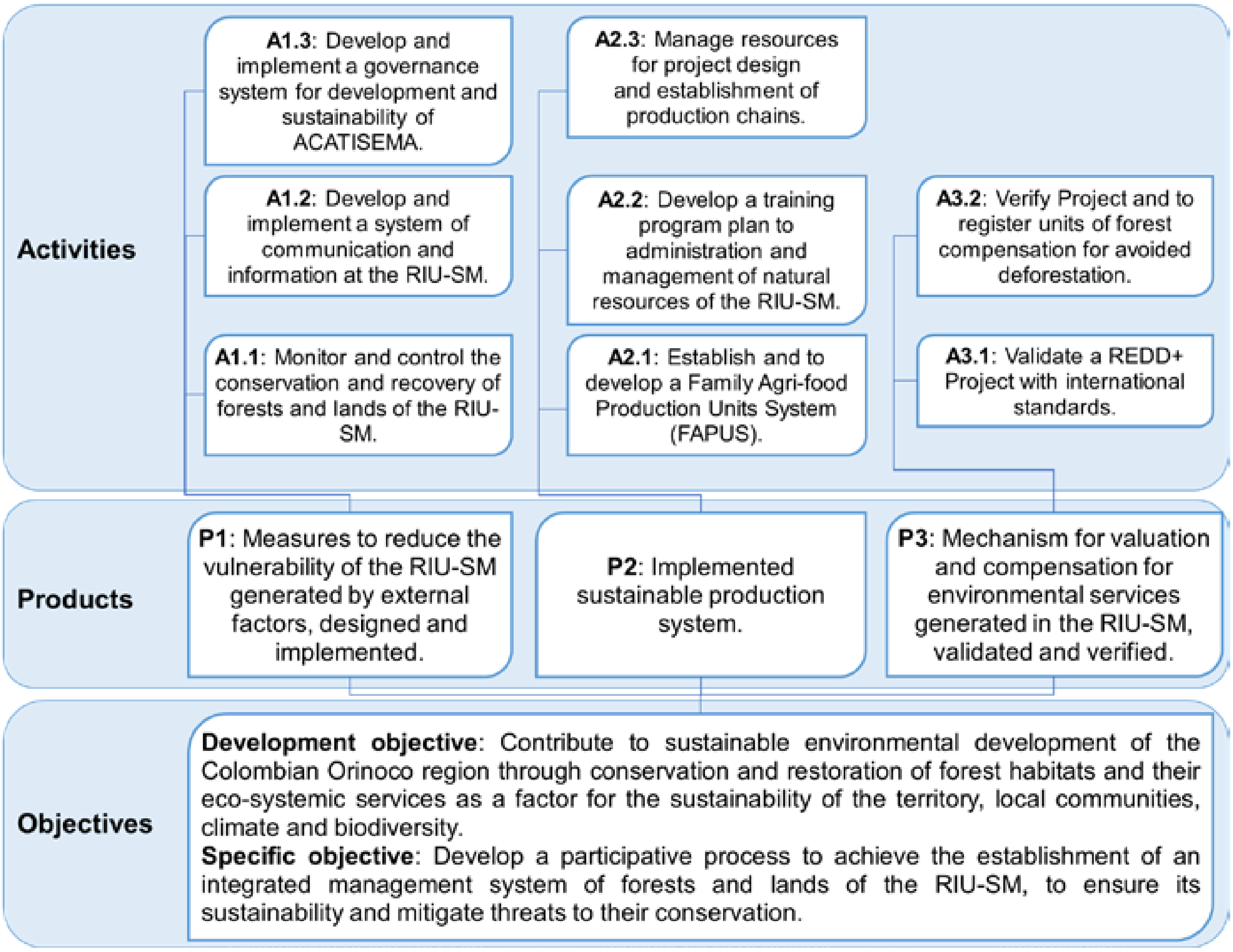
Diagram 1. Sustainable Land and Forest Management Plan (PMSTB) Strategies



Source: REDD+ Matavén Project

Project activities are also implemented within this Sustainable Land and Forest Management Plan (PMSTB) framework, leading to the achievement of 3 outputs and the specific objective of the Project, as shown in Diagram 2.

Diagram 2. Activities, Outputs, and Objectives of the REDD+ Matavén Project



Source: Our own creation

Six special programs are also implemented to improve the living conditions of the six indigenous ethnic groups inhabiting Matavén (ACATISEMA & MEDIAMOS F&M, 2018, 2020)[26] . These Programs are:

- Health & Healthcare Program
- Programa Health & Healthcare Program
- Water, Sanitation & Hygiene Program
- Housing & Moriche Palm Protection Program
- Special Population Program
- Environmental Indigenous Thinking Centers: spaces for cultural survival and indigenous unity
- Emergency Assistance Program
- doméstica.

The initiatives undertaken within the REDD+ Matavén Project framework have not only mitigated deforestation threats in the Resguardo but have also provided benefits that align with and addressed the primary needs and proposals of the local indigenous communities.

[26] *In each of the monitoring reports, section 2 "Implementation Status" details each of the benefits to the community, by Outputs, Activities, and Tasks.*

It raises questions when journalists and internet information compilers, originating from places as distant as Bogotá and Brussels, question the effectiveness of the REDD+ Matavén Project. These criticisms lack empirical and theoretical foundations, and they appear to disregard minimal field exploration, as well as the comprehensive review of monitoring reports, which they fail to reference. These reports meticulously outline the positive impacts in terms of Climate, Community, and Biodiversity (ACATISEMA & MEDIAMOS F&M, 2020).

7.2 Compliance with current regulations

The REDD+ Matavén Project has adhered to the stipulations outlined in Decree 926 of 2017, which establishes requirements for the non-causation of the carbon tax. Specifically, Article 2 introduces, among others, Articles "1.5.5.4. Minimum requirements for voluntary cancellation support" and "1.5.5.5. Verification statement requirements" into Title 5 of Part 5 of Book 1 of Decree 1625 of 2016. And Article 3 introduces, among others, Article "2.2.11.2.1. Characteristics of emission reductions and GHG removals to certify being carbon-neutral" to Title 11 of Part 2 of Book 2 of the Single Regulatory Decree of the Environment and Sustainable Development Sector - 1076 of 2015.

The Verified Carbon Standard (VCS) released a document confirming its alignment with the criteria for certification programs of greenhouse gas (GHG) reductions and removals, qualifying it under the Colombian National Carbon Tax; and that the Verified Carbon Units (VCUs) issued by the VCS Program have been retired in accordance with the conditions stipulated in Decree 926 of 2017, which amends the National Carbon Tax law. Therefore, confirming the VCS Program's adherence to the specified standard requirements.

The REDD+ Matavén Project has adhered to the guidelines outlined in Resolution 1447 of 2018, which regulates the national-level system for monitoring, reporting, and verifying mitigation actions, among other aspects. This resolution, issued five years after the initiation of the project, encompasses the directives specified in its Article 41 - Paragraph 2:

"To verify emission reductions and greenhouse gas (GHG) removals generated from January 2020 onward, the REDD+ Project Developer, who validated the baseline before the issuance of this Resolution, is required to adjust and validate the baseline using the latest updated National Reference Emission Factor (FREL). The baseline adjustment involves the methodological reconstruction of the most recent FREL applicable to the project across its geographical area."

As indicated in the Technical Guide of the National Greenhouse Gas Emissions Reduction Registry (RENARE) V 1.0 (September 8, 2020), Annex 2 - Nesting: Methodological Reconstruction for the REDD+ Project Baseline, *"The methodological reconstruction is the calculation of the expected GHG emissions in the project area with the consistent use of the variables used in the FREL: the definition of forest, the global warming potentials, the emission factors by type of forest, the historical data of deforestation for the project area and its method of estimating emissions and their projection over time".* The project has consistently addressed these variables since its design, ensuring conceptual alignment with the FREL.

The aforementioned conditions apply to the REDD+ Matavén Project and thus, by complying with Article 41 - Paragraph 2 of this resolution, and in accordance with Article 41 - Paragraph 2 of this resolution, the Project is required to adjust its baseline for verifications from 2020 onward. This adjustment has undergone scrutiny in audit processes conducted by the VVBs, including verification processes in 2016-2017, 2018, and 2019 with EPIC Sustainability Services under the

Verified Carbon Standard (VCS), as well as validation and verification processes in 2018 and 2019 with ICONTEC under the Climate, Community, and Biodiversity (CCB) standard.

The assertion made in the CMW article claiming that the Project's traded credits fail to comply with Resolution 1447 of 2018, alleging a non-application of national reference values set by the Government and recorded in the FREL to estimate greenhouse gas (GHG) emissions in the without-project scenario, is inaccurate. This requirement is only mandatory from the year 2020 onward, as specified by Resolution 1447 of 2018. The authors of the CMW and CLIP articles did not verified the applicable timeline for the standard, nor considered the unique conditions of the territory, nor assessed how the Project is actively preparing to adjust and validate its baseline for the verification of results from the year 2020 onward.

The statement from Carbon Market Watch (CMW) in which they mention, "…However, it should be noted that while Carbon Market Watch (CMW) believes that the projects analyzed in this report lack environmental integrity and have generated hot air credits, it is not in a position to assess with sufficient certainty whether the use of these credits breaches any existing regulations…[27]" is contradictory, as CMW attempts to shield themselves with this clarification after disseminating misinformation that has damaged the REDD+ Project and the communities of the Resguardo Indígena Unificado Selva Matavén.

Also, when CMW stated "CMW acknowledges that Verra is in the process of reviewing its rules for REDD+ projects, and has published updated rules for "jurisdictional and nested REDD+"… "However, it is not yet clear how these might impact projects such as the Matavén project which were analyzed here" 13, raising premature and disqualifying conclusions, without being certain that the changes will or will not introduce improvements.

7.3 Project baseline and national FREL as "hypothetical scenarios"

CLIP article states, "The REDD+ model is anchored in guessing the most realistic deforestation trajectory in a natural area, which can be contrasted with the effort made by its inhabitants to prevent it"[28].
The term "guessing" is inaccurate and inconsiderate, as estimates and forecasts are based on rigorous procedures and scientific foundations gathered by the methodologies to determine the requirements that REDD+ projects must meet, including the VCS VM0007.

There are several parties involved in the development of the VCS VM0007 methodology:

Avoided Deforestation Partners.org — Climate Focus
Silvestrum — Winrock International
Carbon Decisions International — TerraCarbon LLC

[27] *Two Shades of Green. How hot air forest credits are being used to avoid carbon taxes in Colombia, page 5.*
[28] *"Colombia's largest carbon credit project could be selling hot air.' Andrés Bermúdez (November 25, 2021). Published by the Latin American Center for Investigative Journalism – CLIP. https://www.elclip.org/el-mayor-proyecto-de-bonos-de-carbono-de-colombia-podria-estar-vendiendo-aire-caliente/, Section 'The questions raised by the Matavén calculations'.*

This highlights a deficiency in the conceptual and methodological framework and a lack of contextual understanding from the authors of the CMW and CLIP articles. This deficiency explains the erroneous approaches and conclusions they have published. It is not a matter of mere speculation; rather, it involves the application of a well-founded conceptual and methodological framework in both scientific principles and knowledge of the territory. This framework allows for forecasting, with the highest probability, the "most realistic trajectory", a goal achieved through the application of the VCS VM0007 methodology and guided by the theoretical and practical knowledge of the Project's technical team. This team is composed of professionals and indigenous leaders collaborating in working teams within the territory. This is a critical situation where importants aspects have not been understood, leading to significant misinformation.

On the other hand, the author of the article fails to address the fact that the reference to "guessing... the most realistic deforestation trajectory" in the context of a REDD+ project also applies to the determination of the national Forest Emission Reference Level (FREL). This FREL serves as the benchmark against which deforestation rates are compared. In both instances, procedures are employed to establish a historical deforestation rate, involving the application of emission factors.

Emphasizing that the FREL represents the most conservative greenhouse gas (GHG) emission projection scenario does not necessarily imply that it is the most realistic and suitable. In fact, such a characterization could potentially discourage efforts to protect forests and inadvertently incentivize scenarios where deforestation processes are accelerated.

The authors of the articles seem to view the FREL as "more conservative", but this characteristic doesn't necessarily make it more realistic than a REDD+ project baseline. For example, the projections of the FREL significantly deviated from the deforestation levels observed in the Amazon biome from 2017 onward, surpassing the predicted values[29].

Annexes 1 and 2 of this document outline various methodological procedures, addressing aspects of conservatism in the design of the REDD+ Matavén Project that are not accounted for in the FREL. These include lower emission factors and deductions from estimated greenhouse gas (GHG) emissions, accounting for potential emissions in the project scenario, leakage, and deposits into a buffer account.

7.4 Counterfactual Model

Concerning the Reference Region RRD, it is assumed that, once the criteria of similarity are met and its location in the Orinoquía-Amazonía transition strip is determined, it represents the most probable region exhibiting patterns of deforestation (agents and drivers) that could occur in the Project Area. This assumption is based on methodological requirements and the indigenous people's knowledge of the territory within the Resguardo Indígena Unificado Selva Matavén, as well as the insights of the Project's technical team. The Reference Region is the most similar area for obtaining the deforestation rate used in forecasting deforestation, also situated within the Project Area over time. This is achieved through another method involving the Reference Region for projection of Location of deforestation (RRL), constituting a model of deforestation risk, as detailed in Annex 1, Part 3: Modeling of Deforestation Prospective.

[29] https://visionamazonia.minambiente.gov.co/deforestacion-en-la-amazonia/

7.5 Other forest and community services not quantified for compensation claims but contributing to climate change mitigation

CLIP article notes *“Protecting forests like those in Matavén has two great potentials to mitigate climate change: firstly, by preventing the release of carbon into the atmosphere when they are cut down, and secondly, by ensuring that they continue to store carbon – ‘sinking’ or ‘sequestering’ it, in environmental jargon…”’*

Therefore, when addressing the alleged overestimation in the expected reductions by the REDD+ Matavén Project, the following considerations should be considered:

Compensation is solely provided for the reduction of GHG emissions that could have occurred due to the deforestation projected during the Project’s life cycle. It does not account for the ongoing absorption of GHGs conducted by the entire Selva Matavén, nor does it acknowledge the pResguardo and stewardship of carbon, water, soil, and biodiversity reservoirs stemming from a forest safeguarded by indigenous communities for centuries as an integral aspect of their ancestral practices. This stewardship is an important contribution to the broader effort against climate change.

As demonstrated throughout this document:

- The baseline of the REDD+ Matavén Project is valid. It is reasonable to observe different deforestation rates for the National Reference Emission Factor (FREL) at 0.243% annually and for the REDD+ Matavén Project at 0.959% annually.
- It is erroneous attempting to apply the FREL deforestation rate to project the future forest loss in the Project Area, based on conclusions and assumptions emerging a decade after determining the deforestation rate of the REDD+ Matavén Project through the proper application of the VCS VM0007 methodology of VERRA.
- As indicated in Table (C8) of this document, these rates correspond to different situations, reflecting two different geographical and social contexts and derived from different calculation methods. Therefore, it is both a conceptual and methodological absurdity to apply the deforestation rate of the Amazon biome to the emission reduction calculations of the REDD+ Matavén Project.

Considering the arguments presented by CMW, it can be concluded that:

A. The REDD+ Matavén Project does not use the official reference values set by the government in the FREL, in particular and especially the deforestation rate, because it is completely erroneous, as has been demonstrated. The Project does not follow the procedures to set its baseline using the methods employed for the FREL as this approach has been shown to be incorrect both conceptually and methodologically.

B. The assertion that the Project deliberately set its baseline high (overestimated) is unfounded and untrue. Likewise, the claim that the Project generated additional carbon credits, as stated by CMW is false: it is based on an insufficient qualitative analysis that only partially covers the characteristics of the Project, and an alleged quantitative reconstruction lacking proper procedures or methodological rigor, relying on a few scattered percentage figures.

   The conclusion drawn by CMW, echoed by CLIP, is inaccurate: “To conclude, this qualitative assessment of the baseline used by Matavén suggests that the baseline is inflated, because the reference area is not a realistic representation of what could happen in the project area, if the project was not implemented. This is particularly true for three key dimensions: the size of the deforestation frontier, the ease of access, and IP tenure of the land.”
   It presents an illogical argument without a conceptual, methodological, and factual basis. It suggests that a “qualitative evaluation” of the baseline of the REDD+ Matavén Project indicates it is artificially high. They do not explain the basis for this “qualitative evaluation” of the baseline, and from where the unfounded conclusion is drawn that the Project’s Reference Region does not constitute a realistic representation, resulting in the assertion that the Project’s baseline is artificially high. It has been conclusively demonstrated that the composition and location of the Reference Region have been appropriately executed, adhering not only to the VCS Standard and the widely accepted VM0007 methodology at the national and global levels but also to the geographical and biophysical conditions of the Transition Zone between the savannas of the Orinoco region and the Amazon forest.

C. The Project has generated tangible benefits, not only for the environment but also for the communities of the six ethnic groups inhabiting the Resguardo Indígena Unificado Selva Matavén.

D. The Project has delivered tangible results for both climate action and the conservation of Matavén biodiversity, as confirmed by the approval of audit processes (validation and verification with ICONTEC for 2013 and 2014-2015 under the VCS Standard, verification 2016-2017, 2018 and 2019 with EPIC Sustainability Services under VCS and validation and verification 2018 and 2019 with ICONTEC under the CCB standard). Consequently, the claim that the carbon credits or rights for greenhouse gas (GHG) emission reductions, achieved by preventing deforestation over the 10 years of Project implementation, represent ‘hot air’ is unfounded.

E. The REDD+ Matavén Project complies with the prevailing national legislation (Decree 926 of 2017 and Resolution 1447 of 2018). The outcomes achieved align with the country’s regulations and do not pose a challenge of double counting concerning the REM - Amazon Vision Program. The Project has accurately accounted for its own credits and any common credits have been appropriately discounted.

F. The deforestation rate established in the Reference Region for the REDD+ Matavén Project Area markedly differs from that identified in the construction of the National Reference Emission Factor (FREL) submitted by the Colombian government to the United Nations Framework Convention on Climate Change (UNFCCC). These rates correspond to distinct situations, reflecting two different geographical and social contexts, and are derived from different calculation methods, as previously explained.

The arguments put forth in the articles by CMW and CLIP are inaccurate, lacking rigor, and devoid of adequate scientific and technical evidence. Hence, their assertion that the baseline of the REDD+ Matavén Project is overestimated is erroneous. Annexes 1 and 2 demonstrate the conceptual and practical rigor of the data managed by the Project, the meticulous application of procedures in accordance with the methodology, and the reliability of the results obtained.

8. Media consequences arising from a false premise

The CMW (2021) article has been replicated on multiple occasions, including a report released by the Amazonian Institute of Scientific Research (Juan Manuel Díaz & Omar Ruiz Nieto, 2023). This report referenced the CMW "study" and raised certain questions regarding the thorough evaluation of the benefits derived from the REDD+ Matavén Project. The analysis conducted by SINCHI, based on the aforementioned article, appears to overlook the positive impacts that the Project has delivered to local communities and forest conservation.

It is important to note that the Association of Councils and Traditional Indigenous Authorities of the Selva Matavén - ACATISEMA - in collaboration with Mediamos F&M, are the DEVELOPERS of the REDD+ Matavén Project. ACATISEMA is the executor of the financial resources of the REDD+ Matavén Project. The SINCHI report fails to consider this aspect, resulting in a distortion of the overall perception for readers of the report. This omission could potentially evoke a sense of bewilderment rather than promoting a rigorous and balanced analysis aimed at achieving an accurate understanding of the facts.

It is important to highlight that the "qualitative analysis" conducted by CMW (2021), upon which the SINCHI report relies, has significant deficiencies that have been addressed from a technical perspective in this document.

It is surprising that SINCHI, as a local and scientific entity, opted to rely on an article with serious technical limitations as its foundation. It would be more appropriate for SINCHI evaluations to be based on solid and rigorous scientific analysis, considering both the integral and positive aspects that projects like this contribute to communities and the environmental surroundings (climate, community, and biodiversity).

On the other hand, the Environmental Justice Atlas30, with a considerably more levity approach, adopts the flawed foundations presented by CMW (2021). It associates the REDD+ Matavén Project with environmental issues such as coltan extraction, extractivist projects, and illegal mining. Once again, it identifies Mediamos F&M as the sole company responsible for the Project, neglecting the crucial fact that the indigenous organization ACATISEMA is also a developer. Curiously, the Atlas does not specify the role of ACATISEMA, distorting the authentic nature of the Project and, once again, highlighting its reliance on inaccurate information, without seeking the technical-scientific rigor of the facts.

It is surprising that the Atlas claims that 16,000 indigenous people have been negatively affected by the REDD+ Matavén Project. This statement fails to acknowledge the significant positive impact and the numerous benefits that the Project has provided to Matavén communities[31]. It also mentions biodiversity loss and forest degradation as environmental impacts, which is surprising given that the REDD+ Matavén Project aims for the exact opposite, even having obtained high-quality certifications under international standards, such as the Verra standard: Climate, Community, and Biodiversity (CCB). Additionally, Atlas mentions biodiversity loss and

[31] *If you wish to expand your knowledge of the project's benefits, see the monitoring reports (ACATISEMA & MEDIAMOS F&M, 2018, 2020)*

[32] *Verify on the VERRA Registry page: https://registry.verra.org/app/projectDetail/VCS/1566*

forest degradation as environmental impacts, which is surprising considering that the REDD+ Matavén Project aims for the opposite, having even attained high-quality certifications under international standards, such as the Verra standard: Climate, Community, and Biodiversity (CCB). In fact, during the verification of results for the years 2018 and 2019, the Project achieved Gold distinction in Climate, demonstrating that the Project's activities generate exceptional benefits for the Climate[32]. The Project has undertaken diligent efforts in identifying endangered species, monitoring ecosystems (aided by drones, extensive fieldwork, and numerous community training sessions), and conducting comprehensive research on fauna and flora.

Before the start of the REDD+ Matavén Project, the Resguardo Indígena Unificado Selva Matavén suffered from a clear lack of attention and support from the State, with only 17 communities identified. This reflected one of the most significant instances of neglect and invisibility by the Colombian state toward this region. However, thanks to the efforts of ACATISEMA and the REDD+ Matavén Project, approximately 260 communities were identified, a notable difference that underscores the importance and impact of the Project. Through 8 Main Activities and 6 Special Programs, the REDD+ Matavén Project has generated real benefits for the climate, communities, and biodiversity, significantly changing the lives of the indigenous people (ACATISEMA & MEDIAMOS F&M, 2018, 2020). The "complaint" presented lacks solid foundations, distorts the reality of the REDD+ Matavén Project, evidencing a lack of rigorous and thoroughly researched information (See Annex 1).

The CMW (2021) article is based on a false premise and argumentative fallacies that have been echoed in various articles, including those presented by Bermúdez Liévano (2021), M. Rodríguez Becerra (2023a, 2023b), SINCHI (Juan Manuel Díaz & Omar Ruiz Nieto, 2023), and the Environmental Conflict Atlas.

This erroneous premise has led to incorrect conclusions and biased interpretations that do not align with the reality of the achievements and benefits generated by the REDD+ Matavén Project.

The baseline and Reference Region of the REDD+ Matavén Project have been meticulously, appropriately, and realistically designed and applied. Contrary to the attempts by some authors to disseminate misinformation with procedures lacking rigorous and technical-scientific foundations.

The Reference Region meets all technical requirements established in certification, validation, and verification standards. We have robustly presented the foundations of this Project's baseline, which also adheres to Resolution 1447/2018 and Decree 926/2016.

Given this situation, we extend an invitation to researchers, journalists, and other interested parties to delve into this topic. We encourage them to review our Project, our data, and engage in a detailed technical-scientific and social debate. REDD+ Matavén Project has achieved significant advances that transcend the barriers of the Colombian state and have positively impacted conservation, indigenous governance, the pResguardo of the biodiversity of the Selva Matavén, and the well-being of all communities.

9. Final Conclusions

The baseline used in the REDD+ Matavén Project has been meticulously constructed, complying with all the requirements established in the VM0007 methodology and its respective VCS VMD0007 module of VERRA. It is supported by the theoretical and practical knowledge of the Project's multidisciplinary technical team, ensuring coherence in the selection of the Reference Region. It has been ensured that this region is representative and reflects the typical characteristics of a transition zone, preserving both savanna and forest features at its boundaries. This counters the erroneous assertions of the articles by CMW (2021) and Bermúdez Liévano (2021), who did not consider any technical specifications and did not conduct visits to the territory.

We have demonstrated that none of the options considered, such as the state of Vichada, the Amazon Biome, or a neighboring region, meets the required criteria to be considered suitable reference regions for the REDD+ Matavén Project. Both the state of Vichada and the Amazon Biome exhibit significant differences in terms of biogeographic characteristics and forest types, limiting their suitability as reference regions. Therefore, the comparisons of deforestation rates between these regions are not valid, as considered in the articles by CMW (2021) and Bermúdez (2021), who also made erroneous comparisons using different Historical Reference Periods and extended incorrect results about the identity of the REDD+ Matavén Project.

After examining the differences between the Colombian FREL and the REDD+ Matavén Project concerning geographic scale, reference period, projection, activity data, and emission factors, several important conclusions can be emphasized:

Firstly, the geographic mapping scale used in the REDD+ Matavén Project allows a more precise identification of changes, resulting in a more detailed estimation of deforestation dynamics. Secondly, differences in reference and projection periods affect the comparability of the results obtained. It is observed that both the FREL and the REDD+ Matavén Project are based on monitoring data generated by the Colombian Forest and Carbon Monitoring System (SBMyC), with some compatible adaptations in the case of the REDD+ Matavén Project. Lastly, the difference in the emission factors used is highlighted, with the REDD+ Matavén Project being more specific in stratifying emission factors for different biomes. These conclusions highlight the importance of considering the particularities of each approach when analyzing deforestation and carbon emission results, unlike CMW and Bermúdez who did not verify the fact that in their "evaluations" made comparisons of biophysically different regions and different Historical Reference Periods.

The deforestation rates of the REDD+ Matavén Project and the FREL correspond to different threat situations, as the FREL considers the total forest in the Amazon biome, while the Project focuses on a part of that forest.

It cannot be assumed that vulnerability of the Resguardo and the Reference Region, located in the 'Orinoquia -Amazon Transition Savanna' strip, is the same as the threat present in an area deep within the dense forest mass of this biome, which would be much further from the edge of the forest.

The REDD+ Matavén Project adheres to methodological guidelines in establishing its spatial boundaries, including the delineation of the Project Area and the Reference Region RRD. In contrast, the FREL took the entire area of the Amazon biome. Consequently, comparing the deforestation rate values used to determine the baseline scenario for the Project with those defined for the FREL 2013-2017 in Colombia is not meaningful.

The deforestation rate associated with the FREL 2013-2017, defended by the authors of the CMW and CLIP articles, is not applicable to the REDD+ Matavén Project nor suitable for extrapolation to the Resguardo. Characterizing the Project's baseline as overestimated with "hot air" credits, expressing concerns about substantial financial losses for the country, is misleading. These assertions and conclusions appear sensationalist, driven by unclear motives and generate misinformation.

Regarding the "qualitative evaluation" of the Project's baseline, which the author of the CMW article claims to apply, it fails to provide evidence supporting the assertion that this baseline is artificially inflated. The Project's baseline stems from a distinct approach, encompassing a different scale of the studied area and addressing diverse threats. This divergence results in dissimilar deforestation rates for the FREL and the REDD+ Matavén Project. The latter rigorously adheres to the procedures outlined in the VCS VM0007 methodology, boasts an interdisciplinary team comprising professionals and local inhabitants equipped with theoretical-practical knowledge of the territory, and remains in compliance with national legislation, notably Decree 926 of 2017 and Resolution 1447 of 2018.

As highlighted in VERRA's response to CLIP, "Projects certified under the VCS Program undergo rigorous, credible, and transparent evaluation processes verified by independent auditors. The Verified Carbon Standard (VCS) is a well-established standard and has been recognized by national governments as a way to meet tax obligations under national carbon tax mechanisms"[33].

This document highlights the complexity of deforestation as a spatiotemporal phenomenon extending beyond numerical calculations over time. A comprehensive understanding of deforestation necessitates an examination of the geographical and temporal specificities of the region, coupled with insights gained from other transition zones between the Colombian regions of Orinoco and Amazon.

Deforestation threats extend beyond internal factors and are predominantly external in nature. The absence of initiatives like REDD+ would deprive Matavén indigenous communities of funding for their conservation-focused life plan. This would leave them at the mercy of the policies and development projects of the current government, such as the '5 engines of development' proposed during the presidency of Juan Manuel Santos (2010-2014). Additionally, the lack of adequate funding sources would perpetually expose these communities to illicit economies, constituting external threats that persist in the environment.

It is vital that any assessment and projection of deforestation considers these complex dimensions and acknowledges the important role of projects like REDD+. This entails not undervaluing the valuable efforts communities have invested over decades in obtaining titles for their reserves. However, it also requires an understanding that safeguarding forests surpasses a mere deed of ownership. While the titling of indigenous lands is a foundational step, it does not unilaterally ensure the sustainable protection of forests.

When analyzing various sources of deforestation data, it is essential to emphazise the particularity of Heterogeneous Agricultural Areas in the transition zone between the Colombian regions of

[33] https://recursos.elclip.org/madera-sin-rastro/Cuestionario_Matavén_Verra.pdf

Orinoco and Amazon. These areas exhibit unique characteristics, where the SMByC approach only shows sensitivity in more recent periods (2016 onwards). The exclusion of deforestation polygons with areas less than 0.5 hectares poses a risk of underestimating the annual figure by approximately 1000 hectares. Moreover, if polygons with areas less than 1 hectare but more than 0.5 hectares are also omitted, the underestimation could escalate to about 1500 hectares annually. Cumulatively, this amounts to approximately 2500 hectares per year. This underscores the significance of REDD+ projects in considering the landscape's specificity and on-the-ground deforestation dynamics for more precise estimations. It also highlights the importance of exercising caution when utilizing national or global data sources, as these may not fully capture the distinctive characteristics of a particular territory.

The evaluation or comparison made by the authors in the articles lacks a solid theoretical and technical foundation, crucial for projects of this nature. Instead, they employed simplistic calculations based on a basic rule of three, intending to convey to their readers the notion that the REDD+ Matavén Project has not effectively countered external deforestation threats.

In summary, these are the methodological differences for determining the baseline of the REDD+ Matavén Project and the FREL.

Methodological Aspect	REDD+ Matavén Project	Forest Emission Reference Level (FREL)
Reference Area (where historical deforestation is analyzed)	Reference Region for Projecting the Deforestation Rate (RRD), which does not include the Project Area (PA) or the Leakage Belt (LB)	The area covered by the FREL as the Reference Area is the Colombian Amazon Biome, which includes the Resguardo Indígena Unificado Selva Matavén and, consequently, the REDD+ Matavén Project Area.
Area at Risk (where deforestation would occur in the future)	Project Area (PA) intended for conservation and includes most of the forests of the Resguardo Indígena Unificado Selva Matavén. Not part of the RRD.	The same Reference Area (Colombian Amazon Biome)
Method to determine the deforestation rate	Average annual rate of historical deforestation analyzed in the RRD during the Historical Reference Period.	Average annual rate of historical deforestation analyzed in the Colombian Amazon Biome during the Reference Period.
Method to project deforestation	Deforestation rate determined in the RRD and applied to the "Reference Region for projecting the Location and magnitude of deforestation" (RRL), which includes the Project Area (PA), the Leakage Belt (LB), and other areas, over 30 years in the future.	Deforestation rate + National circumstances over 5 years into the future.
Fuente	https://registry.verra.org/app/projectDetail/VCS/1566	https://redd.unfccc.int/submissions.html?country=col

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REDD+
Matavén

ANNEX 1

PROCEDURES TO PROJECT THE DEFORESTATION RATE IN THE PROJECT AREA AND ITS MONITORING

CONTENT

PART 1: PROJECT LIMITS

1. Definition of Temporal Limits

Historical Reference Period (PHR):
Start: January 1, 2001
End: January 1, 2011

Accreditation period of the Selva Matavén REDD+ Project:
Start: January 1, 2013
end: December 31, 2042

Date on which the project baseline will be reviewed: Every 10 years

Duration of the monitoring period: Annual

The time limits were defined based on the study of the VCS protocols VMD007 (10 to 12 years) and VMD015 (10 to 15 years).

However, in the current project, a historical reference period of 10 years was defined, starting in 2002 and based on:

- 2001 Beginning of the Historical Reference Period
- 2005 Intermediate Date
- 2011 Most recent date

Year	**2001***	2003	2004	**2005****	2006	2007	2008	2009	2010	**2011*****	2012	2013
Period	1	2	3	4	5	6	7	8	9	10	11	12

Similarity criteria

	Baseline Rate Approach	Mandatory?	% forest	Area limitations
Project area		Yeah	100% at the beginning of the project	-
Leak Belt	Simple history	No, see *LK - ASU*	100% at the beginning of the project	≥90% of the project (except see 1.1.3)
DRR – reference area rate	Simple history	Yeah	100% at the beginning of the historical reference period	≥ *MREF* (see 1.1.1.1) May not contain project area or leak belt.
RRL –location of the reference area	Simple history	No, see Step 3.0.	≥50% at the beginning of the project	The forested proportion must = RRD ± 25% at the beginning of the project. It must contain the project area and the leak belt.

Source: VMD0007

4 spatial limits were generated:

A. Reference Region to project the DRR deforestation rate .
B. Reference Region to locate projected deforestation RRL .
C. Project area.
D. Leak belt.

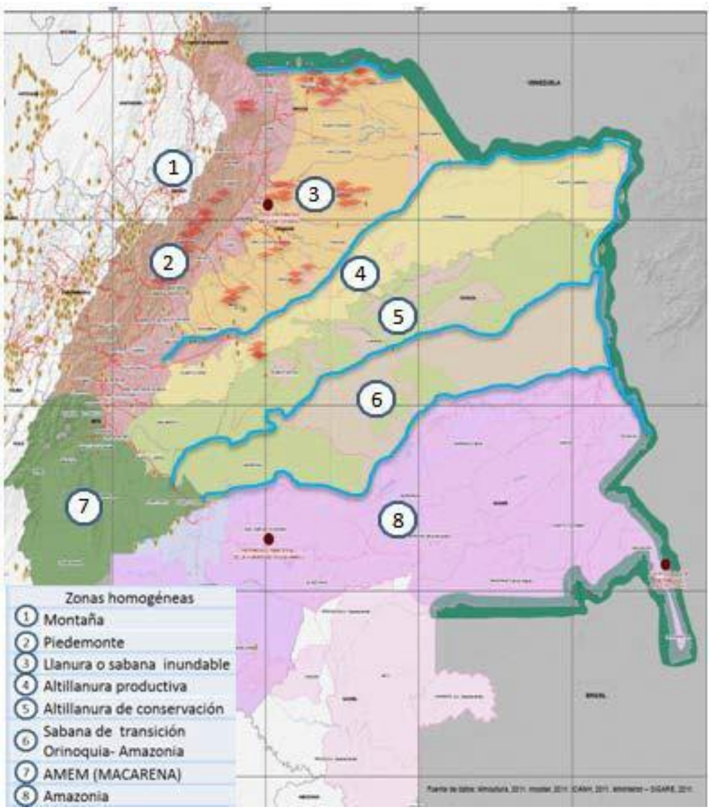
Source: VCS (2010)

A. Reference Region (RRD)

B.

Reference Region to project the deforestation rate (RRD)
This is located in the transition zone between the Orinoquia and the Colombian Amazon.

Coherence of the Reference Region and the PND 2014-2018



The Llanos are a heterogeneous plain that requires a differentiated and comprehensive perspective of territorial planning and development. Eight territorial strips are identified considering geographical and environmental criteria:

1. High foothills
2. Low foothills
3. Flood plain or savanna
4. Productive highland

5. Conservation high plain
6. Orinoquía transition savanna - Amazonia
7. Amazon
8. Macarena Special Management Area

The area of the RRD should be calculated as follows:

MREF = RAF *AP (1)
RAF = 7500 * AP $^{0.7}$ ***(2)***

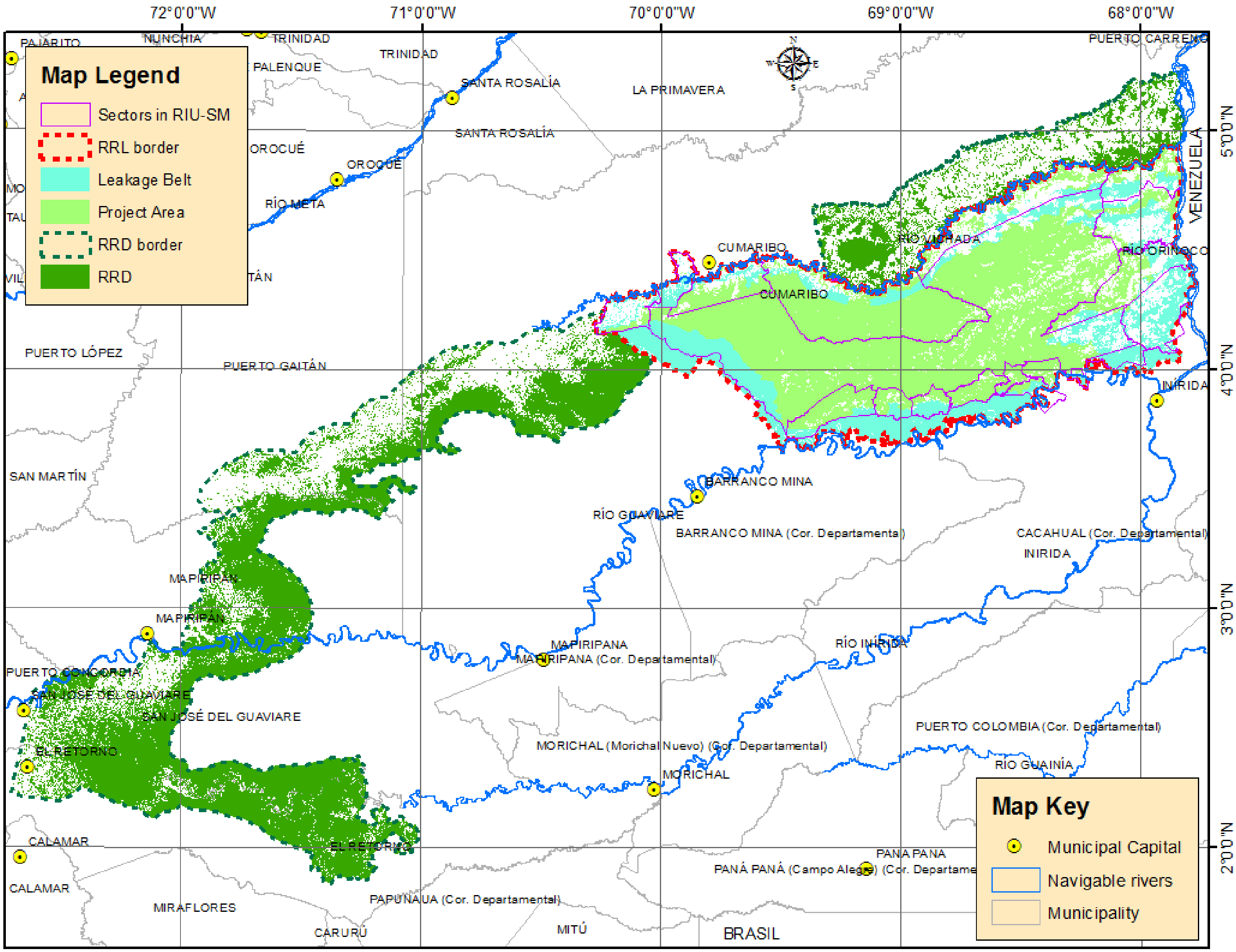
If the RAF calculated using Equation 2 is <1, the RAF should be set equal to 1
Where:

Acronym	Description	Unit	Worth
MREF	Minimum size of the reference region to project the deforestation rate	Ha	1,150,212
AP	Unplanned deforestation project area	Ha	1,150,212
RAF	Reference Area Factor. Factor to multiply by the project area to obtain the minimum reference area	dimensionless	0.4166, so 1

Therefore, it is established that:

- DRR is 100% forest at the beginning of the historical reference period (2002).
- It is equal to MREF .
- Its forest plots represent the general pattern of the Project Area.

DRR Reference Region



Landscape Similarity between AP and RRD

1. Biome

Biome	AP (ha)	AP %	±20%	L.I.	L.S.	DRR (ha)	DRR %
Helobiome	174,516	15.2	3.0	12.1	18.2	230,435	15.9
Peinobiome	326,058	28.3	5.7	22.7	34.0	333,195	23.1
Litobiome	116,099	10.1	2.0	8.1	12.1	158,752	11.0
Zonobiome	533,538	46.4	9.3	37.1	55.7	722,424	50.0
Total BP	1,150,212	100				1,444,805	100

2. Elevation and slope

Elevation masl	AP	DRR
0-500	100%	100%
> 500		

Earring %	AP	DRR
< 15	100%	100%
> 15		

3. Proportion of navigable rivers

Navigable Rivers	AP	DRR
Adjacent distance (m)	625,261	619,025
Area in Km2	11,502	14,448
Proportion (Dist / Km2)	54	43
20%	11	
Lower limit	43	
Upper limit	65	

4. Proportion of Settlements

Settlements	PA	DRR
# adjacent settlements 1 km away	195	315
Area in Km2	11,502	14,448
Proportion (Dist / Km2)	0.02	0.02
twenty%	0.0	0.0
Lower limit		0.018
Upper limit		0.028

C. Reference Region RRL (Project deforestation)

The Reference Region to locate the projected deforestation (RRL) must be a simple, contiguous plot of forest and non-forest, which includes the Project Area and the Leakage Belt, in addition to the following proportionality requirements.

1. RRL must have at least 5% Non-Forest and a minimum of 50% Forest

RRL area (ha)	Forest 2011 (ha)	Forest Percentage Beginning of the Baseline (2011)	No Forest Start of Baseline (2011) (ha)	Percentage of Non-Forest 2011
2,028,439	1,636,423	80.7%	392,016	19.3%

2. The forest area *must be equal to the DRR area in* (±25%)

DRR (ha)	25% Area in DRR	Lower limit on DRR (ha)	Upper limit on DRR (ha)	RRL Forest Area (ha)
1,444,805	361,201	1,083,604	1,806,006	1,636,423

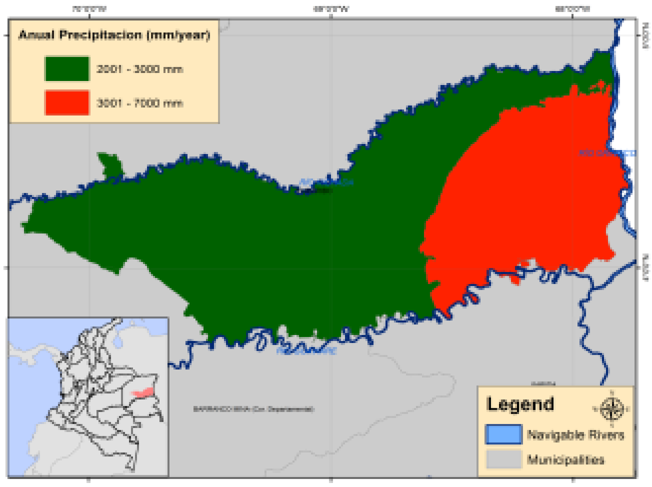
3. Proportionality of Biome soil type between AP and RRL

Suitable forest in AP	AP Has	%	±30%	Lower limit	Upper limit	Suitable forest in RRL	%
PEXc	42	0	0	0	0	2,679	0
AC	2,892	0	0	0	0	4,288	0
CPIc	-	0	-	-	-	12	0
FPP	111,978	9	3	7	12	141,848	9
FPR	423,519	35	11	25	46	541,365	33
PEXc	246,699	21	6	14	27	394,798	24
SPA	414,508	35	10	24	4.5	551,433	3.4
	1,199,638	100				1,636,423	100

Other proportionality requirements for RRL :

4. Proportionality of precipitation between the Project Area and the RRL Region

Precipitation Ranges	AP Has	%	±30%	Lower limit	Upper limit	Forest area in RRL by biome	%
2000-3000mm	906,814	76	23	53	98	1,184,659	72
3000-4000mm	292,824	24	7	17	32	451,764	28
Total	1,199,638	100				1,636,423	100



5. Proportionality of lifting belts (500m), between Project Area and RRL

Elevation (m)	AP	RRL
0 to 500	100%	100%

6. Proportionality of the type of usable soils for the conversion of forest cover to other types of cover between AP and RRL

Guys of forest	AP Has	%	±30%	L.I.	L.S.	RRL hectares Forest Biome	%
Helobiome	174,516	15	5	11	10	280,422	17
Peinobiome	326,058	28	9	20	37	438,138	27
Litobiome	116,099	10	3	7	13	189,724	12
Zonobiome	533,538	46	14	32	60	728,140	44
Total	1,150,212	100				1,636,423	100

D. Project Area (AP)

It must be a 100% forested area at the beginning of the Project (January 2013).

E. Leak Belt (CF)

The Leakage Belt is an area that surrounds the Project Area and that is largely part of the same RIU Selva Matavén Indigenous Reservation, which is also located within the same municipality and department. On the other hand, it is an area that is close to indigenous settlements, and which has the same social ordinance and political regulation.

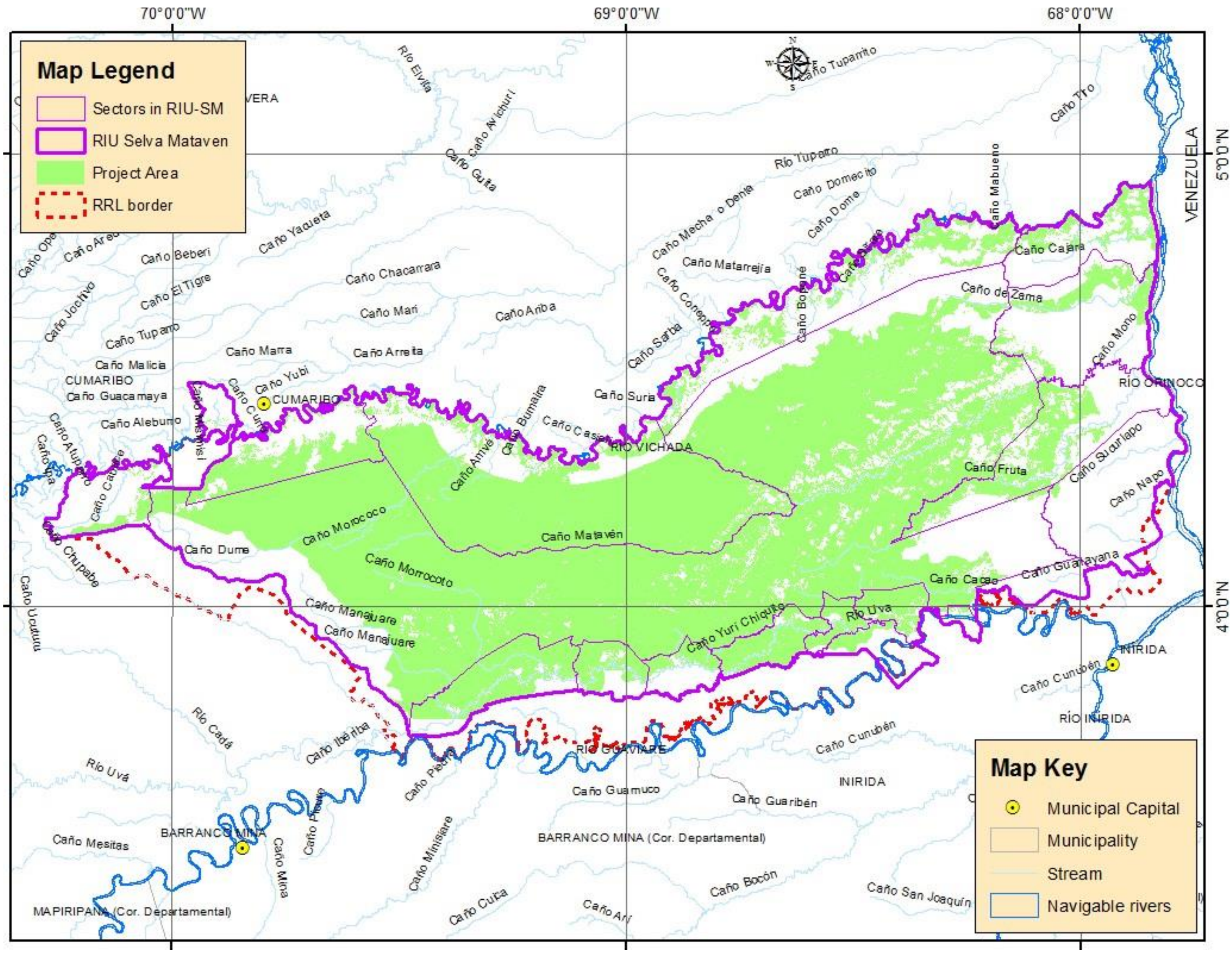
The leak belt meets the following criteria:

a. The zone of the vanishing belt is **Forest Areas Closest to the Project Area** , which to meet this criterion its minimum required surface area must have been less than 75% of the PA, which makes the proportionality criteria from criterion “d” more flexible to criterion “ e” up to ±50%.

b. The entire Leakage Belt is **ADJACENT TO THE THREE NAVIGABLE RIVERS, VICHADA RIVER, ORINOCO RIVER AND GUAVIARE RIVER**, therefore, it is **ACCESSIBLE** . It should be noted that most settlements are located around navigable rivers, since they are the main source of mobility and access to communities.

c. The leak belt is **not biased** in terms of distance and distant edges to PA , because it is adjacent to the edge of the project area and is adjacent to the three main navigable rivers (Rio Vichada, Rio Orinoco and Rio Guaviare), bordering the project area.

Project Area



Leakage Belt – Landscape Criteria

1. Biome

Biome	AP (ha)	AP %	±50%	L.I.	L.S.	CF (ha)	%
Helobiome	174,516	15.2	7.6	7.6	22.8	105,905	21.8
Peinobiome	326,058	28.3	14.2	14.2	42.5	112,079	23.1
Litobiome	116,099	10.1	5.0	5.0	15.1	73,625	15.1
Zonobiome	533,538	46.4	23.2	23.2	69.6	194,602	40.0
Total	1,150,212	100				486,211	100

2. Elevation and slope

Elevation masl	AP	C.F.
0-500	100%	100%
> 500		

Earring %	AP	C.F.
< 15	100%	100%
> 15		

3. Proportion of navigable rivers

Navigable Rivers	AP (has)	CF (has)
Adjacent distance (m)	625,261	296,479
Area in Km ^{2}	11,502	4,862
Proportion (Dist /Km ^{2})	54	61
20%	11	
L.I.	43	
L.S.	65	

4. Proportion of Settlements

Settlements	AP (has)	CF (has)
Adjacent distance (m)	195	124
KM(2)	11,832	4,399
Proportion (Dist / Km2)	0.02	0.03
fifty%	0.0	0.01
L.I.		0.02
L.S.		0.03

PART 2: ANALYSIS OF HISTORICAL DEFORESTATION

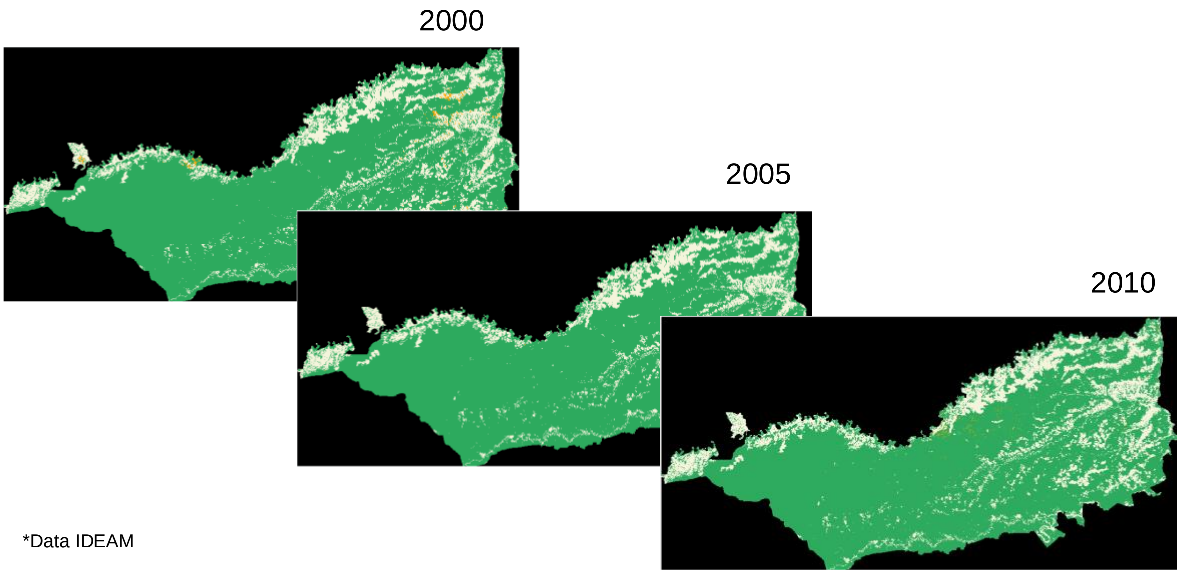
3. Selection and Processing of Satellite Images

Satellite	Sensor	Resolution		Map mosaic (period)	Acquisition date (DD /MM/ YYYY)	Scene or point identifier		ID	Cloudiness
		Spatial	Spectral (microns)			Route/ Latitude	Row/ Length		
Landsat	ETM +	30	0.45 - 2.35	2001	01/09/2001	4	56	LE70040562001009AGS00	0%
Landsat	TM	30			01/08/2001	5	57	LT50050572001008AAA02	10%
Landsat	ETM +	30			02/01/2001	5	57	LE70050572001032AGS00	0%
Landsat	TM	30			01/11/2002	5	59	LT50050592002011CUB00	0%
Landsat	ETM +	30			01/05/2000	6	57	LE70060572000005EDC00	1%
Landsat	ETM +	30			03/12/2001	6	58	LE70060582001071EDC00	0%
Landsat	TM	30			01/31/2001	6	59	LT50060592001031XXX01	0%
Landsat	TM	30			01/26/2004	4	57		
Landsat	ETM +	30			12/26/2004	5	57	LE70050572004361EDC00	0%
Landsat	TM	30			02/02/2004	5	59	LT50050592004033CUB00	54%
Landsat	ETM +	30		2005	04/11/2006	6	57	LE70060572006101ASN00	0%
Landsat	TM	30			02/14/2006	6	58	LT50060582006045CUB00	0%
Landsat	TM	30			02/14/2006	6	59	LT50060592006045CUB00	0%
Landsat	ETM +	30			01/21/2011	4	56		
Landsat	ETM +	30			01/21/2011	4	57	LE70040572011021EDC00	0%
Landsat	ETM +	30			01/09/2010	5	57	LE70050572010009EDC00	0%
Landsat	TM	30			01/20/2011	5	58		
Landsat	TM	30		2011	01/04/2011	5	59	LT50050592011004CUB00	58%
Landsat	ETM +	30			02/04/2011	6	57	LE70060572011035EDC00	twenty%
Landsat	TM	30			08/07/2011	6	58	LT50060582011219CUB00	13%
Landsat	TM	30			03/10/2009	6	59	LT50060592009069CUB00	9%

**Landsat images downloaded from the GLOVIS Portal

Rapid deforestation assessment

The basis of a rapid deforestation assessment consists of performing a **Forest-Non-Forest classification** at different times, estimating the changes from Forest to Non-Forest to calculate the projected rate of deforestation.



*Data IDEAM

Analysis using *Claslite*

ClasLite is a tool for the digital and automatic classification of Landsat and Modis images , developed for non-experts in remote sensing. With the purpose of helping governments, non-governmental institutions and universities with the purpose of monitoring forests.

Advantages

- True results.
- Relative speed.
- Applied by various prestigious institutions worldwide.

Disadvantages

- Underestimates deforestation.

Deforestation data assessment

Evaluated data source:

- IGAC coverage study scale 1:500,000 1998.
- IGAC 2007 coverage layer , SIGOT scale 1:100,000
- GlobCover 2008.
- Modis Coverages MOD12
- IGAC Biome and Ecosystems 1:500,000 1998.
- IDEAM Forest – Not Forest 2010.
- *ClasLite* Results .

Conclusions:

- The data is not consistent with each other. (Differences in scale, processing methods, different interpretations, among others).
- Deforested areas that are not detected or classified in the various data sources. (Regenerating vegetation and secondary forest). Spectral classification does not apply.

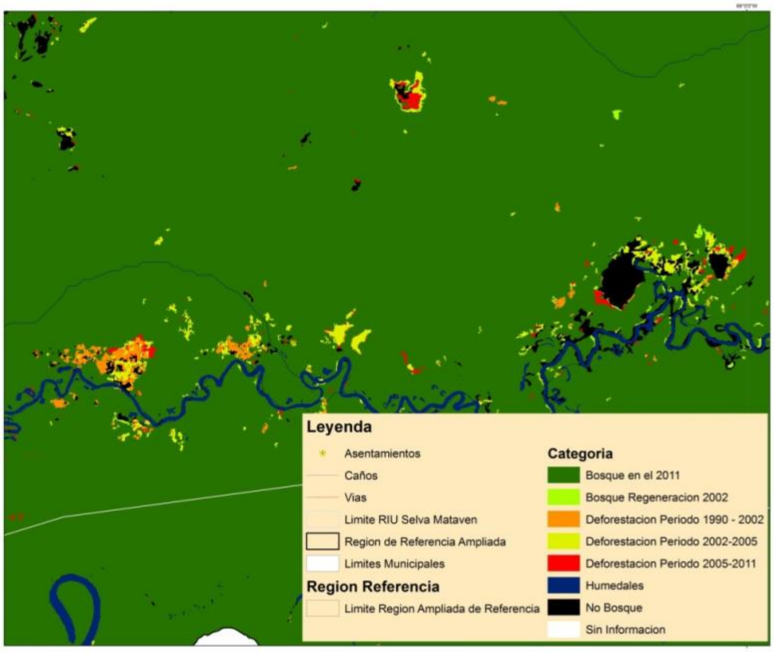
Analysis of the different themes to be generated

Coverage	**Thematic confusion**
Tierra Firme Forest	No
flooded forest	Secondary Forest > 20 Years - floodable
rocky soil forest	floodable Shrub Savannahs
Temporary flood forest	Mainland forest in summer
Secondary Forest > 20 years	Mainland forest
Secondary Forest < 20 years	Vegetation in Regeneration and Cocoa Crops.
Savannah Grassland	No
Shrub Savannah	No
Floodable savanna	Vegetation in floodable regeneration
Temporary Heterogeneous Agricultural Areas - AAH	Vegetation in regeneration, Secondary Forest, grasslands.
Pastureland	Grassland Savannas
Vegetation in Regeneration	AAH

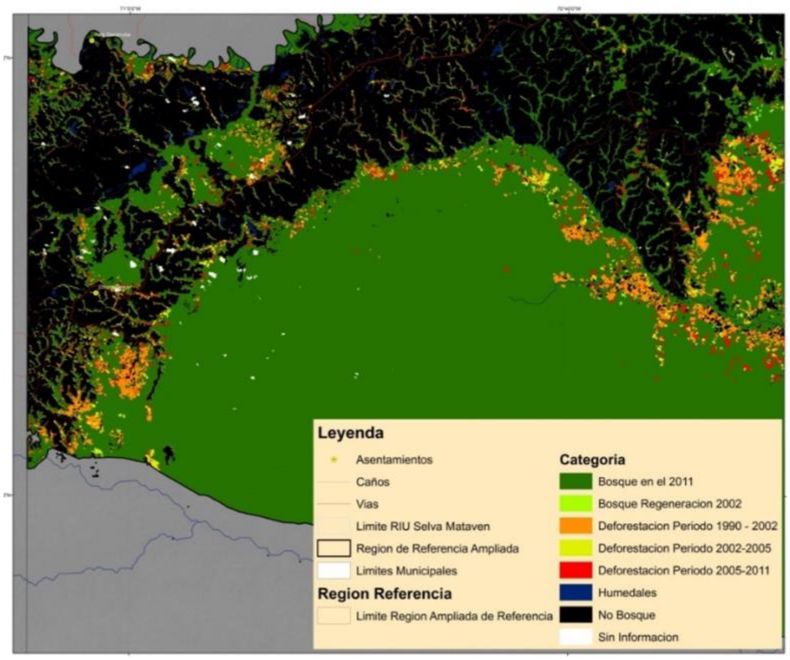
*These confusions arise if classifications are made spectrally.

Analysis of deforestation patterns

Mosaic

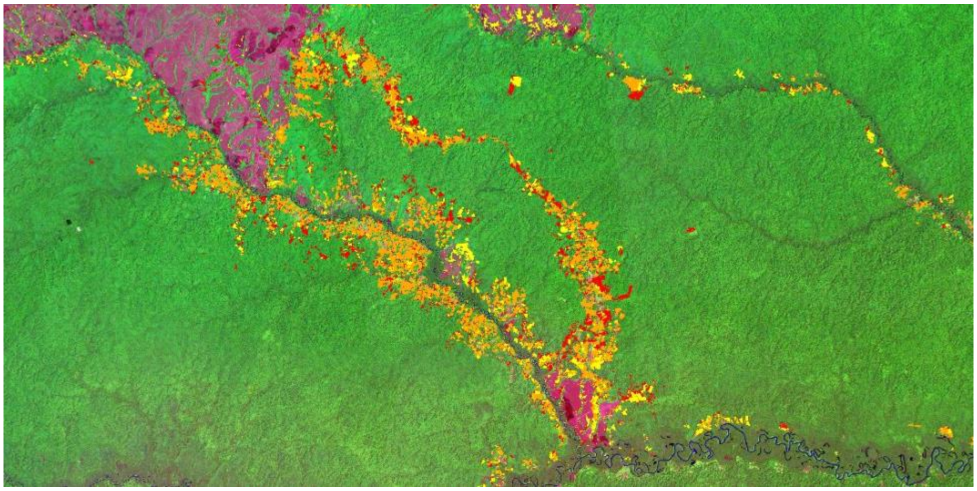


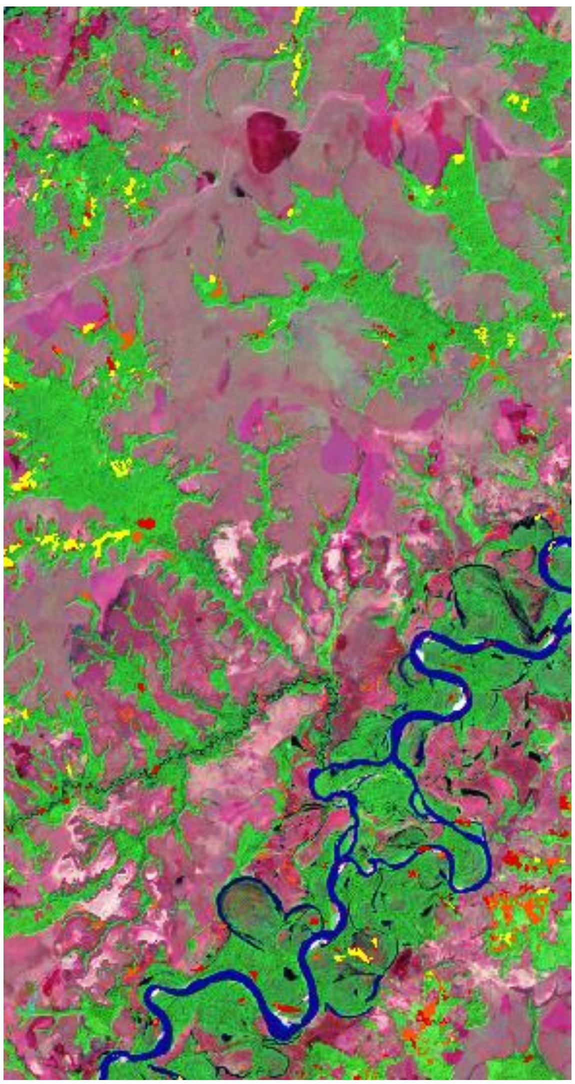
Border



To avoid thematic confusion, it was verified in the field that the deforestation was close to the communities and rivers or canals.

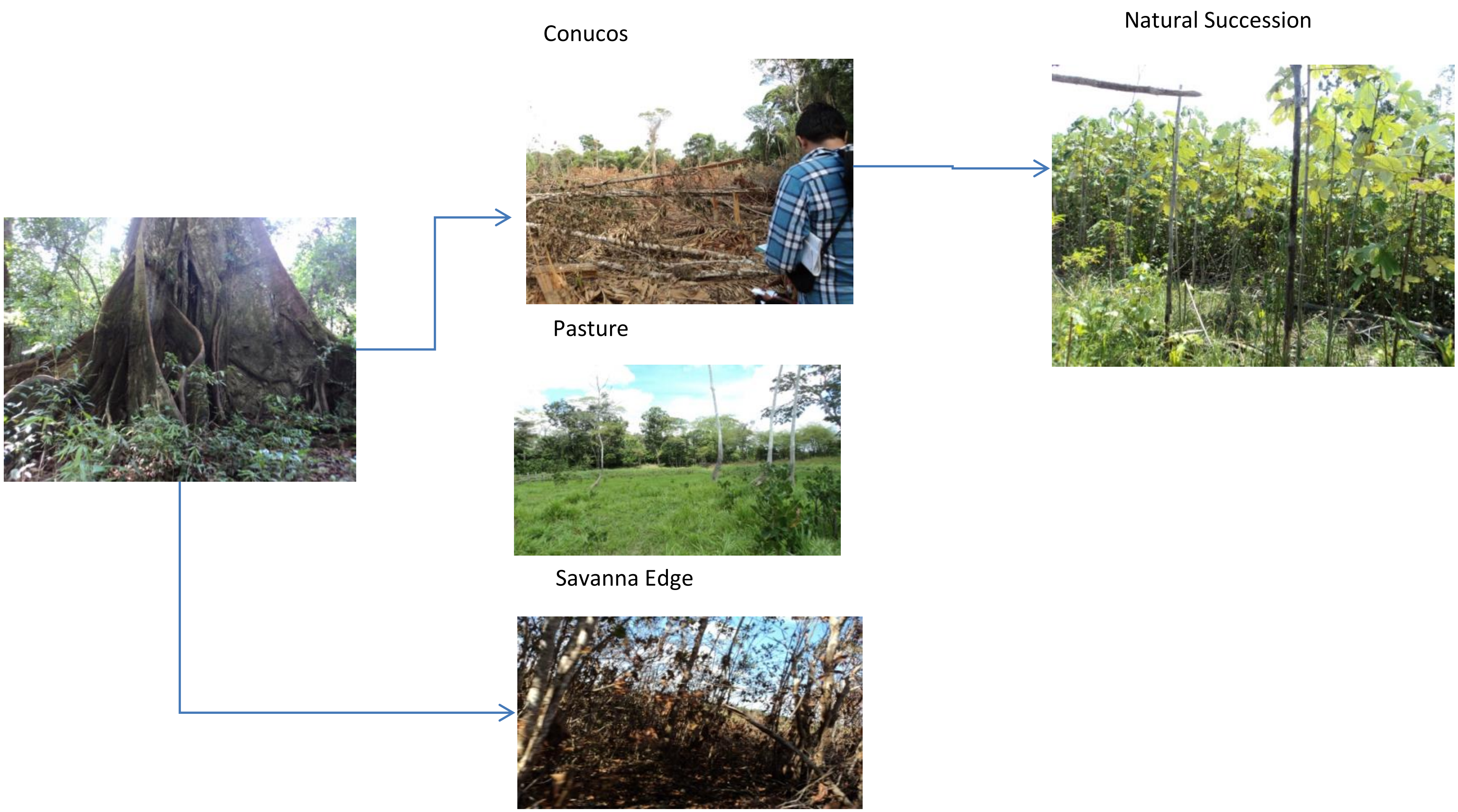
Characterize land change and use patterns on the ground





Analysis of coverage changes

In the field

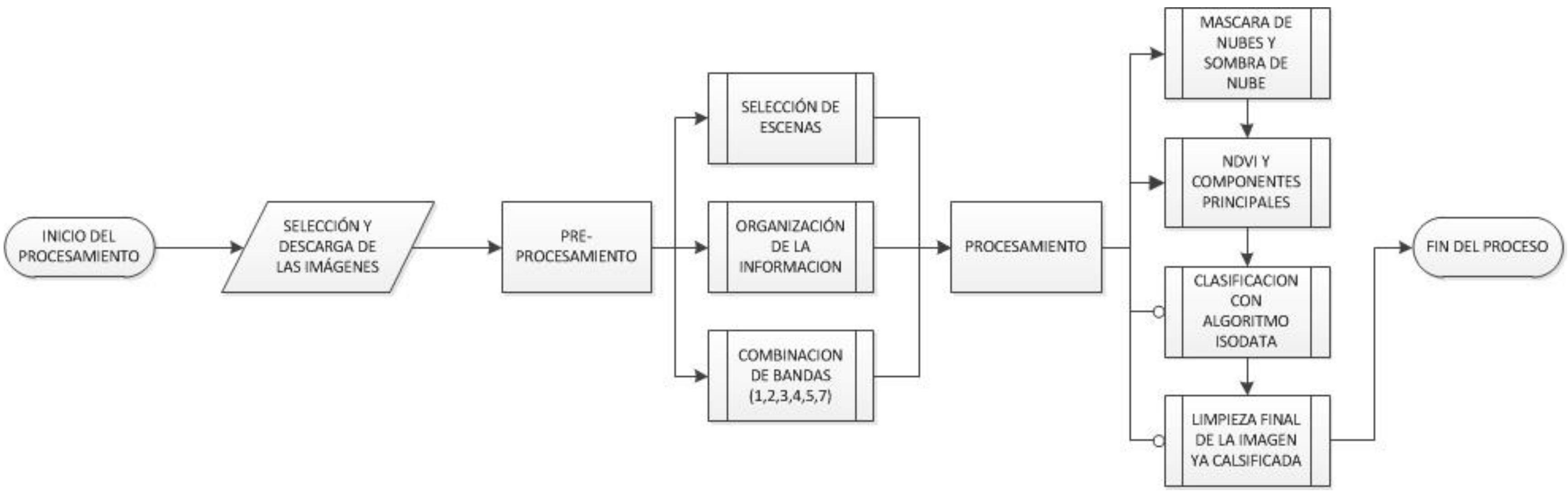


Definition of the Satellite Image Processing method

PROTOCOLS: IDEAM “Digital image processing protocol for the quantification of deforestation in Colombia at the national level – Coarse and fine scale” developed by IDEAM and the guidelines « Sourcebook on REDD GOFC -GOLD, 2011»

- Radiometric calibration and atmospheric correction:
- Geometric correction:
- Initial classification of Forest/Non-Forest coverage (automated tool application)
- Coverage classification

To do this, the following steps were applied:



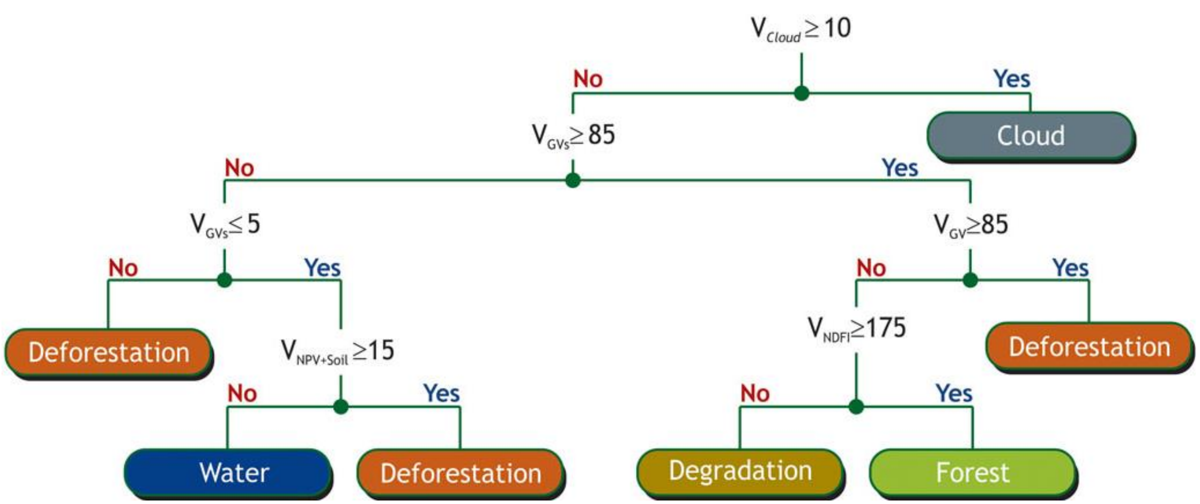
4. Definition of Forest and Non-Forest (other covers)

Description of the process carried out to identify the B/NB:

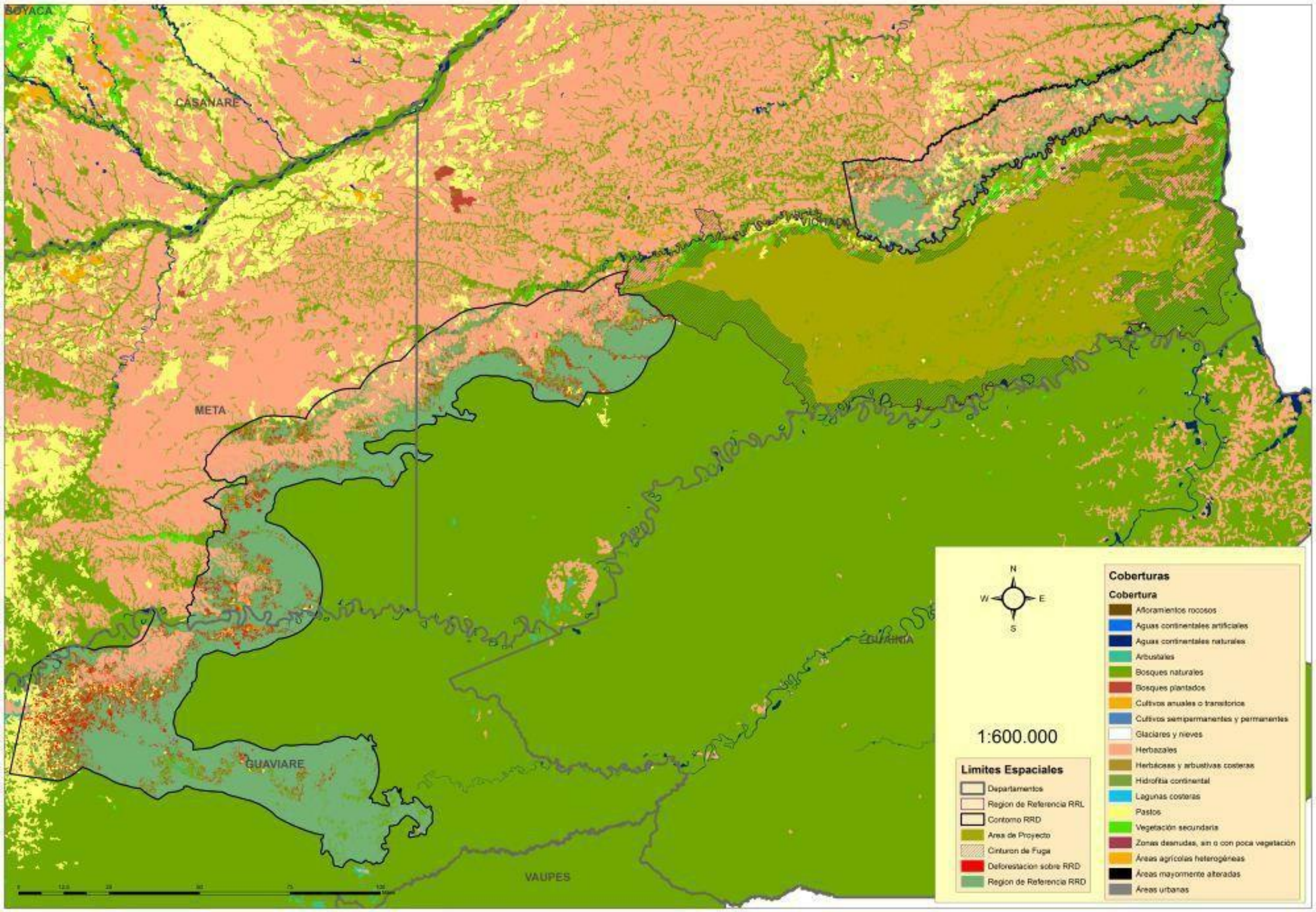
1. Cloud mask and cloud shadow.
   - Selecting band 1 ranges between 120 and 255 and band 6 ranges between 102 and 128 for clouds.
   - Selecting band 4 ranges between 17 and 66 for cloud shadow.

2. NDVI and Main Components.
   - Generation of NDVI from bands 3 and 4.
   - Generation of the first 3 main components.
   - Analysis and selection of the best combination between principal components and NDVI .

3. Classification of images using the Decision Tree method
   - Cleaning of the results obtained from the classification, to determine the Forest/Non-Forest areas.
   - BN MOSAIC of the reference historical period is obtained .



Land use coverage



5. Definition of deforestation in DRR

Biome	2001		Period 1 (2001-2005)		Period 2 (2005-2011)		Period (2001-2011)			Increase _ D (has/year) per 2 vs. per 1
	Area (you have)	%	D (has / year)	t (% year)	D (has / year)	t (% year)	D (has / year)	t (% year)	Trend	
Helobiome	230,435	15.95%	1,602	0.6950%	2,744	1.2247%	2,287	0.9924%	Growing	1,142
Peinobiome	333,195	23.06%	3,663	1.0993%	5,490	1.7235%	4,759	1.4284%	Growing	1,827
Litobiome	158,752	10.99%	86	0.0543%	445	0.2812%	302	0.1901%	Growing	359
Zonobiome	722,424	50.00%	5,459	0.7556%	7,209	1.0289%	6,509	0.9009%	Growing	1,750
Total	1,444,805	100%	10,809	0.7481%	15,888	1.1336%	13,857	0.9591%	Growing	5,079

Based on the results of the previous stages, the deforestation in DRR is obtained , particularly the previous table of deforestation according to the Strata (Biomes) and periods, with which the deforestation rate is obtained, taking into account the data analysis presented in the article " *Technical-scientific rigor against disinformation: Complete exposition of the foundations of the Baseline in the RIU Selva Matavén REDD+ Project* ", Section 6.

In addition, a quality evaluation was made according to the following:

IDEAM 2010 Stratified Sampling

$$n_0 = \frac{\sum_{h=1}^{H} W_h \sqrt{P_h Q_h}}{\frac{\varepsilon^2}{z^2}}$$

$$n = \frac{n_0}{\frac{\frac{N\,\varepsilon^2}{z^2} + \sum_{h=1}^{H} W_h \sqrt{P_h Q_h}}{\frac{N\,\varepsilon^2}{z^2}}}$$

Parameters for sample calculation

P_h	0,90
Q_h	0,10
$\in^2$	0,01
Z^2	3,84
N	3.435.691
$\sqrt{P_h * Q_h}$	0,30
$\boldsymbol{n_0} = \frac{\sum_h^H W_h \sqrt{P_h * Q_h}}{\frac{\in^2}{Z^2}}$	115
$\frac{N \in^2}{Z^2}$	8.943
n	115

Weights per stratum

Strata	**N**	$\boldsymbol{W_h}$	$\boldsymbol{W_h\sqrt{P_hQ_h}}$	$\boldsymbol{n_h}$
Forest	2.483.911	0,72	0,217	83
No Forest	951.780	0,28	0,083	32
Total	3.435.691	1,00	0,30	115

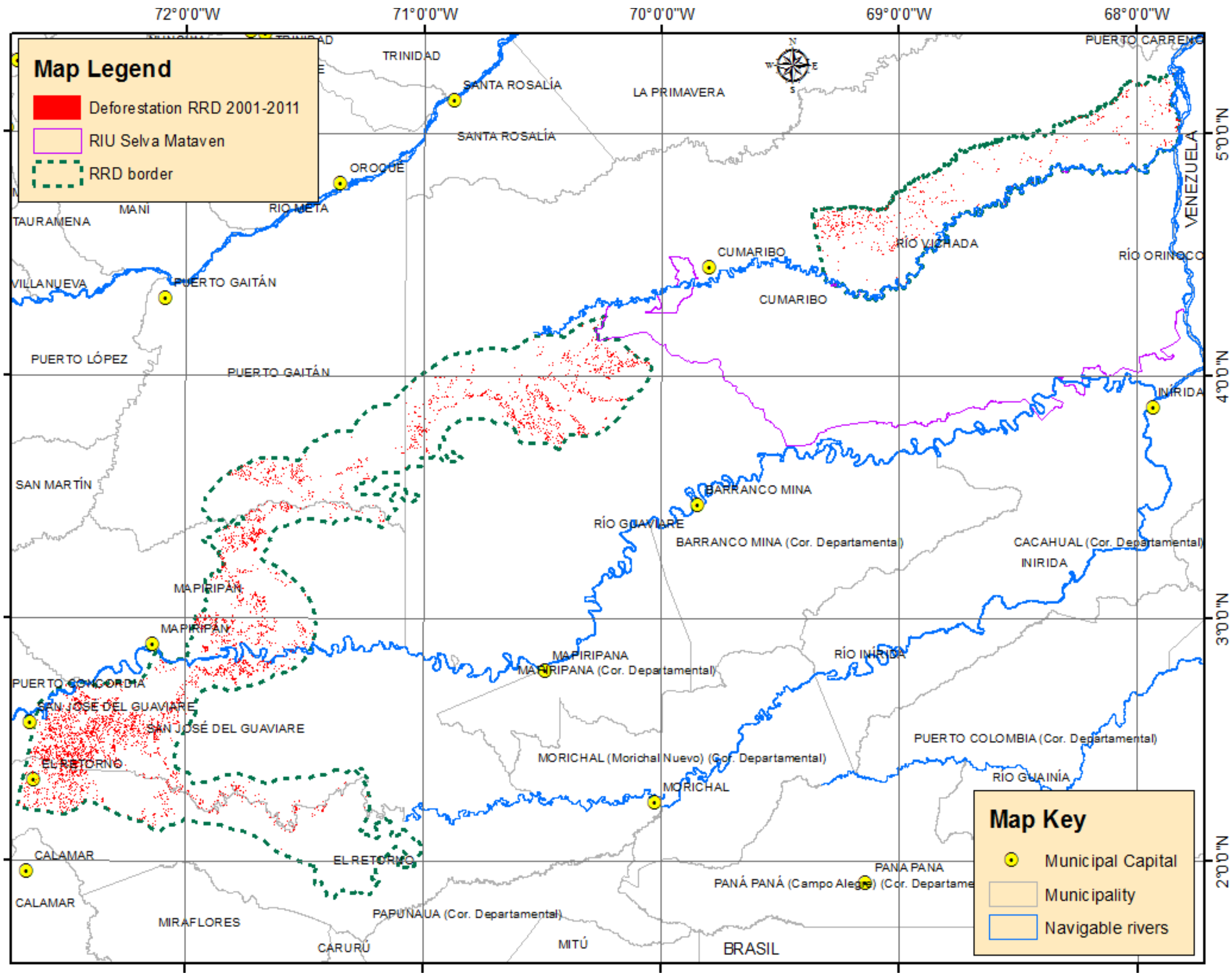
Confusion matrix

	Actual Field Class		**Σ**	**Commission Errors %**	**Accuracy**
Predicted (Map)	**Forest**	**No Forest**			
Forest	136	11	147	7,5	**92,5**
No Forest	2	32	34	5,9	**94,1**
Σ	138	43	168		
Omission Errors %	1,4	25,6			
Precision	98,6	74,4			

As can be seen, all the rigor required in the methodology selected by the Selva Matavén REDD+ Project has been met, especially with the selection of data and its processing, and the calculations applied to estimate the Project's deforestation rate. There is no argument to consider this rate to be inflated as indicated by CMW and CLIP journalists .

On the other hand, the modeling of the prospective deforestation is explained later.

Map with deforestation in DRR in the PHR



PART 3: MODELING THE PROSPECTIVE OF DEFORESTATION

To obtain the estimate of the projections of the area that will be deforested in the Project Area, it was necessary to build a deforestation forecast model that can be reviewed in Annex 10 – VMD0007 of the PDD – " *Part 3 Location and quantification of the threat of unplanned deforestation* ", which requires the estimation of the historical deforestation rate and its trends, determined in Part 2 of this document, which can also be reviewed in Annex 10 of the PDD – "Stage 2.1.3 Calculation of the historical deforestation *rate* ".

6. Calibration and validation of the Deforestation Prospective Model.

The model/software used must:
1. Have been peer reviewed and validated
2. Be transparent. Should not have closed box calculations (Black box)
3. Incorporate the spatial data sets that have been documented to explain the drivers of deforestation
4. Be able to locate projected future deforestation

The software used to develop the model was IDRISI Selva , which in version 17.02 places special emphasis on meeting these requirements. In addition to having an exclusive module for REDD projects.

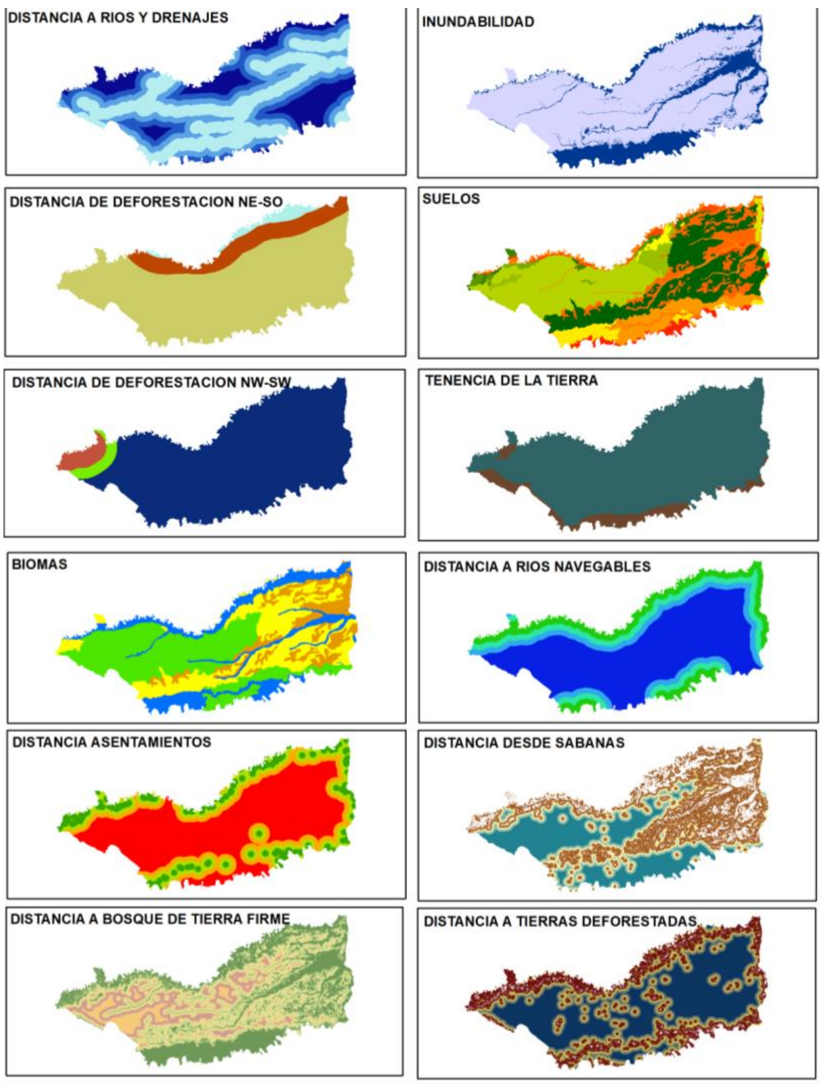
http://www.clarklabs.org/products/Land-Change-Modeling-IDRISI.cfm

Spatial Model Factors

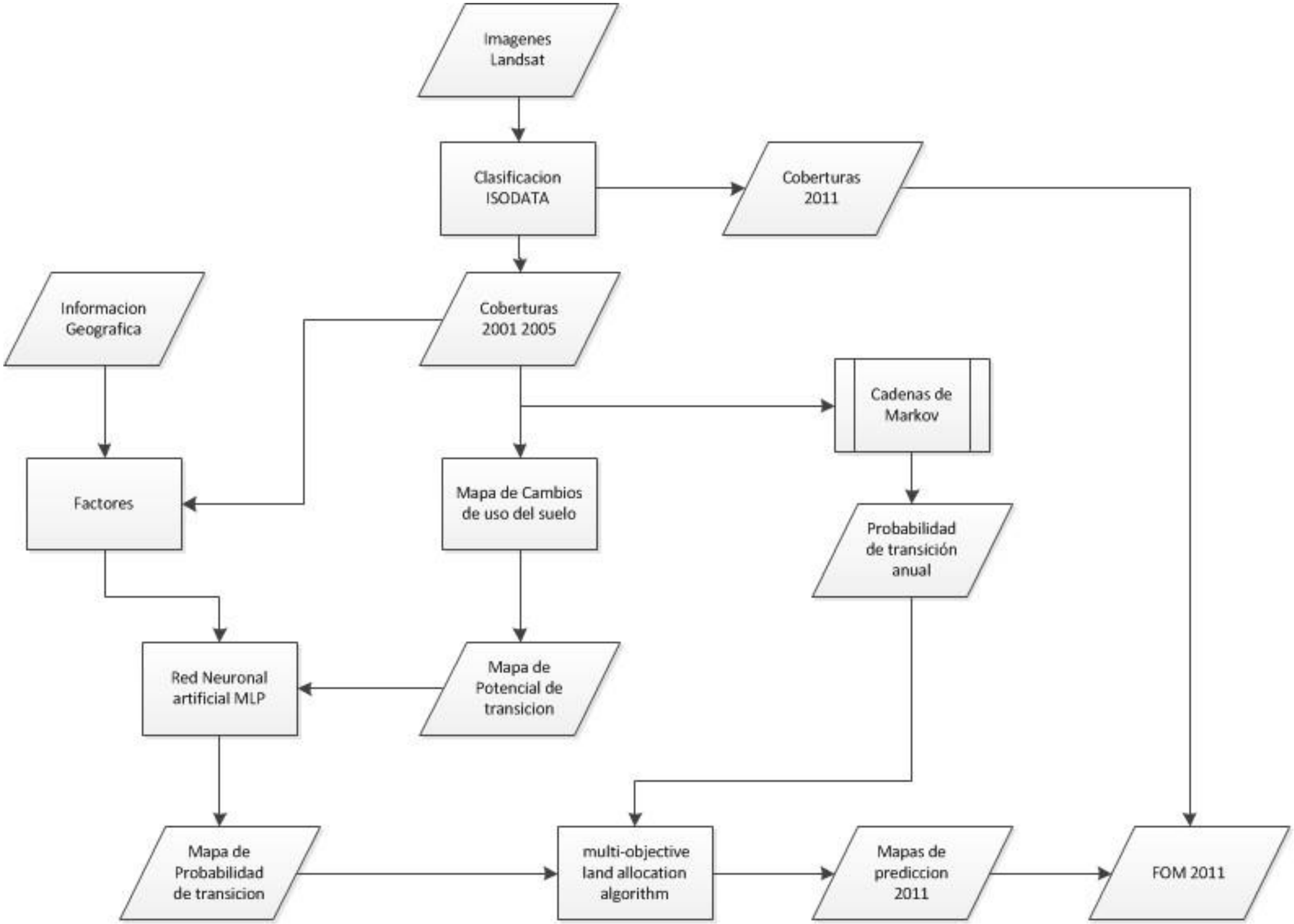
Preparing Data Sets for Spatial Analysis
The factors used for landscape modeling were categorized based on the Euclidean distance within RRL.

Spatial data set	***Deforestation factors category***	***Fountain***	***Year***
1 Biome	Landscape	IGAC	2008
2 Distance from forest to mainland	Accessibility	LANDSAT – Coverage 2011	2011
2 Flooding	Landscape	GeoProcess	2011
3 Type of Soils	Landscape	IGAC	2008
4 Distance to Navigable Rivers	Accessibility	IGAC	2008
5 Distance to Main Drains	Accessibility	IGAC	2008
6 Distance to savanna roads	Accessibility	IGAC	2008

Spatial data set	***Deforestation factors category***	***Fountain***	***Year***
7 Distance to the Western Limit of Cumaribo	Accessibility	IGAC	2008
8 Distance to the RRD Limit -North to Guaviare	Accessibility	IGAC	2008
9 Distance to Indigenous Settlements	Accessibility	Mediamos settlement map - GeoProcess	2012
10 Distance from Edge of Savannah to Forest	Accessibility	LANDSAT – COVERAGE	2011
11 Land Tenure	Land tenure	IGAC	2008
12 Distance to Lands Already Deforested (TD)	Anthropogenic	Mediamos- GeoProcess	2011



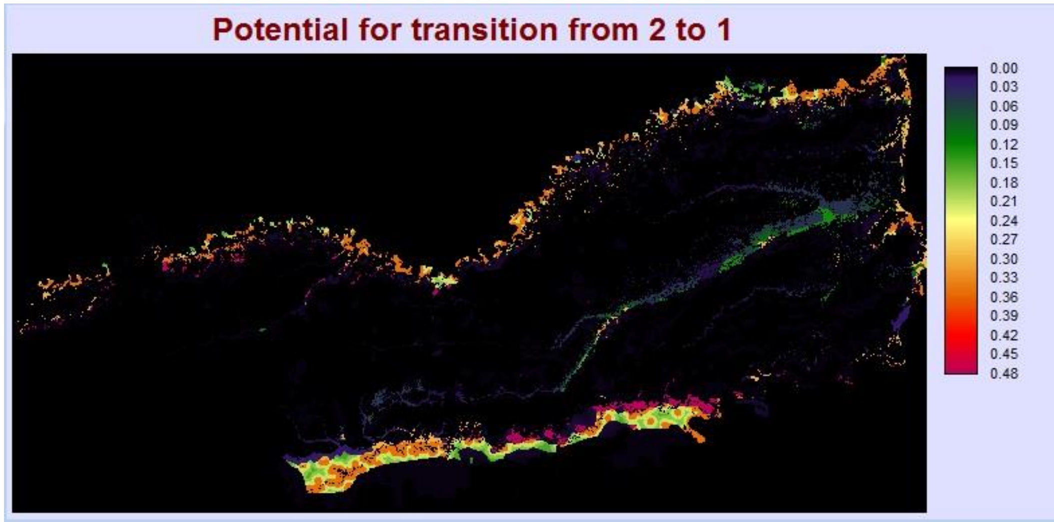
Model Calibration

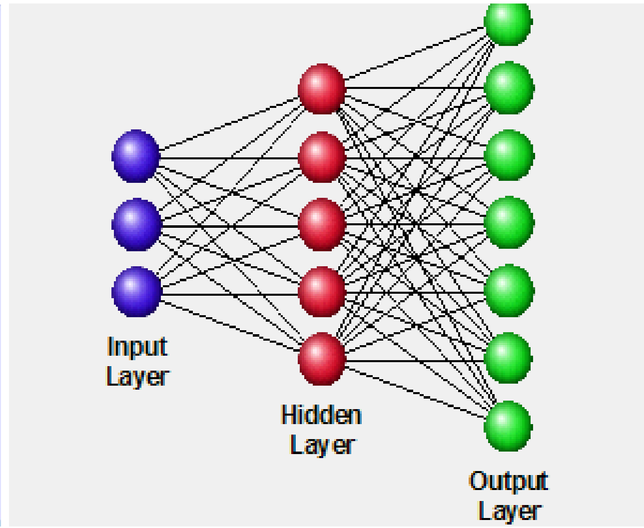


Deforestation Probability Map

A risk map shows, for each pixel position i, the risk, or “susceptibility,” for deforestation as a numerical scale (for example, from 0 = minimum risk to some upper limit representing the maximum).

Matavén Forest Deforestation Risk Map





The transition sub-model used in this case was the *Multi-Layer Perceptron* (MLP) of the module *Land Change Model* (LCM) of the IDRISI Selva software.

MLP is a type of artificial neural network, which tries to simulate human knowledge.

To comply with the requirements of the VMD0007 methodology, 10,000 samples were taken, of which 5,000 were for training the Neural Network and 5,000 for validation.

Metadata - Summary

1. General Model Information

1) Input Files

Independent variable 1	Dist_TD
Independent variable 2	Biomas
Independent variable 3	Dist_BTF
Independent variable 4	Tenencia_Tierra
Training site file	a_Train_Bosqu_to_No Bo

2) Parameters and Performance

Input layer neurons	4
Hidden layer neurons	3
Output layer neurons	2
Requested samples per class	10000
Final learning rate	0.0010
Momentum factor	0.5
Sigmoid constant	1
Acceptable RMS	0.01
Iterations	10000
Training RMS	0.1221
Testing RMS	0.1226
Accuracy rate	98.07%
Skill measure	0.9614

2. Weights Information of Neurons across Layers

1) Weights between Input Layer Neurons and Hidden Layer Neurons

Neuron	h-Neuron 1	h-Neuron 2	h-Neuron 3
i-Neuron 1	-18.4664	-16.6797	41.2103
i-Neuron 2	0.9823	-8.5210	0.9939
i-Neuron 3	-6.7947	-6.9913	13.8583
i-Neuron 4	2.3109	-8.4186	-11.3550

2) Weights between Hidden Layer Neurons and Output Layer Neurons

Neuron	o-Neuron 1	o-Neuron 2
h-Neuron 1	10.5789	-10.5780
h-Neuron 2	2.8442	-4.7075
h-Neuron 3	-4.6594	4.6592

3. Sensitivity of Model to Forcing Independent Variables to be Constant

1) Forcing a Single Independent Variable to be Constant

Model	Accuracy (%)	Skill measure	Influence order
With all variables	98.07	0.9614	N/A
Var. 1 constant	50.45	0.0090	1 (most influential)
Var. 2 constant	98.07	0.9614	3
Var. 3 constant	96.84	0.9368	2
Var. 4 constant	98.07	0.9614	4 (least influential)

2) Forcing All Independent Variables Except One to be Constant

Model	Accuracy (%)	Skill measure
With all variables	98.07	0.9614
All constant but var. 1	98.07	0.9614
All constant but var. 2	50.45	0.0090
All constant but var. 3	50.45	0.0090
All constant but var. 4	50.45	0.0090

3) Backwards Stepwise Constant Forcing

Model	Variables included	Accuracy (%)	Skill measure
With all variables	All variables	98.07	0.9614
Step 1: var.[2] constant	[1,3,4]	98.07	0.9614
Step 2: var.[2,3] constant	[1,4]	98.07	0.9614
Step 3: var.[2,3,4] constant	[1]	98.07	0.9614

Most accurate risk map

To project deforestation, it is necessary to validate the model and its ability to predict future deforestation.

Map validation equation

$$FOM = \frac{CORRECT}{CORRECT - Err_A + Err_B}$$

Where:

CORRECT : Correct area due to observed change predicted as change; ha
ErrA : Area of error due to observed change predicted as persistence; ha
ErrB : Area of error due to observed persistence predicted as persistence; ha

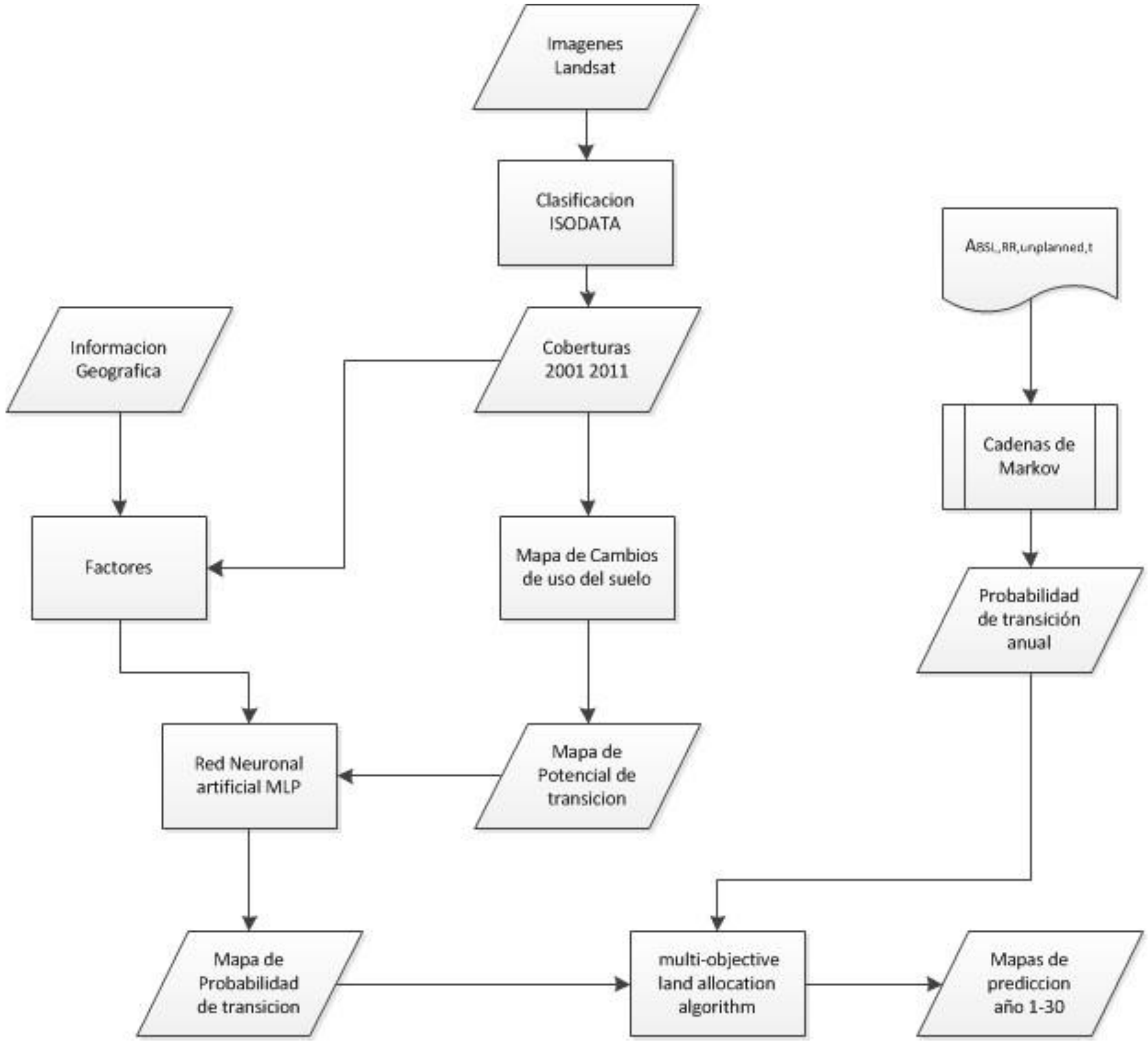
When the transition sub-model has already been run in conjunction with the deforestation factors or patterns, a prediction map for 2011 is generated, which is compared with the real one to obtain the precision of the model.

16 tests were carried out, obtaining an FOM of 84%.

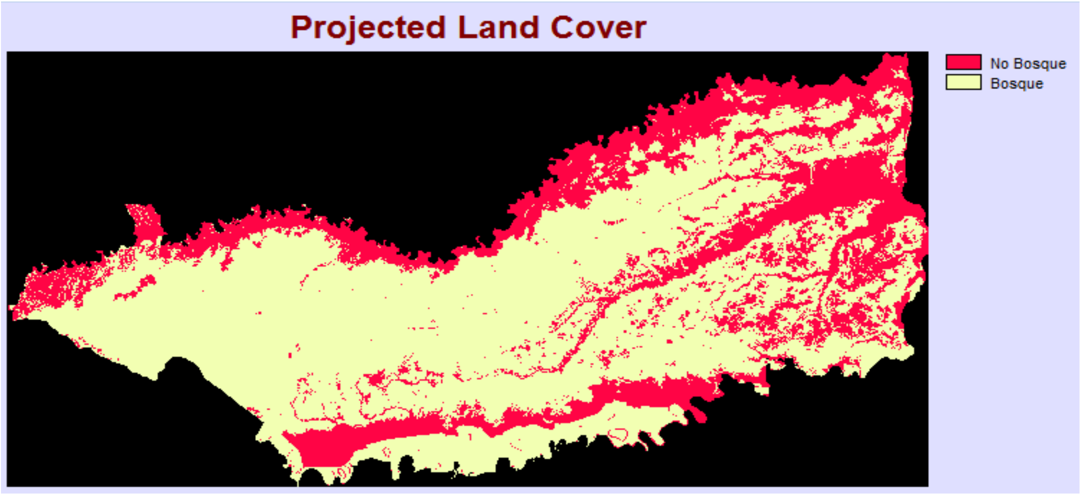
Class	Factors	Evidence															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Landscape	Biome	■					■	■	■	■					■	■	
	Flooding	■	■	■	■	■								■	■		
	Floors	■									■	■	■	■		■	
Accessibility	Distance to Edge of savanna	■			■					■							
	Distance from mainland forest edge	■	■				■				■			■	■	■	
	Distance to navigable rivers	■		■				■				■					
	Distance to paths into the jungle	■				■			■				■	■			
Anthropo - genic	Distance to settlements	■	■	■	■			■		■		■	■			■	
	Distance to Lands already deforested	■				■	■		■		■			■	■	■	■
Land tenure	Land Tenure	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
FOM	Correct	13,369	8,654	1,516	1,506	14,266	14,288	1,043	14,261	1,458	14,268	2,534	2,352	14275.4	14267.1	14261.7	14261.9
	Losses	1913	6,629	13,767	13,776	1,016	995	14,240	1,021	13,825	1,015	12,749	12,931	1007.28	1015.56	1020.96	1020.78
	False alarms	2,648	7,363	14,502	14,511	1,751	1,729	14,974	1,756	14,553	1,750	13,483	13,665	1741.77	1750.05	1755.45	1755.27
FOM (%)		**75**	**38**	**5**	**5**	**84**	**84**	**3**	**84**	**5**	**84**	**9**	**8**	**84**	**84**	**84**	**84**

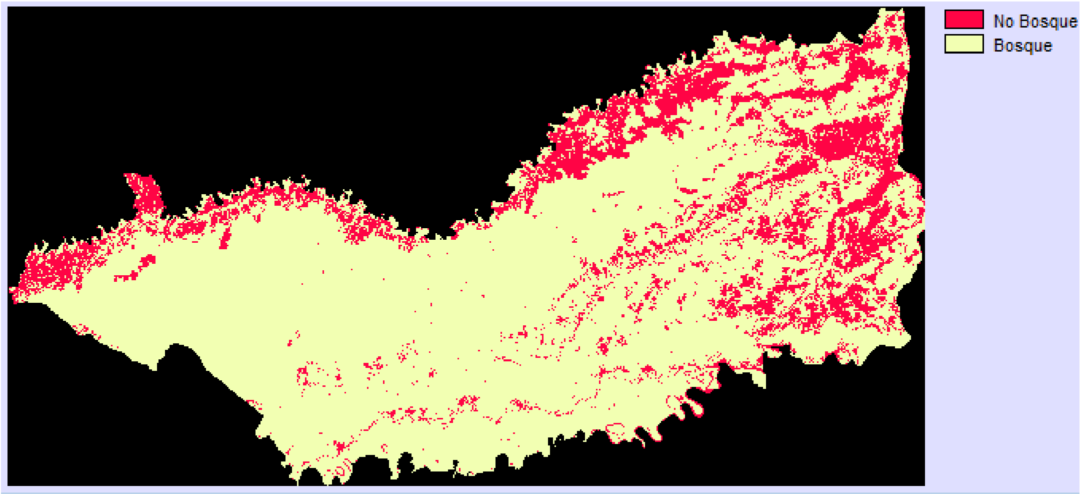
FOM above the average of other REDD+ projects worldwide.

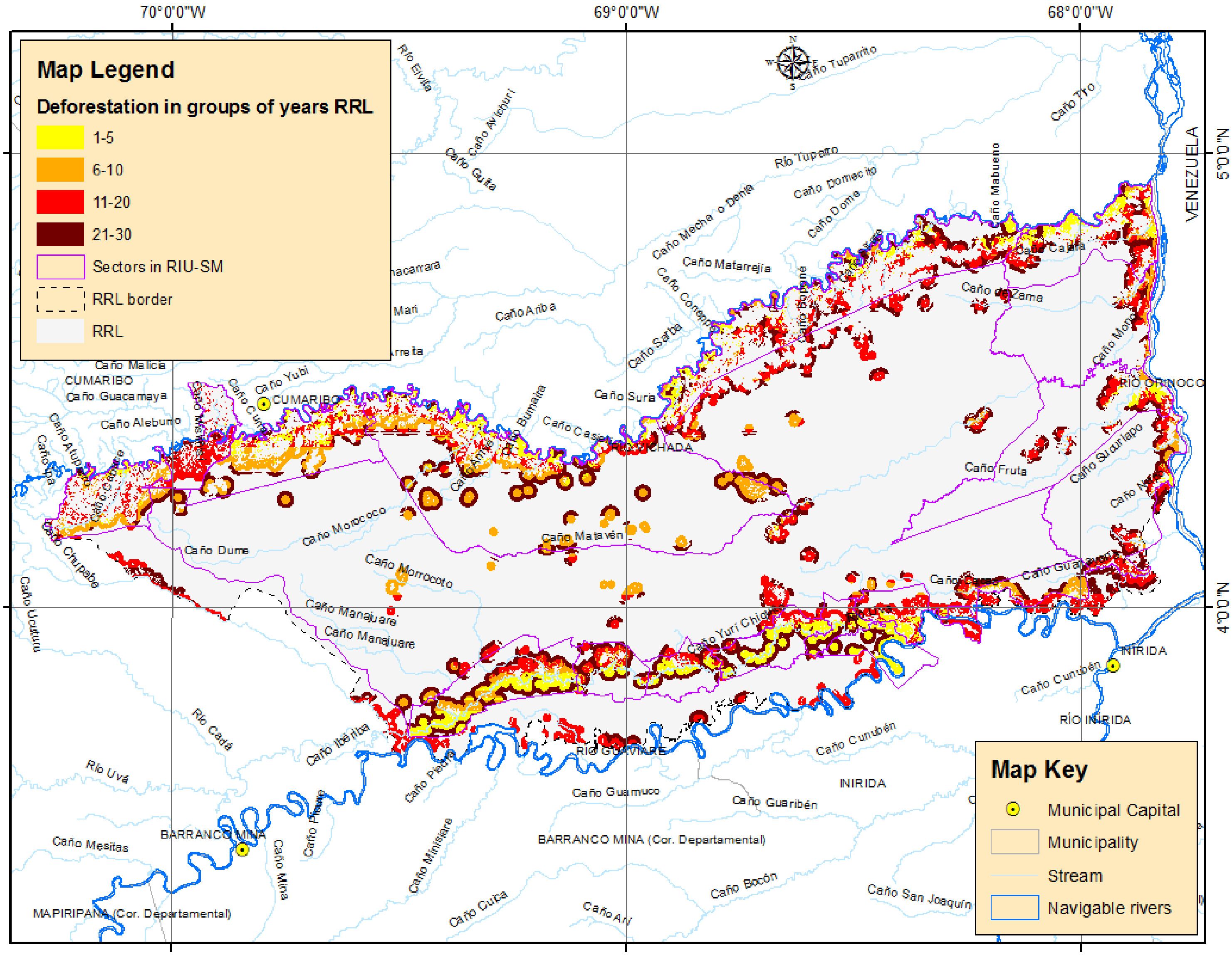
Prediction scheme



Location maps of future deforestation






Map Legend
Deforestation in groups of years RRL
1-5
6-10
11-20
21-30
Sectors in RIU-SM
RRL border
RRL
Map Key
Municipal Capital
Municipality
Stream
Navigable rivers
70°0'0"W
69°0'0"W
68°0'0"W
5°0'0"N
4°0'0"N
VENEZUELA
CUMARIBO
RIO ORINOCO
INIRIDA
RÍO INIRIDA
RIO GUAVIARE
BARRANCO MINA
BARRANCO MINA (Cor. Departamental)
MAPIRIPANA (Cor. Departamental)

PART 4: MONITORING

7. Selection of Images

The images were acquired on the United States Geological Survey server GLOVIS " *The USGS Global Visualization Viewer* " (http://glovis.usgs.gov), which are searched through sensor type, date and percentage of cloud cover.

To estimate the Forest - No Forest of January 2014, satellite images were used

Landsat 8 (RRL):

LC80050572014028LGN00
LC80040572013354LGN00

ETM + satellite images were used . Given that these images are banded, it was decided to work with two scenes per tile, to complete the areas where there is no data:

LE70040572012344EDC00
LE70040572013010EDC00
LE70050572013017EDC00
LE70050572013001EDC00

(IDENTICAL PROCEDURE TO PART 2.)

8. Results

	Strata (forest types)	Area (ha)	Interpretation of deforestation (ha)
Project Area	Helobiome	174,516	103.19
	Peinobiome	326,058	11.39
	Litobiome	116,099	3.88
	Zonobiome	533,538	110.46
	TOTAL GIS AREA	**1,150,212**	**228.92**
Leak Belt	Helobiome	105,905	70.14
	Peinobiome	112,079	47.52
	Litobiome	73,625	11.71
	Zonobiome	194,602	130.90
	TOTAL GIS AREA	**486,211**	**260.27**

Regarding the estimation of GHG reductions (Annex 2), the standard was also rigorously applied and its processes and calculations present aspects that show how decisions were made to apply the conservatism criterion, which contrasts with the accusation of applying an artificially high baseline.

ANNEX 2

ESTIMATION OF THE REDUCTION OF GHG EMISSIONS DUE TO THE PROJECT

Methodology applied to quantify *Verified Carbon Units* (VCUs) is the *REDD Methodology Framework* (REDD-MF), VCS VM0007 – Version 1.5. March 9, 2015.

REDD-MF Modules and Tools (VM0007):

- X- STR (VMD0016): Methods for stratification of the project area
- BL -UP (VMD0007): Estimation of changes in carbon stocks and greenhouse gas emissions from unplanned deforestation at Baseline
- CP-AB (VMD0001): Estimation of carbon stocks in above-ground and below-ground biomass in living trees and non-tree stands
- CP-S (VMD0004): Estimation of stocks in the soil organic carbon pool
- LK -ASU (VMD0010): Estimation of emissions derived from the change in activity due to avoided unplanned deforestation
- M- MON (VMD0015): Methods for monitoring greenhouse gas emissions and removals
- X- UNC (VMD0017): Estimation of uncertainty for REDD project activities
- Tool for the demonstration and evaluation of additionality in the activities of the VCS Agriculture, Forestry and Other Land Use (AFOLU) project
- Tool for the analysis of risk of non-permanence of AFOLU and the determination of the Buffer

Once the DRR Reference Region is defined, the following stages or phases are developed to estimate the reduction of GHG emissions that would be achieved by the implementation of the REDD+ Matavén Project:

1. Baseline Emissions
    1.1 Stratification
        Definition of Strata (biomes) in AP, CF, RRD and RRL (2011)
    1.2 Carbon deposits considered
    1.3 Estimation of carbon content in each deposit, by stratum, pre-deforestation
        1.3.1 Aboveground biomass of trees ($C_{AB\_tree,i}$)
            Stage 1: Determination of tree dimensions and size and number of field plots
            Allometric Equations to calculate biomass in trees
            Stage 3: Estimation of carbon stocks in the biomass for each tree
            Stage 4: Calculation of the average carbon in biomass per plot in each stratum

and its conversion to CO_2e.
Estimation of aboveground biomass (BA) and carbon equivalent. Sampling error (Aspect of Conservatism: Aboveground biomass of the Project less than the Biomass of IDEAM 2011)

1.3.2 Belowground biomass of trees ($C_{BB\_tree,i}$)
Carbon deposits: aboveground biomass + underground biomass

1.3.3 Soil Organic Carbon ($C_{SOC,i}$)
SOC statistics according to simple random sampling in each stratum CO_2 in the soil (cumulative T / ha) by soil depths (cm)

1.3.4 Land use change
Transition matrix 2001 – 2011

1.3.5 Post-deforestation carbon deposits
post-deforestation land use classes (2001-2011)
Estimation of carbon stocks after deforestation

1.3.6 Changes in Carbon stock due to land use (Aspect of Conservatism: The net and non-gross Carbon contents are analyzed, as is done in the NREF)

1.3.7 Projection of deforestation in the Project Area and Leakage Belt
Projected Deforestation

1.3.8 Changes in Carbon stock in baseline
(Aspect of Conservatism: The Project's emission factor is lower than that managed by the NREF)

2. Emissions due to project activities (ex-ante) (Conservatism Aspect: The Project deducts from the gross emissions those that it considers would occur in a scenario with a project)
Ex-ante " estimate of “Net GHG emissions in PA in the Project scenario”
Net changes in carbon stocks due to deforestation in the Project scenario
Net GHG emissions in AP in the Project scenario

3. Emissions due to Leakage due to displacement of deforestation due to Project activities
Net GHG emissions due to the leak
Net GHG emissions due to unplanned deforestation displaced outside the Leakage Belt
(Aspect of Conservatism: The Project deducts from the gross emissions those that it considers would occur due to leaks outside the Project Area and outside the Leakage Belt)

4. GHG emissions reduction estimates

5. Uncertainty Analysis (Aspect of Conservatism: The Project carries out an uncertainty analysis, which is not carried out in the construction of the NREF)

6. “Buffer” Calculation (Aspect of Conservatism: The Project deducts from the net emissions a proportion for the buffer account, which is not applied in the use of the NREF)

7. Calculation of *Verified Carbon Units* (VCUs)

1. Baseline Emissions

1.1 Stratification

The procedures begin with the definition of the Strata, which in the case of the REDD+ Matavén Project were the biomes present in the territory of the Resguardo Indígena Unificado – Selva de Matavén. (PDD table 46)

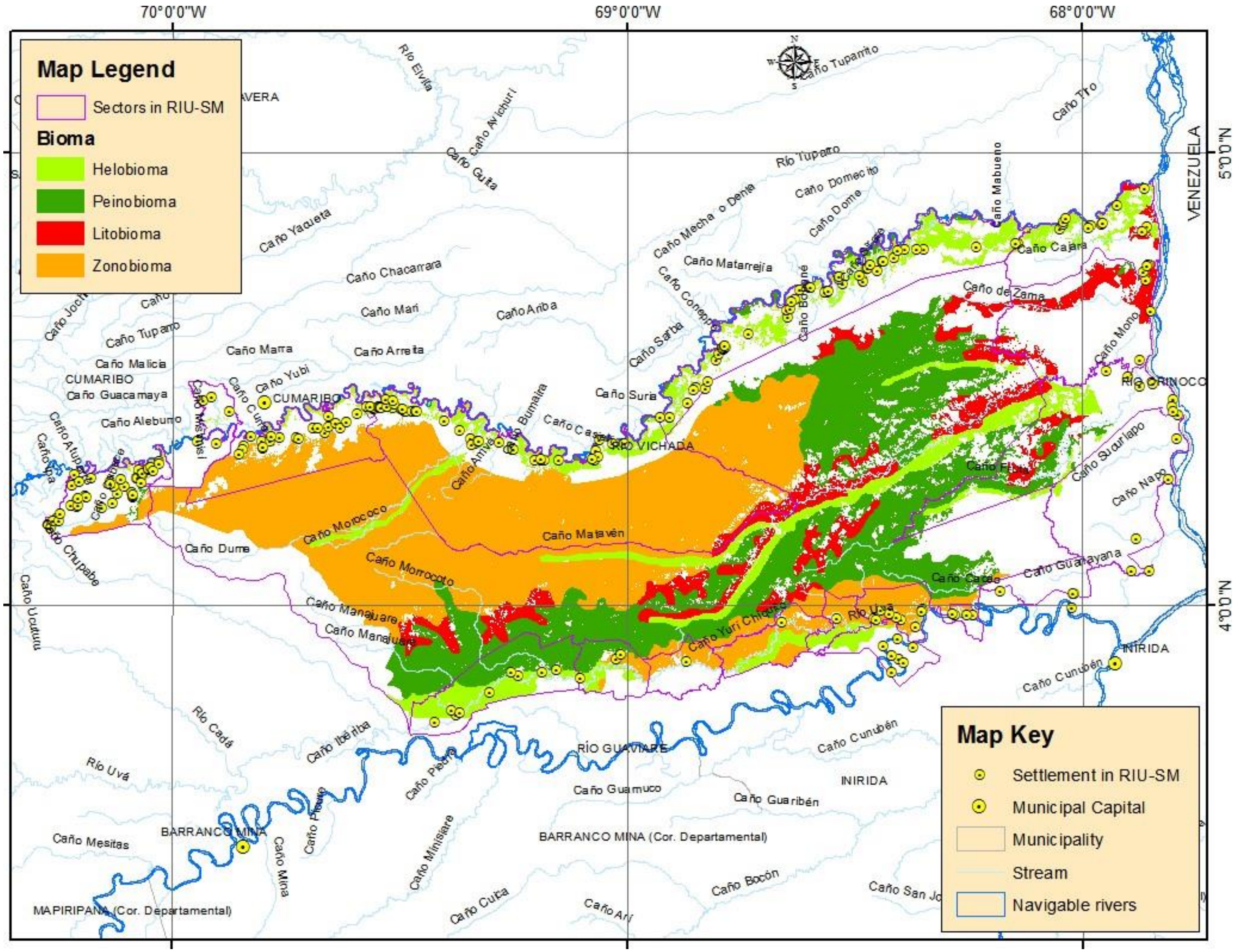
	Biome	Description	Landscape features
1	Helobiome	Floodplain forest without understory	Floodplain forest in the lower plain of Caño Matavén
2	Litobiome	Floodplain forest with understory	Floodplain forest in the Caño Matavén plateau
3	Peinobiome	Rocky hills forest	Forest of rocky hills of residual granite in the Guayanés Shield
4	Zonobiome	Forest land	Plateau forest of moderately dissected ancient sedimentary plains

Definition of Strata (biomes) in AP, CF, RRD and RRL (2011)

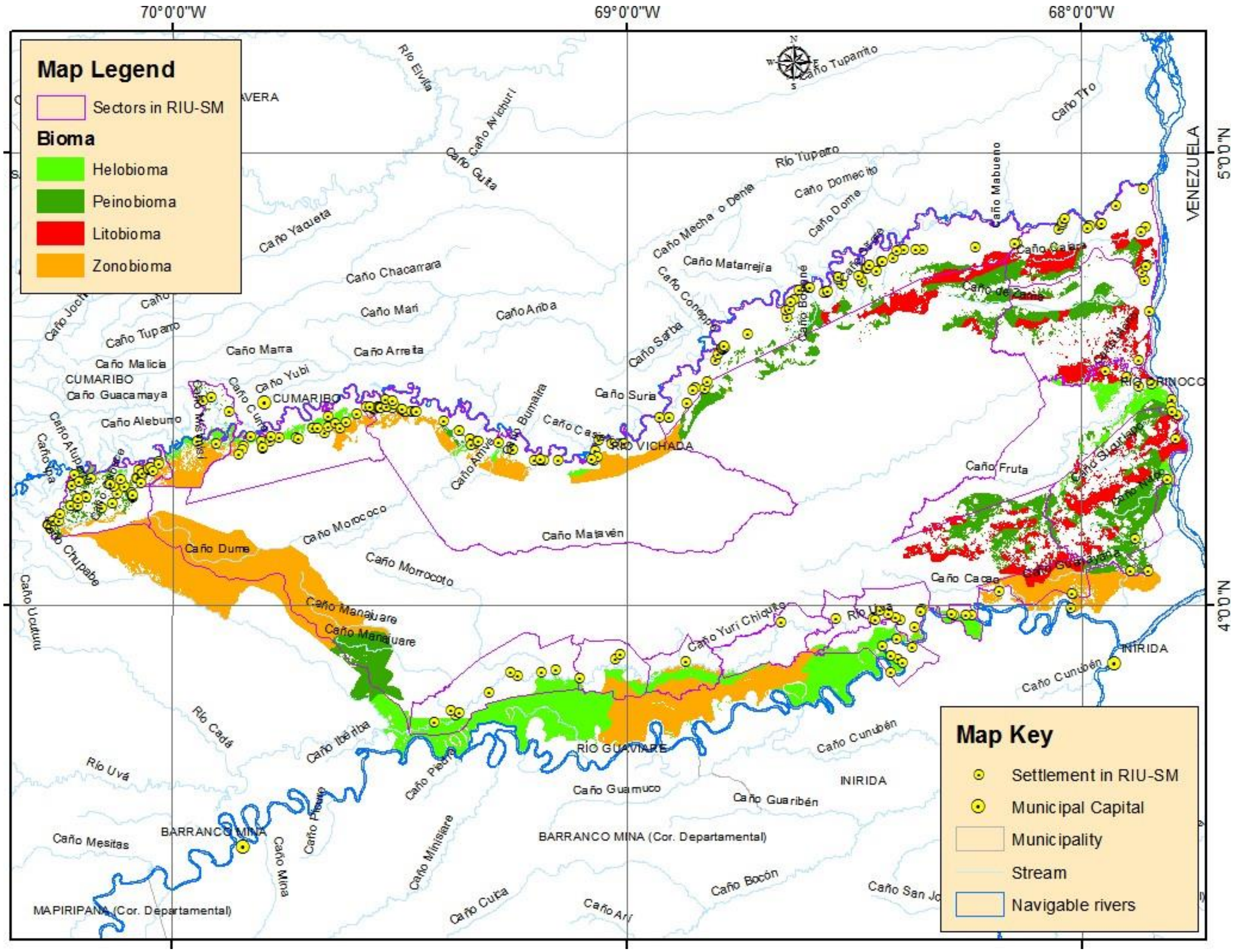
Distribution of areas in Project Area (AP or *Project Area - PA*), Leakage Belt (CF or *Leakage Belt - LB*), Reference Region to project the deforestation rate (RRD) and Reference Region to project the location of deforestation (RRL), according to the biomes. (PDD table 47)

Strata (biomes)	Areas and percentage of coverage									
	AP		C.F.		DRR		RRL Forest		RRL	
	$A_{BSL,i}$ (A_i) Area (ha)	%	$A_{BSL,i}$ (A_i) Area (ha)	%	$A_{BSL,i}$ (A_i) Area (ha)	%	$A_{BSL,i}$ (A_i) Area (ha)	%	$A_{BSL,i}$ (A_i) Area (ha)	%
Helobiome	174,516	15.2	105,905	21.8	230,435	15.9	280,422	17.1	391,909	19.3
Peinobiome	326,058	28.3	112,079	23.1	333,195	23.1	438,138	26.8	579,288	28.6
Litobiome	116,099	10.1	73,625	15.1	158,752	11.0	189,724	11.6	293,615	14.5
Zonobiome	533,538	46.4	194,602	40.0	722,424	50.0	728,140	44.5	763,627	37.6
Total	**1,150,212**	**100**	**486,211**	**100**	**1,444,805**	**100**	**1,636,423**	**100**	**2,028,439**	**100**

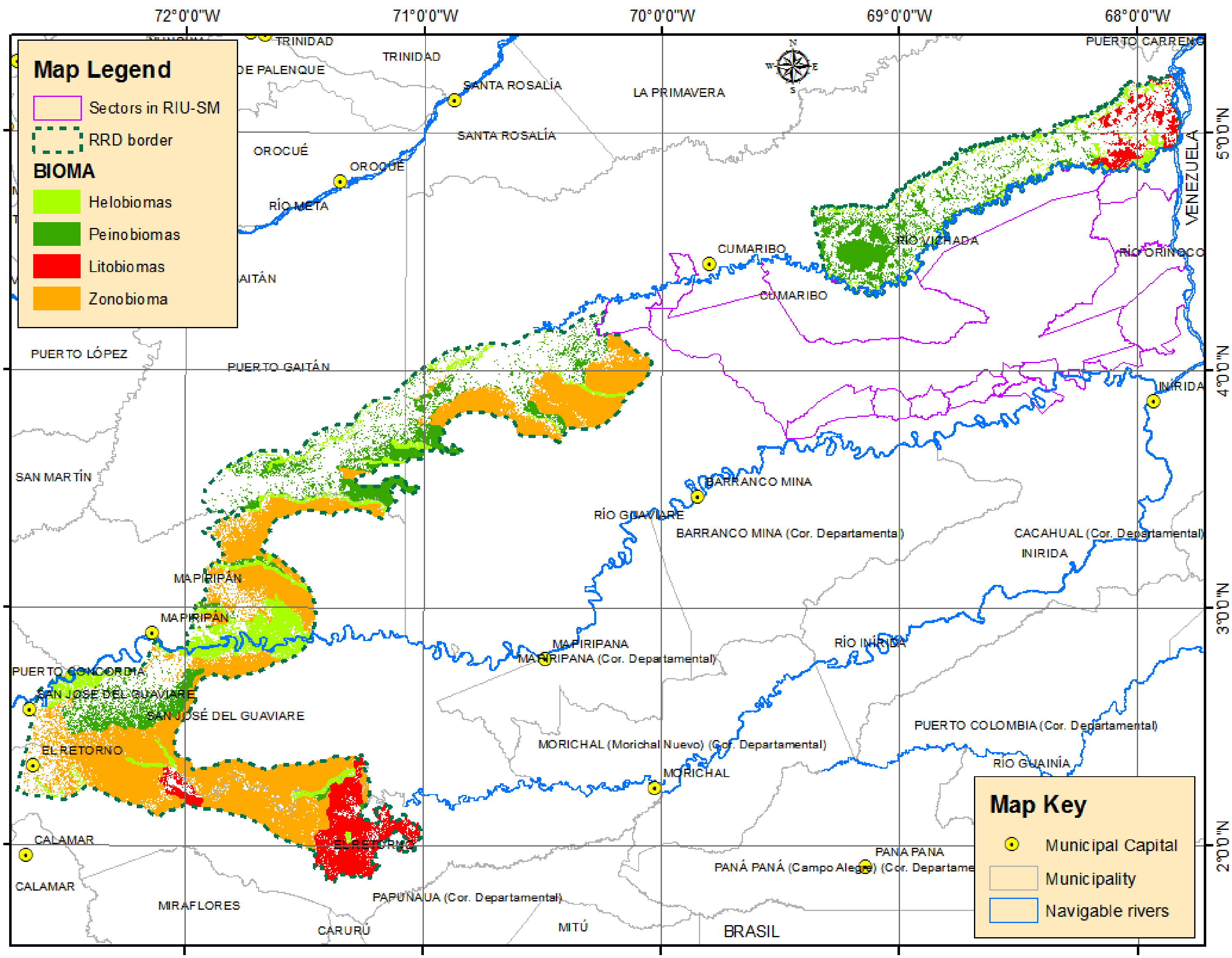
Project Area (strata)



Leakage Belt (strata)



DRR Reference Region (strata)



1.2 Carbon deposits considered

- Aboveground biomass of trees (BA)
- Belowground biomass of trees (BS)
- Soil organic carbon (SOC)

1.3 Estimation of carbon content in each deposit, by stratum, pre-deforestation

The IDEAM "*Protocol for the national and subnational estimation of biomass - carbon in Colombi* " was applied to develop the carbon inventory and the subsequent estimation of the carbon content in the considered deposits.
These estimates were based on field observations obtained from plots in a **stratified random sampling**, using **allometric equations**.
The calculations are based on statistical methods for this type of sampling.
Field work and calculations were carried out between January and May 2013.

1.3.1 Aboveground biomass of trees ($C_{AB\_ tree,i}$)

Stage 1 : Determination of tree dimensions and size and number of field plots

Parameters evaluated:

- DBH (diameter at breast height, for trees whose DBH is greater than 10 cm):
- Species name
- Circumference
- Tree trunk height (HC)
- Total height (HT)
- Georeferenced plots.
- In some plots, an inventory of regeneration was made.
- Marked plots and shafts.
  (Annex 13 CP-AB VMD0001; PDD, page 192)
- Field plot size: 50 m x 50 m
- Number of field plots:
- Percent error: 15%
- Probability level : 95%
  (VCS Module X- UNC VMD0017, page 5)
- To determine the sample size (number of plots), the IDEAM Protocol, equations 4, 5, 6, 8, was applied, following the methods of stratified random sampling.
  (PDD, page 192)
- Number of field plots: 131

	Strata i			
	Helobiome	Peinobiome	Litobiome	Zonobiome
	n1	n2	n3	n4
n.j.	16	29	24	62

Independent simple random sampling in each stratum

$E\% = 9.3\%$, with a probability level of 95%, which conservatively complies with the uncertainty parameters established in the standard

Stage 2 : Selection of Allometric Equations to calculate biomass in trees

ln (BA) = a + B1 ln (D)

Where:
• BA: area biomass of trees (Kg)
• D: average diameter measured 1.3 m (chest height)
• a and b are model parameters
• R^2 model fit indicator

Forest type	**to**	**B1**	**R2**
bh -T	-1,544	2.37	0.932

(Yepes, et al., 2011) Protocol for the national and subnational estimation of biomass - carbon in Colombia, IDEAM 2011, page 49

Allometric equation was selected in comparison to 2 others, and offers the advantage of requiring only the diameter at chest height, which reduces the risks of uncertainty and measurement errors by not needing other variables such as height and density.

For the palms the following was applied:

$$BA = 6.666 + 12.826 * H^{0\,5} * \ln(H)$$

Acronym	Description
B.A.	Aerial biomass as dry matter, expressed in kg/tree
h	Trunk height, meters (in palms, this is the main stem, excluding leaves)

Source: (IPCC, 2003) Annex 4.A.2 (4.A.2 table, page 4.114 [513])

Stage 3 : Estimation of carbon stocks in the biomass for each tree

In the file "plot_study_fustales.xlsm" (folder "calculate_tables") are the estimates, applying the allometric equation from the previous step selected.

Stage 4 : Calculation of the average carbon in biomass per plot in each stratum and its conversion to CO_2e.

Carbon Fraction for dry matter (default = 0.47), (ton C/ton dm) (IPCC, 2006) INV GLs AFOLU Chapter 4 Table 4.3) was used to transform biomass into Carbon; The factor 44/12 (3.67) was used to transform Carbon into CO_2.

In the file "plot_study_fustales.xlsm" (folder " calculate_tables ") are the calculations of the average carbon content in biomass per plot for each stratum, converted to CO_2e. Based on the results of the field work, estimates of carbon densities by strata were made as shown in the following table (these data were considered for AP and LB):

Stratum (biome)	Helobiome			Peinobiome			Litobiome			Zonobiome		
	B.A.	c	CO2 _	B.A.	c	CO2 _	B.A.	c	CO2 _	B.A.	c	CO2 _
Number of plots in the sample stratum	16	16	16	29	29	29	24	24	24	62	62	62
Minimum value	155.3	73.0	267.7	93.5	44.0	161.2	128.2	60.3	221.0	151.9	71.4	261.8
Maximum value	533.2	250.6	918.9	354.0	166.4	610.0	351.5	165.2	605.8	1,296.3	609.3	2,233.9
Average	**278.5**	**130.9**	**479.9**	**218.8**	**102.9**	**377.1**	**222.1**	**104.4**	**382.7**	**280.9**	**132.0**	**484.1**
Coefficient of variation of the average	9.3%	9.3%	9.3%	5.1%	5.1%	5.1%	5.8%	5.8%	5.8%	8.5%	8.5%	8.5%
% Sampling error	19.9%	19.9%	19.9%	10.4%	10.4%	10.4%	12.0%	12.0%	12.0%	16.9%	16.9%	16.9%
Lower limit	223.1	104.9	384.5	196.2	92.2	338.0	195.5	91.9	336.9	233.5	109.8	402.5
Upper limit	333.8	156.9	575.3	241.5	113.5	416.2	248.6	116.8	428.4	328.2	154.3	565.7

Source: REDD+ Matavén Project, file "plot_study_fustales.xlsm", sheets "stad H" - "BA vs. nZ" (folder "calculation_tables"). BA: aerial biomass in t dm /ha; *C: carbon in t/ha;* CO_2e *: carbon dioxide equivalent in t/ha*

	Project Area		Avg/ str		EE	EE%	Confidence limits	
Stratum	**Area (has)**	**%**	$\bar{y}_h$	$W_h * \bar{y}_h$	$t*S(\bar{y}_h)$		**Lower limit**	**Upper limit**
Helobiome	174,516	15.2%	278.5	42.3	55.34	19.9%	223.14	279.06
Peinobiome	326,058	28.3%	218.8	62.0	22.37	10.2%	196.46	244.15
Litobiome	116,099	10.1%	222.1	22.4	28.28	12.7%	193.77	239.38
Zonobiome	533,538	46.4%	280.9	130.3	47.35	16.9%	233.53	297.27
Total	1,150,212	100%		257.0	23,905	9.3%	233.09	280.90

Source: REDD+ Matavén Project, file "plot_study_fustales.xlsm", sheet " Yst calculation var PA (BA)" (folder " calculation_tables")

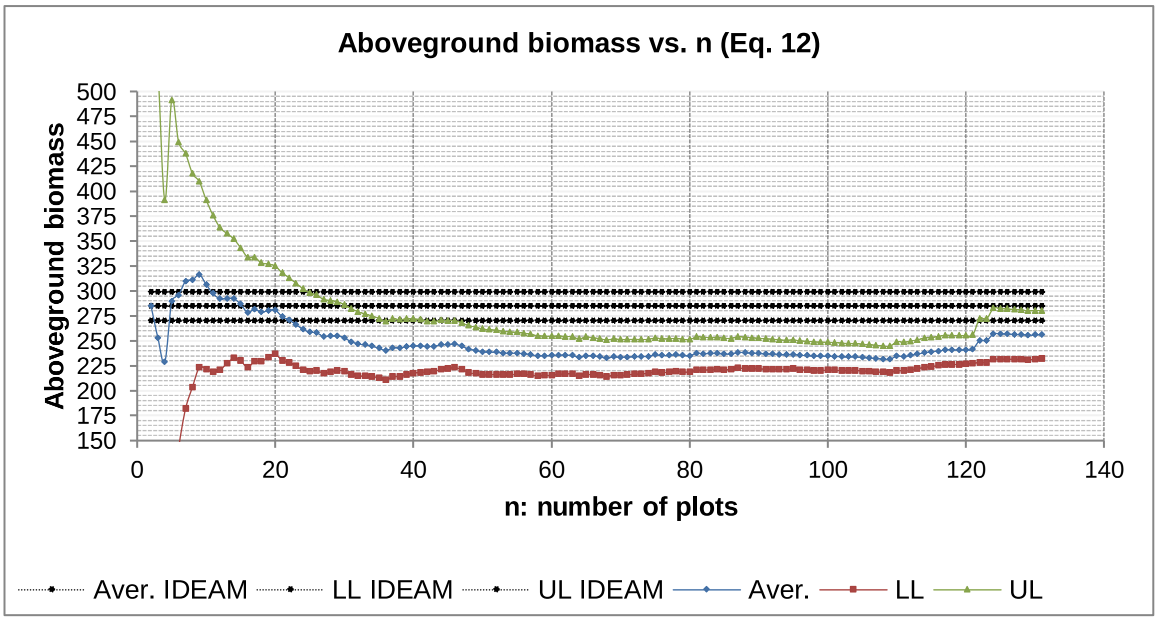
Estimation of aboveground biomass (BA) and carbon equivalent. Sampling error

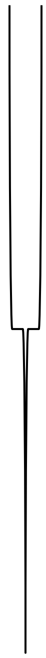
Weighted averages	
256.99	AB (t dm / ha)
442.88	CO_2 e / ha

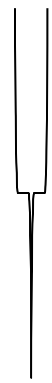
Source: REDD+ Matavén Project, file "plot_study_fustales.xlsm", sheet " Yst calculation var PA (BA)" (folder "calculation_tables")

Complies with the sampling error and confidence level requirements: Sampling error: **9.3%** less than or equal to **15%**
Confidence level: **95%** probability
Also presented in this Annex 19 is the study of the number of fruit trees per plot and per hectare (trees with D>= 10cm).

Aerial biomass: IDEAM vs. REDD+ Matavén Project







Data from IDEAM   Data from the REDD+ Matavén Project

Aspect of Conservatism

The estimate of aerial biomass is lower in the REDD+ Matavén Project than that determined by IDEAM in 2011.

1.3.2 Belowground biomass of trees ($C_{BB\_ tree,i}$)

The carbon content in underground biomass in trees was calculated by multiplying the aboveground biomass by the value **R=0.24** (root-to-stem ratio), according to *AFOLU Guidelines (IPCC 2006, Chapter 4, page 4.49)*.

	Helobiome			**Peinobiome**			**Litobiome**			**Zonobiome**		
	Biomass	c	CO_2e	Biomass	c	CO_2e	Biomass	c	CO_2e	Biomass	c	CO_2e
B.A.	278.5	130.9	479.9	218.8	102.9	377.1	222.1	104.4	382.7	280.9	132.0	484.1
B.S.	66.83	31.41	115.18	52.52	24.68	90.51	53.29	25.05	91.84	67.41	31.68	116.17
BA+BS	**345.33**	**162.31**	**595.08**	**271.32**	**127.58**	**467.61**	**275.39**	**129.45**	**474.54**	**348.31**	**163.7**	**600.27**

AB and BB : above-ground and underground biomass in t dm /ha; *C: carbon in t/ha;* CO_2e *: carbon dioxide equivalent in t/ha*

Carbon deposits: aboveground biomass + underground biomass

Considering the average carbon content in aboveground biomass, added to the average carbon content in underground biomass and their respective CO2 values, we would have the following weighted average according to the biomes:

	PA		Average CO_2 / Stratum	
Stratum	**Area (has)**	**%**	$\bar{y}_h$	$W_h * \bar{y}_h$
Helobiome	174,516	15.20%	595.08	90.45
Peinobiome	326,058	28.30%	467.61	132.33
Lithobiome	116,099	10.10%	474.54	47.93
Zonobiome	533,538	46.40%	600.27	278.53
Total	1,150,212	100%	Weighted average CO_2 (AB+BB)	**549.24**

Additional information is in Annex 13 CP-AB VMD0001, and specifically:

- Templates for data collection plots: upper part of the stem, regeneration and soils (folder "Annex 13. CP-AB - VMD0001")
- Location of plot data (file "plot_study_fustales.xlsm", sheet " Plots ", folder " calculation_tables ")
- Basic Statistics (plot code and location, biome, number of trees, diameter, total height) (file "plot_study_fustales.xlsm", sheets "stat H" - "BA vs. n gral ", folder " calculation_tables ")
- CO_2 content y / tree plot, ha (file "plot_study_fustales.xlsm", sheets "stat H" -"BA vs. n gral ", folder " calculation_tables ")

1.3.3 Soil Organic Carbon ($C_{soc,i}$)

- Estimated Soil Organic Carbon (SOC) content in the case of the baseline (before and after deforestation) and in the case of the Project.
- Similarly , the Soil Organic Carbon stock was carried out using the IDEAM Protocol . The results are presented in Annex 14 of the PDD.
- There is an instructional document with instructions on how to carry out field work to collect soil samples using "calicata" and how to make a report on the soil analysis in the laboratory.
- The estimation of soil carbon content was carried out based on samples collected in some of the established Plots.

Statistics according to simple random sampling in each stratum CO_2 in the soil (cumulative T / ha) by soil depths (cm)

STRATA	CO2 _ (Accumulated t/ha) per soil depth (cm)									
	0-10	0-20	0-30	0-40	0-50	0-60	0-70	0-80	0-90	0-100
Helobiome										
n	12	12	12	12	12	12	12	12	12	12
Minimum	16.2	34.1	59.6	73.4	86.8	95.6	104.3	111.0	112.3	113.6
Maximum	88.9	173.0	263.3	353.6	443.9	508.5	635.8	763.1	890.4	1,017.7
Average	55.5	87.6	123.5	159.4	195.3	222.1	249.0	275.9	302.8	329.7
Coefficient of variation	12.2%	12.8%	14.6%	16.3%	17.5%	19.1%	20.8%	22.4%	23.9%	25.2%
% sampling error	26.9%	28.2%	32.2%	35.9%	38.5%	42.1%	45.9%	49.4%	52.6%	55.4%
Peinobiome										
n	twenty	twenty	twenty	twenty	twenty	twenty	twenty	twenty	twenty	twenty
Minimum	18.4	27.7	34.0	40.4	46.7	54.3	62.0	69.6	77.2	84.9
Maximum	320.0	449.7	499.1	548.4	597.8	647.9	697.9	748.0	798.1	848.1
Average	98.5	165.4	195.8	226.1	256.5	276.5	296.5	316.5	336.5	356.5
Coefficient of variation	17.9%	14.3%	12.9%	12.2%	11.8%	12.1%	12.4%	12.8%	13.1%	13.5%
% sampling error	37.4%	30.0%	27.0%	25.5%	24.7%	25.3%	26.0%	26.7%	27.5%	28.2%
Litobiome										
n	9	9	9	9	9	9	9	9	9	9
Minimum	11.8	23.9	39.8	55.6	71.5	86.4	91.3	96.1	101.0	105.8
Maximum	253.9	660.2	809.5	958.7	1,108.0	1,178.3	1,248.7	1,319.0	1,389.3	1,459.7
Average	78.9	158.3	207.8	257.2	306.6	331.5	356.3	381.2	406.0	430.9
Coefficient of variation	31.0%	41.3%	37.9%	35.9%	34.8%	34.3%	34.1%	33.9%	33.7%	33.7%
% sampling error	71.4%	95.3%	87.3%	82.9%	80.1%	79.2%	78.5%	78.1%	77.8%	77.6%
Zonobiome										
n	47	47	47	47	47	47	47	47	47	47
Minimum	2.9	15.6	31.5	40.0	41.8	47.9	54.0	60.1	66.2	72.4
Maximum	701.5	931.3	1,446.3	1,961.2	2,476.1	2,603.2	2,730.3	2,857.3	2,984.4	3,111.5
Average	88.4	153.4	199.2	244.9	290.6	317.4	344.1	370.9	397.6	424.4
Coefficient of variation	21.4%	18.3%	19.7%	20.7%	21.6%	20.9%	20.4%	20.0%	19.7%	19.4%
% sampling error	42.5%	36.5%	39.1%	41.3%	42.9%	41.7%	40.7%	39.8%	39.1%	38.5%

Accumulated CO_2 averages

STRATA	CO2 _ (Accumulated t/ha) per soil depth (cm)									
	0-10	0-20	0-30	0-40	0-50	0-60	0-70	0-80	0-90	0-100
Helobiome	55.5	87.6	123.5	159.4	195.3	222.1	249.0	275.9	302.8	329.7
Peinobiome	98.5	165.4	195.8	226.1	256.5	276.5	296.5	316.5	336.5	356.5
Litobiome	78.9	158.3	207.8	257.2	306.6	331.5	356.3	381.2	406.0	430.9
Zonobiome	88.4	153.4	199.2	244.9	290.6	317.4	344.1	370.9	397.6	424.4

- The Carbon content results obtained at a depth of 30 cm were used.

Weighted average of Soil Organic Carbon content (30 cm depth) according to biomes:

	Project Area		Average CO_2 / Stratum	
Stratum	**Area (has)**	**%**	$\bar{y}_h$	$W_h * \bar{y}_h$
Helobiome	174,516	15.20%	123.45	18.77
Peinobiome	326,058	28.30%	195.76	55.40
Lithobiome	116,099	10.10%	207.77	20.98
Zonobiome	533,538	46.40%	199.15	92.41
Total	**1,150,212**	**100%**		**187.55**

Based on the previous estimates, we then have:

Average carbon content (t CO2 /ha) pre-deforestation according to deposits per stratum (Table 53 of the PDD):

C deposits	Acronym	Helobiome	Peinobiome	Litobiome	Zonobiome
Tree aerial biomass	*CABtree- bsl,i*	479.9	377.1	382.7	484.1
Non-aerial tree biomass	*CABnon-tree-bsl,i*	0	0	0	0
Above ground biomass	*CBBtree- bsl,i*	115.2	90.5	91.8	116.2
Non-aerial underground biomass	*CBBnon-tree-bsl,i*	0	0	0	0
dead wood	*CDW,bsl ,i*	0	0	0	0
Leaf litter	*CLI,bsl ,i*	0	0	0	0
organic soil	*CSOC,bsl ,i*	123.5	195.8	207.8	199.2
Subtotal		**718.5**	**663.4**	**682.3**	**799.4**

Source: Annex 10- VMD0007, 5. PROCEDURES , Part 4 Estimation of carbon stock changes and greenhouse gas emissions , STEP 4.2 Estimation of carbon stocks and carbon stock changes per stratum , 4.2.1 Forest carbon stocks; file "VMD0007.xlsx", sheet " P4 Step4.2.1 forest C stock" (Folder "calculation_tables")

Weighted average carbon content (t CO2 /ha) pre-deforestation according to deposits per stratum:

	Project Area		Average CO_2 / Stratum	
Stratum	**Area (has)**	**%**	$\bar{y}_h$	$W_h * \bar{y}_h$
Helobiome	174,516	15.20%	718.58	109.22
Peinobiome	326,058	28.30%	663.41	187.75
Litobiome	116,099	10.10%	682.34	68.92
Zonobiome	533,538	46.40%	799.47	370.95
Total	**1,150,212**	**100%**		**736.84**

Changes in carbon stocks, when deforestation occurs, require studying changes in land use.

1.3.4. Land use change

- Tables 58, 59 and 60 (of the PDD) show changes in land use in DRR in each period and for the entire Historical Reference Period (PHR), and in particular deforestation, information necessary to calculate "Stock Estimation". of carbon after deforestation by stratum" (section 3.1.2.7 PDD)
- Transition matrices were built, where there are areas and % of changes from forests to other land uses.

Summary of changes from forest to other land uses in PHR (PDD Table 57)

Forest change to:	2001 -2005 (has)	2005-2011 (has)	2001-2011 (has)
Regenerating Vegetation (VR)	17,569	50,156	67,677
Heterogeneous Agricultural Area (HAA)	7,851	14,054	21,350
Grassland (G)	17,806	31,100	49,502

Source: REDD+ Matavén Project. Based on land cover and use changes (Folder " calculation_tables ", File "transition_changes.xlsx", Sheet " Transition biomes")

Transition matrix 2001 – 2011 (values in hectares):

Classes	Forest 2001	%	Forest 2011	VR 2011	AAH 2011	P 2011	H 2011	SD 2011	Subt class/coverage 2001	Change loss 2011	%	Change loss / year	% / year
	1,444,805	100%	1,306,212	67,677	21,350	49,512	28	27	1,444,805	138,565	9.59%	13,857	0.96%
% Area in 2011			90.4%	4.7%	1.5%	3.4%	0.002%	0.00%					
Gain – change 2011				67,677	21,350	49,512	28	27	138,593				
%									0.00%		D:	13,857	has/year
Earnings - changes / year				6,768	2,135	4,951	3	3	13,859				
Net change			-138,565	67,677	21,350	49,512	28	27	28				
Net change/year			-13,857	6,768	2,135	4,951	3	3	3				
%NET			-9.59%						-9.59%				
% NET / year			-0.96%						-2.40%				

VR: Regenerating Vegetation; AAH : Heterogeneous Agricultural Area; Q: Grassland; H: Wetland; SD: Bare Ground
Source: REDD+ Matavén Project. Land cover and use changes (Folder " calculation_tables ", File " transition_changes.xlsx ", Sheet " Transition biomes")

1.3.5. Post-deforestation carbon deposits

- An estimate of the carbon stock per stratum after deforestation is made, based on the weights obtained in the transition tables of the historical reference period (2001-2011) (table 63 PDD) and on the estimates of the carbon stocks according to land uses in each stratum (tables 64 to 67 PDD).

- The methods used are presented in Annex 10 - VMD0007, Part 4 - Estimation of changes in carbon stocks and GHG emissions, Step 4.2 Estimation of carbon stocks and carbon stocks by stratum, 4.2.2 and 4.2.3 Estimation of carbon stocks after deforestation.

Post-deforestation land use classes (2001-2011) (Table 63 of the PDD)

Post-deforestation land use classes , u	Strata			
	Helobiome	Peinobiome	Litobiome	Zonobiome
u1 = VR	47.0%	40.9%	18.6%	54.8%
u2 = AAH	24.2%	23.4%	12.5%	8.3%
u3 = P	28.7%	35.7%	68.8%	37.0%
u4 = H	0.1%	0.0%	0.0%	0.0%
u5 = SD	0.1%	0.0%	0.1%	0.0%
Totals	100.0%	100.0%	100.0%	100.0%

Folder REDD+ Project " calculation_tables ", file "land-uses_weights.xlsx", Sheet " pond_pt2_alt2 "

Estimation of carbon stocks after deforestation due to land use (Tables 64, 65, 66, 67 of the PDD)

	C deposits	VR	AAH	Q
Helobiome	1. CABtree- post,i	110.0	0	0
	2. CABnon-tree- post,i	0	113.7	11.4
	3. CBBtree- post,i	26.4	0	0
	4. CBBnon-tree- post,i	0	27.3	18.2
	7. CSOC,post ,i	121.8	62.7	119.8
	Subtotal	**258.2**	**203.6**	**149.3**
Peinobiome	1. CABtree- post,i	110.0	0	0
	2. CABnon-tree- post,i	0	113.7	11.4
	3. CBBtree- post,i	26.4	0	0
	4. CBBnon-tree- post,i	0	27.3	18.2
	7. CSOC,post ,i	193.2	99.4	189.9
	Subtotal	**329.6**	**240.4**	**219.4**
Litobiome	1. CABtree- post,i	110.0	0	0
	2. CABnon-tree- post,i	0	113.7	11.4
	3. CBBtree- post,i	26.4	0	0
	4. CBBnon-tree- post,i	0	27.3	18.2
	7. CSOC,post ,i	205.1	105.5	201.5
	Subtotal	**341.5**	**246.5**	**231.1**

	C deposits	VR	AAH	Q
Zonobiome	1. CABtree- post,i	110.0	0	0
	2. CABnon-tree- post,i	0	113.7	11.4
	3. CBBtree- post,i	26.4	0	0
	4. CBBnon-tree- post,i	0	27.3	18.2
	7. CSOC,post ,i	196.6	101.1	193.2
	Subtotal	**333.0**	**242.1**	**222.7**

Source: Annex 10 - VMD0007, 5. PROCEDURES , Part 4 Estimation of carbon stock changes and greenhouse gas emissions , STEP 4.2 Estimation of carbon stocks and carbon stock changes per stratum , 4.2.2 Estimation of post-deforestation carbon stocks - Estimation of Carbon Stocks after deforestation for land use; file "VMD0007.xlsx", sheet " P4 Step4.2.2 postdef C stock" (folder " calculation_tables ")

Estimation of carbon stocks after deforestation by stratum (Table 68 of the PDD)

carbon pool		Helobiome	Peinobiome	Litobiome	Zonobiome
Tree aerial biomass	*CABtree- bsl,i*	51.7	44.9	20.4	60.2
Non-aerial tree biomass	*CABnon-tree-bsl,i*	30.7	30.7	22.1	13.6
Above ground biomass	*CBBtree- bsl,i*	12.4	10.8	4.9	14.5
Non-aerial underground biomass	*CBBnon-tree-bsl,i*	11.8	12.9	15.9	9.0
dead wood	*CDW,bsl ,i*	0	0	0	0
Leaf litter	*CLI,bsl ,i*	0	0	0	0
organic soil	*CSOC,bsl ,i*	106.7	170.0	190.0	187.4
Subtotal		**213.3**	**269.3**	**253.3**	**284.7**

Source: Annex 10 - VMD0007, 5. PROCEDURES , Part 4 Estimation of carbon stock changes and greenhouse gas emissions , STEP 4.2 Estimation of carbon stocks and carbon stock changes per stratum , 4.2.2 Estimation of post-deforestation carbon stocks; file "VMD0007.xlsx", sheet " P4 Step4.2.2 postdef C stock" (folder " calculation_tables ")

1.3.6 Changes in Carbon stock due to land use

- Equations 16 to 22 of the VCS Module VMD0007 BL -UP were used to calculate change in carbon stock in Baseline in different deposits. In general, equations 16 to 22 have the following structure for the respective deposit:

$$\textbf{\textit{Baseline Carbon Stock change}}_{pool} = \textbf{\textit{BSL Carbon stock}}_{pool} - \textbf{\textit{Post-deforestation coalstock}}_{pool}$$

- That is, the results of table 53 minus the results of table 68 (table 69 PDD):
  Source: Annex 10 - VMD0007, 5. PROCEDURES , Part 4 Estimation of carbon stock changes and greenhouse gas emissions , STEP 4.2 Estimation of carbon stocks and carbon stock changes per stratum , 4.2.2 Estimation of post-deforestation carbon stocks; file "VMD0007.xlsx", sheet " P4 Step4.2.2 postdef C stock" (folder "calculation_tables")

Estimation of changes in carbon stocks by stratum (Table 69 of the PDD)

carbon pool		Helobiome	Peinobiome	Litobiome	Zonobiome
Tree aerial biomass	*ΔCABtree ,i*	428.2	332.2	362.2	423.8
Non-aerial tree biomass	*ΔCABnon- tree,i*	-30.7	-30.7	-22.1	-13.6
Above ground biomass	*ΔCBBtree ,i*	102.8	79.7	86.9	101.7
Non-aerial underground biomass	*ΔCBBnon- tree,i*	-11.8	-12.9	-15.9	-9.0
dead wood	*ΔCDW ,i*	0	0	0	0
Leaf litter	*ΔCLI ,i*	0	0	0	0
organic soil	*ΔCSOC ,i*	16.7	25.7	17.8	11.7
Subtotal			505.2	394.1	429.0

Source: Annex 10 - VMD0007, 5. PROCEDURES , Part 4 Estimation of carbon stock changes and greenhouse gas emissions , STEP 4.2 Estimation of carbon stocks and carbon stock changes per stratum , 4.2.3 Estimation of carbon stock changes per stratum ; file "VMD0007.xlsx", sheet " P4 Step4.2.3 Eq16 -22 C st- ch,i " (folder "calculation_tables")

The average **weighted** carbon content (t CO2 /ha) post-deforestation , considering above-ground and underground biomass and soil organic carbon, by stratum:

	Project Area		Average CO_2 / Stratum	
Stratum	**Area (has)**	**%**	$\bar{y}_h$	$W_h * \bar{y}_h$
Helobiome	174,516	15.20%	505.2	76.79
Peinobiome	326,058	28.30%	394.1	111.53
Litobiome	116,099	10.10%	429	43.33
Zonobiome	533,538	46.40%	514.7	238.82
Total	**1,150,212**	**100%**	Post-deforestation weighted average CO_2 (BA+BS+COS)	**470.47**

Aspect of Conservatism

Post-deforestation Carbon , unlike the NREF which does not take into account the biomass present in other land uses after losing the forest layer.

1.3.7 Projection of deforestation in the Project Area and Leakage Belt

- To obtain the projections of the deforested area, a model was built for the deforestation forecast (the indications of the VCS Module BL -UP VMD0007, Part 3: Location and quantification of the threat of deforestation were applied).
- This requires estimating the historical rate of deforestation and its trend. Annex 10 VMD0007 of the PDD, Stage 2.1.3 Calculation of historical deforestation.

Historical deforestation rate

Remaining Forests and Deforested Areas in DRR (Table 54 of the PDD)

Year	Deforested area	Remaining forest
2001	-	1,444,805
2005	43,237	1,401,568
2011	95,328	1,306,212
	138,565	

- **0.96%** average per year
- **13,587** hectares per year in the historical reference period

Deforestation in PHR in each of the biomes (Table 55 of the PDD)

	2001		Deforestation Period 1 (2001-2005)		Deforestation Period 2 (2005-2011)	
Stratum	**Area (has)**	**%**	**D (has / year)**	**t (% year)**	**D (has / year)**	**t (% year)**
Helobiome	230,435	15.95%	1,602	0.6950%	2,744	1.2247%
Peinobiome	333,195	23.06%	3,663	1.0993%	5,490	1.7235%
Litobiome	158,752	10.99%	86	0.0543%	445	0.2812%
Zonobiome	722,424	50.00%	5,459	0.7556%	7,209	1.0289%
Total	1,444,805	100%	10,809	0.7481%	15,888	1.1336%

D: deforestation rate
Source: REDD+ Matavén Project. Folder " calculation_tables ", file " transition_changes.xlsx", Sheets " Transit Helob ", " Transit Peinob ", " Transit Litob " and " Transit "Zonob "

Deforestation trends in PHR (PDD Table 56)

	Deforestation period (2001-2011)			Increase D (has/year) per 2 vs. per 1
Stratum	**d (has / year)**	**t (% year)**	**Trend**	
Helobiome	2,287	0.9924%	Growth	1,142
Peinobiome	4,759	1.4284%	Growth	1,827
Litobiome	302	0.1901%	Growth	359
Zonobiome	6,509	0.9009%	Growth	1,750
Total	13,857	0.9591%	Growth	5,079

D: Increase in deforestation rate (has/year): Period 2 vs. Period 1
Source: REDD+ Matavén Project. Changes in coverage and land use (Folder " calculation_tables ", File "transition_changes.xlsx", Sheet " trends general")

- Based on the deforestation rate observed in DRR during 10 years prior to the Project, a projection of deforestation in the Project Area and the Leakage Belt was estimated.

Projected Deforestation

In the Project Area: 11,031 ha / year

In the Leakage Belt: 4,663 ha / year

- With these values, a spatial model was applied that projects the location of deforestation in AP and CF during the life cycle of the Project (2013-2042).
- With the results of the estimates of the annual deforestation areas in the Baseline, in the Project Area and in the Leak Belt and applying the procedures of the spatial model (Annex 10 VMD0007, Part 3, section "3.4.2 Where location analysis "), the annual projected Baseline area of unplanned deforestation in the Project Area was estimated.
- The results are presented in Tables 61 and 62 (PDD) and the corresponding locations are shown on Map 31 (PDD).
- A total of 298,410 deforested hectares have been estimated in the Project Area and 169,828 hectares in the Leakage Belt.

Projection of deforestation in the Project Area (Table 61 of the PDD)

t	Helobiome	Peinobiome	Litobiome	Zonobiome	Subtotal $\sum_i A_{BSL,PA,unplanned,t}$
2013	402	2	0	11,872	12,276
2014	11,337	6	0	2	11,345
2015	12,879	10	5	10	12,904
2016	12,597	10	1	4	12,611
2017	4,755	4,074	0	1	8,831
2018	19	2,576	4,152	3,821	10,568
2019	3	2	0	13,903	13,909
2020	4	0	0	11,897	11,901
2021	8	4	0	9,386	9,398
2022	5	3	0	14,488	14,496
Subtotal year 1-10	42,008	6,687	4,159	65,385	118,239
2023	11,229	0	0	2,125	13,356
2024	10,310	2	4	eleven	10,326
2025	4,290	1,909	3	8	6,209
2026	7	6,917	2	4	6,930
2027	7	7,516	3,445	4	10,973
2028	2	6	4,050	2	4,060
2029	3	0	0	9	eleven
2030	0	0	0	17	17
2031	19	4,129	1,466	5,341	10,955
2032	11,993	4	901	3	12,902
Subtotal year 10-20	37,860	20,484	9,871	7,524	75,739
2033	9,018	4	0	6	9,028
2034	1,293	5	0	12,554	13,853
2035	7	3,956	6	2,869	6,838
2036	1	8,162	723	2	8,888
2037	4,893	6	3,945	1	8,845
2038	4,664	2	3	9,408	14,077
2039	1	2	0	14,562	14,565
2040	7	2	0	13,736	13,745
2041	2	8	1	12,013	12,024
2042	6	2,560	1	4	2,570
Subtotal year 20-30	19,893	14,706	4,679	65,154	104,433
Total years 1-30	99,762	41,877	18,710	138,062	298,410

Results of the application of the Deforestation Model in the Project Area, by stratum and by year ABSLunplanned,i ,t (PA)

Projection of deforestation in the Leak Belt (Table 62 of the PDD)

t	Helobiome	Peinobiome	Litobiome	Zonobiome	Subtotal $\sum_i A_{BSL,LK,unplanned,t}$
2013	293	3	0	2,969	3,265
2014	4,198	2	1	2	4,203
2015	2,600	3	0	2	2,606
2016	2,959	0	0	5	2,965
2017	4,976	1,753	1	1	6,730
2018	3	1,161	2,580	1,247	4,990
2019	1	2	0	1,685	1,687
2020	2	5	0	3,699	3,705
2021	3	2	0	6,189	6,194
2022	2	1	0	1,111	1,115
Subtotal year 1-10	15,037	2,931	2,582	16,910	37,460
2023	2,185	6	3	0	2,195
2024	5,150	6	3	10	5,169
2025	882	8,353	3	9	9,248
2026	1	8,645	6	4	8,656
2027	0	6	4,665	0	4,671
2028	1,405	1,105	1,863	7,181	11,554
2029	13,628	2	0	1971	15,601
2030	4	1,631	0	13,949	15,584
2031	1,169	1,453	1,095	952	4,669
2032	2,185	1	526	1	2,713
Subtotal year 10-20	26,609	21,209	8,164	24,077	80,059
2033	6,631	0	0	5	6,636
2034	56	1	0	1,773	1,830
2035	2	7,664	12	1,143	8,821
2036	2	1,930	789	4,069	6,788
2037	161	1,028	5,620	1	6,811
2038	1,210	2	0	364	1,576
2039	0	2	0	1,128	1,129
2040	0	0	0	1949	1949
2041	2,880	1	0	788	3,669
2042	12,378	719	0	1	13,099
Subtotal year 20-30	23,319	11,349	6,421	11,220	52,309
Total years 1-30	64,965	35,488	17,168	52,207	169,828

Results of the application of the Deforestation Model in the Leak Belt, by stratum and by year ABSLunplanned,i ,t (LB)

1.3.8 Changes in C stock in baseline

- Calculations of changes in carbon stocks in the baseline in each deposit, stratum and year, in the Project Area and in the Leakage Belt.

- Equation 24 of the VCS Module VMD0007 is applied (Annex 10 PDD)

$$\Delta C_{BSL,i,t} = A_{unplanned,i,t} * (\Delta C_{ABtree,i} + \Delta C_{ABnon\text{-}tree,i} + \Delta C_{LI,i})$$
$$+ (\sum_{t-10}^{t} A_{unplanned,i,t}) * (\Delta C_{BBtree,i} + \Delta C_{BBnon\text{-}tree,i} + \Delta C_{DW,i}) * (1/10)$$
$$+ (\sum_{t-20}^{t} A_{unplanned,i,t}) * (C_{WP100,i} + \Delta C_{SOC,i}) * (1/20)$$

- Equation 24 can be interpreted as:

$\Delta\ C_{BSL,i,t} = Q_{,i,t} + R_{i,t} + S_{i,t}$

Where:

$Q_{i,t} = A_{unplanned,i,t} * (\Delta C_{ABtree,i} + \Delta C_{ABnon\text{-}tree,i} + \Delta C_{LI,i})$
$Q_{i,t} = A_{unplanned,i,t} * T1_{i}$

C stock changes (emissions) corresponding to aboveground biomass and leaf litter are produced at the time of deforestation (i.e., the entire stock is emitted at the time of deforestation); Your annual rate is your entire stock corresponding to 1 year

Ri,t =(Σt-10tAunplanned,i,t)*(ΔCBBtree,i+ΔCBBnon-tree,i+ΔCDW,i)*(1/10)
Ri,t =(Σt-10tAunplanned,i,t)* T2i

*Emissions from **underground biomass** , dead wood, **soil** and wood products are produced gradually over time*
*Stock changes in **underground biomass** and dead wood are produced at an **annual rate** of (1/10) of the 10-year stock.*

If,t =(Σt-20t planned,i,t)*(CWP100,i+ΔCSOC,i)*(1/20)
Si,t =(Σt-20t planned,i,t)* T3i

*For **soil organic carbon** : Changes in its stock occur at an annual rate of (1/20) for 20 years.*

It is assumed that they are issued at an annual rate of (1/20) of their corresponding stock for 20 years

Thus, for a given year, emissions are summed based on deforested areas from time (t-10) to *time (t) for underground biomass and dead wood, and from time (t-20) to time (t) for soil organic carbon and wood products.*

There are then 3 types of rates: T1i , T2i and T3i for each forest stratum and which correspond to the previous matrices Q, R and S

T1i , T2i and T3i rates	Unit	Fountain	Entry for
$T1_i = \Delta C_{ABtree,i} + \Delta C_{ABnon\text{-}tree,i} + \Delta C_{LI,i}$	$t\ CO_2\text{-e}\ ha^{-1}$	*Part 4 Step4.2.3 Eq16,17,21*	$Q_{i,t}$
$T2_i = \Delta C_{BBtree,i} + \Delta C_{BBnon\text{-}tree,i} + \Delta C_{DW,i} *(1/10)$	$t\ CO_2\text{-e}\ ha^{-1}$	*Part 4 Step4.2.3 Eq18,19,20*	$R_{i,t}$
$T3_i = C_{WP\ 100,i} + \Delta C_{SOC,i} *(1/20)$	$t\ CO_2\text{-e}\ ha^{-1}$	*Part 4 Step4.2.3 Eq22*	$Yes_{i,t}$

	Forest layer i			
T1i , T2i and T3i rates	**i=1 Helobiome**	**i=2 Peinobiome**	**i=3 Lithobiome**	**i=4 Zonobiome**
$T1_i = \Delta C_{ABtree,i} + \Delta C_{ABnon\text{-}tree,i} + \Delta C_{LI,i}$	397.51	301.52	340.18	410.21
$T2_i = \Delta C_{BBtree,i} + \Delta C_{BBnon\text{-}tree,i} + \Delta C_{DW,i} *(1/10)$	9.10	6.68	7.10	9.27
$T3_i = C_{WP\ 100,i} + \Delta C_{SOC,i} *(1/20)$	0.84	1.29	0.89	0.59
Emission Factors by Stratum	**407.44**	**309.49**	**348.17**	**420.07**

Aspect of Conservatism

The REDD+ Matavén Project uses an average emission factor lower than that calculated by the NREF, since it weights the factors for each stratum according to their proportion in the Project Area (i 1 : 15.17%, i_2 : *28.35 %* , i_3 : 10.09%, i_4 : 46.39%) results in 379.55 tCO_2 / ha . compared to 556.08 tCO_2 /ha of the NREF.

Total changes in baseline carbon stocks in the **Project Area** (tCO2 -e/ha) (*Δ CBSL,i ,t (PA)*) (Table 70 of the PDD)

t	Helobiome	Peinobiome	Litobiome	Zonobiome	Subtotal
2013	163,835	533	0	4,987,314	5,151,681
2014	4,623,071	1,743	138	118,030	4,742,981
2015	5,364,083	3,003	1,828	121,288	5,490,203
2016	5,377,201	3,118	268	118,796	5,499,384
2017	2,306,981	1,261,177	204	117,731	3,686,093
2018	424,633	829,979	1,445,687	1,722,286	4,422,586
2019	418,308	53,947	33,235	5,995,321	6,500,811
2020	418,640	53,380	33,235	5,289,568	5,794,823
2021	420,369	54,637	33,235	4,351,920	4,860,161
2022	419,059	54,302	33,235	6,588,006	7,094,602
2023	4,988,934	53,421	33,391	1,427,464	6,503,210
2024	4,622,630	53,838	34,513	560,036	5,271,017
2025	2,155,011	644,051	34,112	558,761	3,391,935
2026	337,935	2,209,055	34,063	557,307	3,138,361
2027	294,913	2,422,556	1,232,732	557,517	4,507,718
2028	292,983	140,731	1,441,335	521,294	2,396,343
2029	293,070	138,997	63,671	394,951	890,689
2030	291,967	139,115	63,671	288,092	782,845
2031	299,797	1,416,823	574,135	2,437,646	4,728,400
2032	5,178,662	173,081	389,224	113,899	5,854,866
2033	3,982,921	173,251	82,588	88,270	4,327,030
2034	822,021	173,428	82,659	5,359,379	6,437,487
2035	260,989	1,383,384	84,715	1,414,713	3,143,802
2036	248,092	2,670,363	334,190	238,762	3,491,406
2037	2,237,179	155,912	1,437,589	238,080	4,068,761
2038	2,192,360	151,455	63,966	4,187,703	6,595,483
2039	338,804	151,417	62,984	6,437,045	6,990,250
2040	341,361	151,249	63,050	6,226,531	6,782,190
2041	339,194	125,529	52,787	5,583,261	6,100,771
2042	231,514	915,354	46,506	648,500	1,841,874
Total years 1-30	**49,686,515**	**15,758,830**	**7,792,946**	**67,249,471**	**140,487,762**

Total changes in Baseline carbon stocks in the **Leak Belt** (tCO2 -e / ha) (*Δ CBSL,i ,t (LB)*) (Table 70 of the PDD)

t	Helobiome	Peinobiome	Litobiome	Zonobiome	Subtotal
2013	119,531	837	0	1,247,094	1,367,463
2014	1,713,439	491	419	30,094	1,744,443
2015	1,103,989	1,099	128	30,124	1,135,340
2016	1,276,116	122	98	31,403	1,307,740
2017	2,127,151	542,663	228	29,769	2,699,811
2018	150,274	373,269	898,167	553,106	1,974,816
2019	149,536	23,786	20,634	749,584	943,540
2020	149,971	24,733	20,634	1,612,046	1,807,384
2021	150,552	24,075	20,634	2,694,551	2,889,812
2022	150,331	23,622	20,634	622,622	817,209
2023	1,037,128	25,233	21,682	139,208	1,223,251
2024	2,228,449	25,343	21,557	143,473	2,418,821
2025	517,222	2,608,645	21,794	142,979	3,290,640
2026	139,774	2,765,551	22,919	140,956	3,069,200
2027	94,310	149,186	1,644,873	139,345	2,027,714
2028	666,820	481,455	688,406	3,144,199	4,980,880
2029	5,660,965	148,773	54,589	1,011,045	6,875,373
2030	245,359	653,045	54,589	6,027,620	6,980,612
2031	719,726	611,053	435,835	648,110	2,414,724
2032	1,145,310	173,035	246,493	247,924	1,812,762
2033	2,958,369	172,941	67,552	247,746	3,446,608
2034	295,045	173,211	67,504	990,161	1,525,921
2035	263,236	2,488,928	71,690	743,043	3,566,897
2036	260,791	717,438	342,073	1,983,320	3,303,622
2037	321,758	451,579	1,997,349	314,722	3,085,408
2038	737,854	133,261	70,244	399,831	1,341,189
2039	132,865	133,189	70,095	704,935	1,041,084
2040	132,843	121,797	70,188	929,572	1,254,401
2041	1,295,687	112,270	62,321	448,646	1,918,924
2042	5,174,074	334,694	58,633	125,368	5,692,769
Total years 1-30	**31,118,475**	**13,495,322**	**7,071,964**	**26,272,596**	**77,958,356**

Once the changes in carbon stocks due to deforestation have been estimated for the baseline it is estimated:

The emissions due to project activities, **emissions due to leaks, adjustments due to uncertainty due to project activities and adjustments due to the level of risk of non-permanence, which represent deductions in the final accounting of VCUs of the Selva REDD+ Matavén Project.**

2. Emissions due to project activities (Ex-ante)

Ex-ante " estimate was made of the “Net GHG Emissions in AP under the Project scenario” (*ΔCp*), conservatively considering that 85% effectiveness would be achieved, that is, that 15% of the estimated deforestation in the baseline (15% ineffectiveness).

1st. 15% of the projected deforested area in AP was calculated for the baseline (data in table 61 - PDD), predicted by the application of the Spatial Model (VMD0007, step 3, point 3.4.2 ABSL,unplanned, i *,t (PA)*). These results are presented by year (*t=1 at=30*):

Projected deforested area for Baseline in AP * 15% *ABSL,unplanned ,i,t (PA) * 15%* (Table 72 of the PDD)

t (years)	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	Subtotal
2013	60	0	0	1,781	1,841
2014	1,701	1	0	0	1,702
2015	1,932	1	1	1	1,936
2016	1,890	1	0	1	1,892
2017	713	611	0	0	1,325
2018	3	386	623	573	1,585
2019	0	0	0	2,085	2,086
2020	1	0	0	1,785	1,785
2021	1	1	0	1,408	1,410
2022	1	0	0	2,173	2,174
Subtotal year 1-10	6,301	1,003	624	9,808	17,736
2023	1,684	0	0	319	2003
2024	1,546	0	1	2	1,549
2025	643	286	0	1	931
2026	1	1,038	0	1	1,039
2027	1	1,127	517	1	1,646
2028	0	1	607	0	609
2029	0	0	0	1	2
2030	0	0	0	2	3
2031	3	619	220	801	1,643
2032	1,799	1	135	0	1,935
Subtotal year 10-20	5,679	3,073	1,481	1,129	11,361
2033	1,353	1	0	1	1,354
2034	194	1	0	1,883	2,078
2035	1	593	1	430	1,026
2036	0	1,224	108	0	1,333
2037	734	1	592	0	1,327
2038	700	0	0	1,411	2,112
2039	0	0	0	2,184	2,185
2040	1	0	0	2,060	2,062

t (years)	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	Subtotal
2041	0	1	0	1,802	1,804
2042	1	384	0	1	386
Subtotal year 20-30	2,984	2,206	702	9,773	15,665
Total years 1-30	60	0	0	1,781	1,841

Source: folder " calculation_tables ", file "VMD0015.xlsx", sheet "Model Cp,t Ex ante", table " ***ABSL,unplanned,i,t (PA) * 15%*** *".*

2nd. Results of changes in carbon stocks by stratum, due to changes in land use (*u*)

carbon content in pre-deforestation (table 53 of the PDD)
[less]
carbon content in post-deforestation (table 68 of the PDD)

Equation 6 of VCS Module VMD0015 applies

$$C_{post,u,i} = C_{AB\_tree,i} + C_{BB\_tree,i} + C_{AB\_non\text{-}tree,i} + C_{BB\_non\text{-}tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,PD\text{-}BSL,i}$$

And you get:

Table 73. Estimates of carbon stocks according to land uses after deforestation in each stratum (*CP ,post,u,i*) (subtotals of tables 64 to 67)

Post-deforestation land use u	i = 1 Helobiome	i = 2 Peinobiome	i = 3 Litobiome	i = 4 Zonobiome
u=1 VR	258.2	329.6	341.5	333.0
u=2 AAH	203.6	240.4	246.5	242.1
u = 3P	149.3	219.4	231.1	222.7
u=4H	0.0	0.0	0.0	0.0
u=5 SD	0.0	0.0	0.0	0.0

Source: Folder " calculation_tables ", file "VMD0015.xlsx", sheet " Eq6 CP,post ,u,i,t "

Equation 5 of VCS Module VMD0015 applies

$$\Delta C_{pools,Def,u,i,t} = C_{BSL,i} - C_{P,post,u,i} - CWP_{,i}$$

CBSL,i corresponds to the results of table 53 (PDD)

	i = 1 Helobiome	i = 2 Peinobiome	i = 3 Litobiome	i = 4 Zonobiome
CBSL,i	718.5	663.4	682.3	799.4

And you get:

Net changes in carbon stocks in all pools as a result of deforestation in the case of land use project u in stratum i at time t (*Δ Cpools,Def,u,i,t*) (Table 74 of the PDD)

Post-deforestation land use u	i = 1 Helobiome	i = 2 Peinobiome	i = 3 Litobiome	i = 4 Zonobiome
u=1 VR	460.3	333.8	340.8	466.4
u=2 AAH	514.9	423.0	435.8	557.3
u = 3P	569.2	444.0	451.2	576.6
u=4H	0.0	0.0	0.0	0.0
u=5 SD	0.0	0.0	0.0	0.0

Source: Folder " calculation_tables ", file "VMD0015.xlsx", sheet " Eq5 Cpools,Def ,i,t "

3rd. Changes in carbon stocks are the result of "Net changes in carbon stocks in all pools as a result of deforestation in the case of the project, in land use u, in *stratum* i , *at* time *t* " (Table 74) weighted according to "Weights by classes of land use deforestation (2001-2011)" (Table 63 of the PDD).

The results are:

Changes in carbon stock (by stratum and land use) (Table 75 of the PDD)

Land use post-deforestation u	i = 1 Helobiome	i = 2 Peinobiome	i = 3 Litobiome	i = 4 Zonobiome
u=1 VR	216.16	136.37	63.32	255.39
u=2 AAH	124.43	99.04	54.61	46.13
u = 3P	163.33	158.53	310.38	213.17
u=4H	0.00	0.00	0.00	0.00
u=5SD	0.00	0.00	0.00	0.00
Δ Cpools,Def ,i,t (tCO2 /ha)	**503.91**	**393.94**	**428.31**	**514.69**

Source: folder " calculation_tables ", file "VMD0015.xlsx", sheet "Model Cp,t Ex ante", table " ***Change in land use by strata (u,i) * ΔCpools,Def,u,i,t (tCO2 /ha)*** *".*

4th. The procedures defined in the VCS REDD-MF VM0007, Section 8 Quantification of greenhouse gas emissions reductions, subsection 8.2, subsection 8.2.2 REDD (Annex 9), which are based on the procedures defined in the VCS Module, apply . M-REDD VMD0015, section 5 Procedures: Calculation of ΔCp : "Net greenhouse gas emissions within the project area in the project scenario" (Annex 11).

- Are calculated for the project scenario, using equation 3 of the VCS M-REDD VMD0015 module.
- These results are expressed per year (t = 1 at = 30):

Equation 3 of the VCS Module M-REDD VMD0015 ΔCP,DefPA,i,t (Ex-ante)

$$\Delta C_{P,DefPA,i,t} = \Sigma_{u=1}^{U} (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t}$$

Which can be expressed in the following way:

$$\Delta C_{P,DefPA,i,t} = A_{DefPA,i,t} * \Delta C_{pools,P,Def,i,t}$$

Changes in net carbon stocks due to deforestation in the case of the project in AP (*Δ CP,DefPA ,i,t*) (Table 76 of the PDD)

t (years)	Δ C p,DefPA ,i,t by Forest strata i				Subtotal	Accumulated
	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	ΔC p ,t	ΔCp _
2013	30,394	102	0	916,595	947,090	947,090
2014	856,911	330	25	176	857,443	1,804,534
2015	973,491	562	337	771	975,161	2,779,695
2016	952,193	570	41	295	953,098	3,732,793
2017	359,406	240,758	28	92	600,284	4,333,077
2018	1,439	152,227	266,755	294,984	715,406	5,048,483
2019	231	138	0	1,073,380	1,073,749	6,122,231
2020	286	26	0	918,477	918,790	7,041,021
2021	600	266	0	724,591	725,457	7,766,478
2022	343	195	0	1,118,542	1,119,079	8,885,558
Subttl 1-10	3,175,293	395,173	267,187	5,047,904	8,885,558	
2023	848,796	24	29	164,090	1,012,938	9,898,496
2024	779,281	110	236	821	780,448	10,678,944
2025	324,236	112,809	163	585	437,793	11,116,736
2026	494	408,724	151	310	409,679	11,526,416
2027	525	444,160	221,333	344	666,362	12,192,777
2028	186	337	260,185	190	260,899	12,453,676
2029	203	0	0	662	865	12,454,542
2030	0	23	0	1,284	1,307	12,455,849
2031	1,466	243,982	94,193	412,306	751,948	13,207,797
2032	906,544	2. 3. 4	57,911	251	964,939	14,172,736
Subttl 10-20	2,861,732	1,210,402	634,200	580,843	5,287,178	
2033	681,628	261	0	438	682,327	14,855,063
2034	97,771	292	18	969,198	1,067,279	15,922,343
2035	544	233,741	401	221,490	456,177	16,378,520
2036	103	482,275	46,430	176	528,984	16,907,503
2037	369,857	361	253,483	54	623,755	17,531,258
2038	352,533	141	185	726,352	1,079,211	18,610,468
2039	80	131	0	1,124,212	1,124,422	19,734,891
2040	553	96	12	1,060,445	1,061,106	20,795,997
2041	171	453	39	927,444	928,108	21,724,104
2042	431	151,249	60	306	152,047	21,876,151
Subttl 20-30	1,503,672	869,000	300,629	5,030,114	7,703,415	
Total 1-30	**7,540,697**	**2,474,575**	**1,202,016**	**10,658,862**	**21,876,151**	

Source: Annex 9 - VM0007, 8. Quantification of GHG Emission Reductions and Removals , 8.2 Project emissions , 8.2.2 REDD, in turn Based on Annex 11 - VMD0015 M-REDD, 5. PROCEDURES,Calculation of ΔCP : Net Greenhouse Gas Emissions within the Project Area under the Project Scenario (Ex ante estimation) (Equation 1 ΔCPt); file "VMD0015.xlsx", sheet " Eq1 CP PA Exante " (folder " calculation_tables ").

Conservatory appearance

The REDD+ Matavén Project estimates the GHG emissions that would occur in the project scenario anyway, which are deducted from the emissions already calculated for the projected deforestation for the Project Area (according to the deforestation rate found in RRD).

- In the case of the REDD + Matavén Project, in the project scenario, changes in carbon due to degradation are not considered, taking into account the principle of conservatism in the estimates.

In this way ΔCP , Deg , i, t = 0 (Equation 7 of the VCS Module M-REDD VMD0015)
The same situation is happening with natural alterations in the Project Area and forest growth:

In this way ΔCP, DistPA, i, t = 0 (Equation 20 of the VCS Module M-REDD VMD0015)
In this way ΔCP, Enh, i, t = 0 (Equation 25 of the VCS Module M-REDD VMD0015)

It is considered that there are no significant emissions of greenhouse gases other than CO2 .
In this way, GHGP, E, i, t = 0 (Equation 30 of the VCS Module M-REDD VMD0015)

- Net greenhouse gas emissions within the project area are calculated under the project scenario, applying Equation 1 of the VCS Module VMD0015. These results are expressed per year (t = 1 at = 30):

ΔCP Module Equation 1 (Ex-ante)

$$\Delta C_P = \Sigma_{t=1}^{t^*} \Sigma_{i=1}^{M} (\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t})$$

Which can be expressed as:

$$\Delta C_P = \Sigma_{t=1}^{t^*} \Sigma_{i=1}^{M} (\Delta C_{P,DefPA,i,t} + 0 + 0 + 0 - 0)$$

$$\Delta C_P = \Sigma_{t=1}^{t^*} \Sigma_{i=1}^{M} (\Delta C_{P,DefPA,i,t})$$

Which are the same values from table 76 of the PDD, for a total

ΔC_P = **21,876,151 t CO2e**

3. Emissions due to Leakage due to displacement of deforestation due to Project activities

$$\Delta C_{LK-AS,unplanned} = \Delta C_{LK-ASU-LB} + \Delta C_{LK-ASU-OLB} + GHG_{LK,E}$$

Source: VCS Module VMD0010 LK -ASU Estimation of emissions activity shifting for avoiding unplanned deforestation , Equation 16 ***ΔCLK- AS, unplanned***

To obtain the " *Net greenhouse gas emissions due to activity change leakage for projects that avoid unplanned deforestation Net CO2 emissions (Δ CLK- AS, unplanned)* " the following steps were completed:

1st. Equation 1 of the VCS Module VMD0010 LK -ASU was applied to calculate " *Net CO2 emissions due to unplanned deforestation displaced from the project area to the Leakage Belt (ΔCLK -ASU-LB)* ".

In the " *calculation_tables "* folder , file " *VMD0010.xlsx* ", sheet " *S3" Exante Eq1 CLK - ASU,LB* " are the calculations of Δ *CLK -ASU-LB* .

$$\Delta C_{LK-ASU-LB} = \Delta C\,P_{,LB} - \Delta C_{BSL,LK,unplanned}$$

ΔCP ,LB It is estimated by adding to " *Net CO2 emissions in the baseline from unplanned deforestation in the leakage band (ΔCBSL,LK,unplanned,i,t)* " (table 71) a proportion of 6.45% of " *Net emissions of CO2 in the baseline of unplanned deforestation in the Project Area (ΔCBSL,PA,unplanned,i,t)* " (table 70 of the PDD).

$$\Delta CP_{,LB} = \Delta CBSL_{,LK,unplanned,i,t} + (\Delta CBSL_{,PA,unplanned,i,t} * 0.0645)$$

Net $CO_{2\ emissions}$ due to shifting deforestation from the Project Area to the Leakage Belt (ΔCLK - ASU-LB) (PDD Table 77)

t (years)	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	$\Delta C_{LK-ASU-LB}$
2013	10,559	3. 4	0	321,434	332,028
2014	297,959	112	9	7,607	305,687
2015	345,717	194	118	7,817	353,846
2016	346,563	201	17	7,656	354,437
2017	148,686	81,283	13	7,588	237,570
2018	27,368	53,492	93,175	111,002	285,037
2019	26,960	3,477	2,142	386,401	418,980
2020	26,981	3,440	2,142	340,915	373,479
2021	27,093	3,521	2,142	280,483	313,239
2022	27,009	3,500	2,142	424,599	457,250
2023	321,539	3,443	2,152	92,001	419,134
2024	297,930	3,470	2,224	36,095	339,719
2025	138,891	41,509	2,199	36,012	218,611
2026	21,780	142,374	2,195	35,919	202,269
2027	19,007	156,135	79,450	35,932	290,524
2028	18,883	9,070	92,895	33,598	154,445
2029	18,888	8,958	4,104	25,455	57,405
2030	18,817	8,966	4,104	18,568	50,455
2031	19,322	91,315	37,003	157,107	304,747
2032	333,767	11,155	25,086	7,341	377,348
2033	256,701	11,166	5,323	5,689	278,879
2034	52,980	11,178	5,327	345,414	414,898
2035	16,821	89,160	5,460	91,179	202,619
2036	15,990	172,106	21,539	15,388	225,022
2037	144,187	10,049	92,653	15,344	262,233
2038	141,298	9,761	4,123	269,899	425,081
2039	21,836	9,759	4,059	414,870	450,524
2040	22,001	9,748	4,064	401,302	437,115
2041	21,861	8,090	3,402	359,843	393,197
2042	14,921	58,995	2,997	41,796	118,709

Source: REDD+ Matavén Project, Folder " calculation_tables ", file "VMD0010.xlsx", sheet " S3" Exante Eq1 CLK- ASU,LB "

2nd. Equation 6 of the VCS VMD0010 LK -ASU module was applied to calculate " net CO2 emissions due to unplanned deforestation displaced outside the vanishing belt " *(ΔCLK - ASU- OLB)* ".

In the " *calculation_tables* " folder , file "*VMD0010.xls* ", sheet "*S4" Eq6 CLK-ASU,OLB* " is the calculation of Δ *CLK -ASU- OLB*

$$\Delta C_{LK-ASU,OLB} = (\Delta C_{BSL,LK,unplanned} - \Delta C_{P,LB}) * LK_{PROP}$$

Δ CBSL,LK ,unplanned,i,t of Table 71 of the PDD.
ΔCP ,LB It is estimated by adding to " *Net CO2 emissions in the baseline desde unplanned deforestation in the leakage belt (ΔCBSL,LK,unplanned,i,t)* " (table 71) a proportion of 6.45% of " *Net CO2 emissions in the baseline desde unplanned deforestation in the Project Area (ΔCBSL,PA,unplanned,i,t)* " (table 70).
Δ CP,LB = ΔCBSL,LK,unplanned,i,t + (ΔCBSL,PA,unplanned,i,t * 0.0645)

LKPROP : Proportional leakage for areas with an immigrant population according to Equation 5 of the VCS Module VMD0010:

$$LK_{PROP} = PROP_{IMM} * (1 - PROP_{LB}) * PROP_{CS}$$

PROPIMM	**0.0976**	**Estimated proportion of initial deforestation caused by immigrant population**
PROPLB	0.0824	Area of forest available in the vanishing belt for unplanned deforestation as a proportion of the total national forest area available for unplanned deforestation
PROPCS	1.0930	The proportional difference in carbon stocks between forest areas available for unplanned deforestation both inside and outside the Runaway Belt

Net CO2 emissions due to the displacement of deforestation outside the Leakage Belt (*ΔCLK-ASU,OLB*) (Table 78 of the PDD)

t (years)	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	$\Delta C_{LK-ASU-OLB}$
2013	1,034	3	0	31,473	32,510
2014	29,174	eleven	1	745	29,931
2015	33,851	19	12	765	34,646
2016	33,933	twenty	2	750	34,704
2017	14,558	7,959	1	743	23,261
2018	2,680	5,238	9,123	10,869	27,909
2019	2,640	340	210	37,834	41,024
2020	2,642	337	210	33,380	36,569
2021	2,653	3. 4. 5	210	27,463	30,670
2022	2,645	343	210	41,574	44,771
2023	31,483	337	211	9,008	41,039
2024	29,171	340	218	3,534	33,263
2025	13,599	4,064	215	3,526	21,405
2026	2,133	13,940	215	3,517	19,805
2027	1,861	15,288	7,779	3,518	28,446
2028	1,849	888	9,096	3,290	15,122
2029	1,849	877	402	2,492	5,621
2030	1,842	878	402	1,818	4,940
2031	1,892	8,941	3,623	15,383	29,839
2032	32,680	1,092	2,456	719	36,948
2033	25,135	1,093	521	557	27,306

t (years)	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	$\Delta C_{LK-ASU-OLB}$
2034	5,187	1,094	522	33,821	40,624
2035	1,647	8,730	535	8,928	19,839
2036	1,566	16,852	2,109	1,507	22,033
2037	14,118	984	9,072	1,502	25,676
2038	13,835	956	404	26,427	41,621
2039	2,138	956	397	40,622	44,113
2040	2,154	954	398	39,293	42,800
2041	2,141	792	333	35,234	38,499
2042	1,461	5,776	293	4,092	11,623

Now, equation 16 of the VCS Module VMD0010 LK - ASU (presented above) is applied.

The results are:
Net greenhouse gas emissions due to leak displacement ($\Delta CLK\text{-}AS,unplanned$) (PDD Table 79)

t (years)	$\Delta C_{p,DefPA,i,t}$ by Forest strata i				Subtotal	
	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	$\Delta C_{LK-AS,unplanned}$	Accumulated
2013	11,593	38	0	352,907	364,538	364,538
2014	327,133	123	10	8,352	335,618	700,156
2015	379,568	212	129	8,582	388,492	1,088,648
2016	380,496	221	19	8,406	389,142	1,477,790
2017	163,244	89,242	14	8,331	260,831	1,738,621
2018	30,047	58,730	102,298	121,871	312,946	2,051,567
2019	29,600	3,817	2,352	424,235	460,004	2,511,571
2020	29,623	3,777	2,352	374,295	410,047	2,921,618
2021	29,746	3,866	2,352	307,946	343,910	3,265,528
2022	29,653	3,842	2,352	466,174	502,021	3,767,549
Subttl 1-10	1,410,703	163,870	111,878	2,081,098	3,767,549	
2023	353,022	3,780	2,363	101,009	460,173	4,227,722
2024	327,102	3,810	2,442	39,629	372,982	4,600,705
2025	152,491	45,574	2,414	39,538	240,017	4,840,721
2026	23,913	156,315	2,410	39,436	222,073	5,062,794
2027	20,868	171,422	87,229	39,450	318,970	5,381,765
2028	20,732	9,958	101,990	36,887	169,568	5,551,332
2029	20,738	9,836	4,505	27,947	63,026	5,614,358
2030	20,660	9,844	4,505	20,386	55,395	5,669,753
2031	21,214	100,256	40,626	172,490	334,586	6,004,339
2032	366,447	12,247	27,542	8,060	414,296	6,418,635
Subttl 10-20	1,327,186	523,042	276,028	524,832	2,651,086	
2033	281,835	12,259	5,844	6,246	306,185	6,724,820
2034	58,167	12,272	5,849	379,235	455,523	7,180,343
2035	18,468	97,890	5,995	100,106	222,458	7,402,801

t (years)	Δ C p,DefPA ,i,t by Forest strata i				Subtotal	
	i=1 Helobiome	i=2 Peinobiome	i=3 Litobiome	i=4 Zonobiome	ΔC LK-AS,unplanned	Accumulated
2036	17,555	188,957	23,648	16,895	247,055	7,649,857
2037	158,305	11,032	101,725	16,847	287,909	7,937,766
2038	155,133	10,717	4,526	296,326	466,703	8,404,469
2039	23,974	10,714	4,457	455,491	494,637	8,899,106
2040	24,155	10,702	4,462	440,595	479,914	9,379,020
2041	24,002	8,883	3,735	395,077	431,696	9,810,716
2042	16,382	64,771	3,291	45,888	130,333	9,941,049
Subttl 20-30	777,977	428,199	163,531	2,152,707	3,522,414	
Total 1-30	3,515,866	1,115,110	551,436	4,758,637	9,941,049	

Source: Annex 9 - VM0007, 8. Quantification of GHG Emission Reductions and Removals , 8.3 Leakage , in turn Based on Annex 12 - VMD0010, 5. PROCEDURES , 5.7 Step 7: Estimation of total leakage due to the displacement of unplanned deforestation (Equation 16 Exante ΔCLK-AS,unplanned); file "VMD0010.xlsx", sheet " S7 Eq16 CLK-AS,unp Exante " (folder " calculation_tables ")

Aspect of Conservatism

The REDD+ Matavén Project estimates the GHG emissions that would occur in the scenario with the project due to leaks outside the Project Area and outside the Leakage Belt motivated by the implementation of the Project Activities , which are deducted from the emissions already calculated from the projected deforestation for the Project Area (based on the deforestation rate found in DRR).

4. GHG emissions reduction estimates

- For this estimation, the methods presented in Annex 9 - VM0007, 8.4 Summary of reduction and/or removal of GHG emissions, 8.4.2 REDD were used (results of Equation 1 equivalent to the results of Equation 2 ***NERREDD***).

$$NER_{REDD+} = NER_{REDD} + NGR_{ARR} + NER_{WRC}$$

- As $NGR_{ARR} = 0$ and $NER_{WRC} = 0$

$$NER_{REDD+} = NER_{REDD}$$

Equation 2 VCS VM0007 REDD-MF

$$NER_{REDD} = \Delta C_{BSL\text{-}REDD} - \Delta C_{WPS\text{-}REDD} - \Delta C_{LK\text{-}REDD}$$

Equation 3 VCS VM0007 REDD-MF

$$\Delta C_{BSL\text{-}REDD} = \Delta C_{BSL,planned} + \Delta C_{BSL,unplanned} + \Delta C_{BSL,degrad\text{-}FW/C}$$

Equation 4 VCS VM0007 REDD-MF

$$\Delta C_{LK\text{-}REDD} = \Delta C_{LK\text{-}AS,planned} + \Delta C_{LK\text{-}AS,unplanned} + \Delta C_{LK\text{-}AS,degrad\text{-}FW/C} + \Delta C_{LK\text{-}ME}$$

Net GHG emission reductions from the REDD project until year t* (*NER* $_{REDD+}$) (Table 80 of the PDD)

t (years)	Total net GHG emissions reductions from REDD project activity through year t*	Net GHG emissions in the REDD baseline scenario until year t*	Net GHG emissions in the REDD project scenario until year t*	Net GHG emissions from leaks from REDD project activity until year t*
	NER REDD+	**ΔC BSL -REDD**	**ΔC WPS-REDD**	**ΔC LK-REDD**
t = 1 : 2013	3,840,053	5,151,681	947,090	364,538
t = 2 : 2014	3,549,920	4,742,981	857,443	335,618
t = 3 : 2015	4,126,550	5,490,203	975,161	388,492
t = 4 : 2016	4,157,144	5,499,384	953,098	389,142
t = 5 : 2017	2,824,977	3,686,093	600,284	260,831
t = 6 : 2018	3,394,234	4,422,586	715,406	312,946
t = 7 : 2019	4,967,059	6,500,811	1,073,749	460,004
t = 8 : 2020	4,465,986	5,794,823	918,790	410,047
t = 9 : 2021	3,790,794	4,860,161	725,457	343,910
t = 10 : 2022	5,473,502	7,094,602	1,119,079	502,021
Subttl 1-10	**40,590,219**	**53,243,326**	**8,885,558**	**3,767,549**
t = 11 : 2023	5,030,098	6,503,210	1,012,938	460,173
t = 12 : 2024	4,117,587	5,271,017	780,448	372,982
t = 13 : 2025	2,714,125	3,391,935	437,793	240,017
t = 14 : 2026	2,506,608	3,138,361	409,679	222,073
t = 15 : 2027	3,522,386	4,507,718	666,362	318,970
t = 16 : 2028	1,965,876	2,396,343	260,899	169,568
t = 17 : 2029	826,797	890,689	865	63,026
t = 18 : 2030	726,143	782,845	1,307	55,395
t = 19 : 2031	3,641,866	4,728,400	751,948	334,586
t = 20 : 2032	4,475,631	5,854,866	964,939	414,296
Subttl 10-20	**29,527,118**	**37,465,383**	**5,287,178**	**2,651,086**
t = 21 : 2033	3,338,518	4,327,030	682,327	306,185
t = 22 : 2034	4,914,685	6,437,487	1,067,279	455,523
t = 23 : 2035	2,465,166	3,143,802	456,177	222,458
t = 24 : 2036	2,715,367	3,491,406	528,984	247,055
t = 25 : 2037	3,157,097	4,068,761	623,755	287,909
t = 26 : 2038	5,049,569	6,595,483	1,079,211	466,703
t = 27 : 2039	5,371,191	6,990,250	1,124,422	494,637
t = 28 : 2040	5,241,170	6,782,190	1,061,106	479,914
t = 29 : 2041	4,740,967	6,100,771	928,108	431,696
t = 30 : 2042	1,559,494	1,841,874	152,047	130,333
Subttl 20-30	**38,553,224**	**49,779,053**	**7,703,415**	**3,522,414**
Total 1-30	**108,670,562**	**140,487,762**	**21,876,151**	**9,941,049**

Source: Annex 9 - VM0007, 8.4 Summary of GHG emissions reduction and/ or removals , 8.4.2 REDD (Equation 1 results equivalent to Equation 2 results ***NERREDD*** *) ; file "VM0007.xlsx", sheet " Eq2 NER REDD" (folder " calculation_tables ")*

5. Uncertainty Analysis

UNC module (Annex 16) combines uncertainty information and conservative estimates and produces an overall uncertainty estimate of total net GHG emissions reductions.

anthropogenic GHG emission reductions should be adjusted at each point in time to account for uncertainty, as outlined in the X- UNC module.

(The allowable uncertainty under this methodology is +/- 15% of NERREDD + at the 95% confidence level. When this level of precision is achieved, uncertainty should not be deducted. When the uncertainty exceeds 15% of NERREDD + at 95% confidence level, then the deduction should be equal to the amount by which the uncertainty exceeds the allowable level).

X- UNC calculates an adjusted value for NERREDD + for any point in time.

This *Adjusted_NERREDD* + should be the basis of the calculations at each point in time in equation 13. (Annex 16 X- UNC - VMD0017).

$$Uncertainty_{REDD\_BSL,t^*} = \sqrt{[Uncertainty_{BSL,RATE,t^*} + Uncertainty_{REDD\_BSL,SS}]}$$

$$Uncertainty_{REDD\_BSL,t^*} = 8.36\%$$

Since the uncertainty does not exceed 15% of NERREDD + at the 95% confidence level, then uncertainty should not be deducted.

$$Adjusted\_C_{REDD,t} = NER_{REDD+,t}$$

Aspect of Conservatism

The REDD+ Matavén Project carries out an uncertainty analysis in compliance with a requirement of the applied methodology, a procedure that is not carried out in the construction of the NREF.

6. "Buffer" Calculation

Equation 7 VCS VM0007 REDD-MF

$$Buffer_{TOTAL} = Buffer_{Planned} + Buffer_{Unplanned} + Buffer_{Degrad-FW/C} + {}_{WRC}Buffer + {}_{ARR}Buffer$$

Equation 9 VCS VM0007 REDD-MF

$$Buffer_{Unplanned} = \left\{ \begin{array}{l} (\Delta C_{BSL,unplanned} - \underset{Baseline\ \ Unplanned}{\Sigma_{t=1}^{t^*} \Sigma_{i=1}^{M}} (E_{FC,i,t} + N_2O_{direct,i,t})) - \\ (\Delta C_{P,Unplanned} - \underset{Project\ \ Unplanned}{\Sigma_{t=1}^{t^*} \Sigma_{i=1}^{M}} (E_{FC,i,t} + N_2O_{direct,i,t})) \end{array} \right\} * Buffer\%$$

Buffer" retention by Project activities (Table 81 of the PDD)

t (years)	*Buffer Unplanned*	∆C *BSL-unplanned*	∆C *P*
t = 1 : 2013	714,780	5,151,681	947,090
t = 2 : 2014	660,541	4,742,981	857,443
t = 3 : 2015	767,557	5,490,203	975,161
t = 4 : 2016	772,869	5,499,384	953,098
t = 5 : 2017	524,587	3,686,093	600,284
t = 6 : 2018	630,221	4,422,586	715,406
t = 7 : 2019	922,601	6,500,811	1,073,749
t = 8 : 2020	828,926	5,794,823	918,790
t = 9 : 2021	702,900	4,860,161	725,457
t = 10 : 2022	1,015,839	7,094,602	1,119,079
t = 11 : 2023	933,346	6,503,210	1,012,938
t = 12 : 2024	763,397	5,271,017	780,448
t = 13 : 2025	502,204	3,391,935	437,793
t = 14 : 2026	463,876	3,138,361	409,679
t = 15 : 2027	653,031	4,507,718	666,362
t = 16 : 2028	363,025	2,396,343	260,899
t = 17 : 2029	151,270	890,689	865
t = 18 : 2030	132,861	782,845	1,307
t = 19 : 2031	675,997	4,728,400	751,948
t = 20 : 2032	831,288	5,854,866	964,939
t = 21 : 2033	619,599	4,327,030	682,327
t = 22 : 2034	912,935	6,437,487	1,067,279
t = 23 : 2035	456,896	3,143,802	456,177
t = 24 : 2036	503,612	3,491,406	528,984
t = 25 : 2037	585,651	4,068,761	623,755
t = 26 : 2038	937,766	6,595,483	1,079,211
t = 27 : 2039	997,191	6,990,250	1,124,422
t = 28 : 2040	972,584	6,782,190	1,061,106
t = 29 : 2041	879,353	6,100,771	928,108
t = 30 : 2042	287,271	1,841,874	152,047
Total 1-30	**20,163,974**	**140,487,762**	**21,876,151**

Source: Annex 9 VM0007, Equation 9; folder " calculation_tables " file "VM0007.xlsx", Sheet " Eq9 Buffer unplan"

Aspect of Conservatism

The REDD+ Matavén Project deducts a proportion of the reductions generated and deposits them in a special account called buffer, which is in charge of the VERRA Certifier, as a measure to mitigate the risk of non-permanence and reversal of the results achieved, a procedure that It is not applied in the use of the NREF .

7. Calculation of Verified Coal Units (VCUs)

Equation 13 VCS VM0007 REDD-MF

$$VCU_t = (Adjusted\_NER_{REDD+,t2} - Adjusted\_NER_{REDD+,t1}) - TOTAL\ Buffer$$

To achieve more conservative VCU estimates, a discount is applied for each year corresponding to the "% efficiency" indicated in Table 82 of the PDD.

Number of VCUs per year (Table 82 of the PDD)

t (years)	Adjusted_ NER $_{REDD,t}$	TOTAL Buffer = $_{Unplanned\ Buffer}$	%efficiency	VCU $_t$
t = 1 : 2013	3,840,053	714,780	10%	2,812,745
t = 2 : 2014	3,549,920	660,541	10%	2,600,441
t = 3 : 2015	4,126,550	767,557	8%	3,090,273
t = 4 : 2016	4,157,144	772,869	8%	3,113,533
t = 5 : 2017	2,824,977	524,587	5%	2,185,370
t = 6 : 2018	3,394,234	630,221	5%	2,625,812
t = 7 : 2019	4,967,059	922,601	5%	3,842,235
t = 8 : 2020	4,465,986	828,926	5%	3,455,208
t = 9 : 2021	3,790,794	702,900	5%	2,933,500
t = 10 : 2022	5,473,502	1,015,839	5%	4,234,780
t = 11 : 2023	5,030,098	933,346	5%	3,891,914
t = 12 : 2024	4,117,587	763,397	5%	3,186,481
t = 13 : 2025	2,714,125	502,204	5%	2,101,325
t = 14 : 2026	2,506,608	463,876	5%	1,940,595
t = 15 : 2027	3,522,386	653,031	5%	2,725,887
t = 16 : 2028	1,965,876	363,025	5%	1,522,708
t = 17 : 2029	826,797	151,270	5%	641,751
t = 18 : 2030	726,143	132,861	5%	563,617
t = 19 : 2031	3,641,866	675,997	5%	2,817,576
t = 20 : 2032	4,475,631	831,288	5%	3,462,126
t = 21 : 2033	3,338,518	619,599	5%	2,582,973
t = 22 : 2034	4,914,685	912,935	5%	3,801,662
t = 23 : 2035	2,465,166	456,896	5%	1,907,857
t = 24 : 2036	2,715,367	503,612	5%	2,101,168
t = 25 : 2037	3,157,097	585,651	5%	2,442,873
t = 26 : 2038	5,049,569	937,766	5%	3,906,213
t = 27 : 2039	5,371,191	997,191	5%	4,155,300
t = 28 : 2040	5,241,170	972,584	5%	4,055,156
t = 29 : 2041	4,740,967	879,353	5%	3,668,534
t = 30 : 2042	1,559,494	287,271	5%	1,208,612
Total 1-30	**108,670,562**	**20,163,974**		**83,578,228**
Annual Avg.	3,622,352	672,132		2,785,941

Source: Annex 9 VM0007, Equation 13; folder " calculation_tables " file "VM0007.xlsx", Sheet " Eq13 " "VCUt "

This demonstrates the rigor with which GHG emissions reductions are estimated and the conservatism criteria that are taken into account, which is not the case with the NREF.

In summary, these are the conservatism criteria that are taken into account:

- Aerial biomass of the Project less than the Biomass of IDEAM 2011.
- The net and non-gross Carbon contents are analyzed, as is done in the NREF.
- The Project's emission factor is lower than that managed by the NREF.
- The Project deducts from the gross emissions those that it considers would occur in a scenario with a project.
- The Project deducts from the gross emissions those that it considers would occur due to leaks outside the Project Area and outside the Leakage Belt.
- The Project carries out an uncertainty analysis, which is not carried out in the construction of the NREF .
- The Project deducts a proportion from the net emissions for the buffer account, which is not applied in the use of the NREF.

With these rigorous analyzes in the estimation of GHG emissions reductions in the REDD+ Matavén Project, the confidence and integrity of the results obtained is confirmed, ratifying the erroneous analyzes of the CMW and CLIP journalists .

The Baseline is realistic, not artificially high, and has offered practical results for climate and forest conservation (see Monitoring Reports at https://registry.verra.org/app/projectDetail/VCS/1566).

It should also be highlighted that the differences between the values of the deforestation rates of the REDD+ Matavén Project and the NREF are due, as has been sufficiently demonstrated, to the fact that they are very different contexts. It is completely inaccurate and erroneous to apply the NREF deforestation rate to the Project to try to induce malicious results and analyzes against the Project, as CMW and CLIP journalists have done .

REDUCED GHG EMISSIONS (2013 and 2014-2015)

- The monitoring report presented corresponds to two periods:
  Period 1: 2013
  Period 2: 2014 and 2015
- So the information on “GHG emissions reductions achieved” is presented separately for the two periods and then consolidated.

To calculate the GHG emissions reduced in the monitoring periods (2013 and 2014-2015), the following is done:

1. Monitoring results of deforested areas
2. Baseline Emissions

3. Project Emissions (ex-post)
   3.1 Calculation of carbon stock in Baseline by deposit/stratum
   3.2 Calculation of carbon stock after deforestation in all pools by land use/stratum
   3.3 Calculation of changes in net carbon stocks after deforestation in all pools by land use/stratum
   3.4 Determination of the deforested area in the Project Area in all deposits by land use/stratum
   3.5 Calculation of changes in net carbon stocks after deforestation in the Project Area, in all pools by land use/stratum
4. Leak Emissions
   4.1 Calculation of the area deforested by immigrants in the Project Area and the Leakage Belt, in the project scenario
   4.2 Calculation of the total area deforested by immigrants in the Baseline and in the project scenario
   4.3 Calculation of the area deforested by immigrants outside the Project Area and Leakage Belt
   4.4 Calculation of net CO_2 emissions due to unplanned deforestation displaced outside the Leakage Belt
   4.5 Determination of the deforested area in the Leakage Belt in all deposits by land use/stratum
   4.6 Calculation of net changes in carbon stocks after deforestation in the Fugas Belt, in all deposits by land use / stratum
   4.7 Net $CO_{2\ emissions}$ due to unplanned deforestation displaced from the Project Area to the Leak Belt
   4.8 Leaks in the 2013 Period
   4.9 Leaks in the 2014-2015 Period
   4.10 Leaks in the Periods 2013 and 2014-2015
5. Net GHG emissions reductions 2013
6. Reductions in net GHG emissions 2014-2015

1. Monitoring results of deforested areas

The description of the procedure for the implementation of monitoring in the Project Area and in the Leak Belt Area according to the processing of digital images and the monitored points on the ground with their respective results for the period 2013 and the period 2014-2015, are presented below.

The deforestation and land cover update maps were processed according to the guidelines of the "Digital image processing protocol for the quantification of deforestation in Colombia at the national level - gross and fine scale" developed by IDEAM and its procedures were They are considered official for regional planning at a scale of 1: 100,000.

Step 1 : Radiometric calibration and atmospheric correction.
Step 2 : Geometric correction.
Step 3 : Change detection.
Step 4 : Inspection.
Step 5 : Calculation of deforestation in the RRL forest .
Step 6 : Coverage Assignment

Deforestation in the Project Area (PA) and Leakage Belt (LB) (2013; 2014-2015) (Table 95 of the PDD)

	Monitoring (2013)		Monitoring (2014-2015)				
	You have	%	You have	%	Total (has)	%	Has/year
Project Area (PA)	245.7	40.6%	788.5	45.1%	1,034.2	44.0%	344.7
Leak Belt (CF)	358.8	59.4%	960.1	54.9%	1,318.9	56.0%	439.6
Total	**604.5**	**100%**	**1,748.6**	**100%**	**2,353.1**	**100%**	
Deforested/year	604.5		874.3				784.4

Source: REDD+ Matavén Project, GIS (file "monitoring.xlsx", folder " calculation_tables ")

Deforestation 2013 and 2014-2015 in the Project Area (by stratum) (Table 96 of the PDD)

	Monitoring (2013)		Monitoring (2014-2015)				
	You have	%	You have	%	Total (has)	%	Has/year
Helobiome	97.2	39.6%	405.2	51.4%	502.4	48.6%	167.5
Peinobiome	16.5	6.7%	45.5	5.8%	62.0	6.0%	20.7
Litobiome	0.0	0.0%	7.3	0.9%	7.3	0.7%	2.4
Zonobiome	132.0	53.7%	330.5	41.9%	462.5	44.7%	154.2
Total	**245.7**	**100%**	**788.5**	**100%**	**1,034.2**	**100%**	
Deforested/year	245.7		394.2				344.7

Source: REDD+ Matavén Project, GIS (file "monitoring.xlsx", folder " calculation_tables ")

Deforestation 2013 and 2014-2015 in the Leak Belt (by stratum) (Table 97 of the PDD)

	Monitoring (2013)		**Monitoring (2014-2015)**				
	You have	**%**	**You have**	**%**	**Total (has)**	**%**	**Has/year**
Helobiome	119.4	33.3%	206.8	21.5%	326.3	24.7%	108.8
Peinobiome	33.1	9.2%	107.8	11.2%	140.9	10.7%	47.0
Litobiome	28.4	7.9%	16.6	1.7%	45.0	3.4%	15.0
Zonobiome	177.8	49.6%	628.9	65.5%	806.7	61.2%	268.9
Total	**358.8**	**100%**	**960.1**	**1.0**	**1,318.9**	**100%**	
Deforested/year	358.8		480.0				439.6

Source: REDD+ Matavén Project, GIS (file "monitoring.xlsx", folder " calculation_tables ")

Deforestation in the Project Area (PA) and Leakage Belt (LB) due to changes in land use (Table 98 of the PDD)

		Land cover categories (ha)												
		AAH	**%**	**Q**	**%**	**S.D.**	**%**	**VR**	**%**	**h**	**%**	**Total**	**%**	**Has/year**
Project Area (AP)	(2013)	222.9	27.2%	21.0	89.9%		0.0%	1.9	1.0%		0.0%	245.7	23.8%	245.7
	(2014-2015)	597.6	72.8%	2.4	10.1%	0.9	100.0%	184.2	99.0%	3.5	100.0%	788.5	76.2%	394.2
	Total	**820.5**	**100%**	**23.3**	**100%**	**0.9**	**100%**	**186.0**	**100%**	**3.5**	**100%**	**1,034.2**	**100%**	
	Defor /year	273.5		7.8		0.3		62.0		1.2				344.7
Leakage belt (CF)	(2013)	260.9	27.7%	29.9	43.9%			68.0	22.0%		0.0%	358.8	27.2%	358.8
	(2014-2015)	680.2	72.3%	38.2	56.1%			240.7	78.0%	1.0	100.0%	960.1	72.8%	480.0
	Total	**941.1**	**100%**	**68.1**	**100%**	**0.0**		**308.7**	**100%**	**1.0**	**100%**	**1,318.9**	**100%**	
	Defor /year	313.7		22.7		0.0		102.9		0.3				439.6
	TOTAL	**1,761.6**		**91.5**		**0.9**		**494.7**		**4.5**		**2,353.1**		
	Defor /year	587.2		30.5		0.3		164.9		1.5				784.4
	%	74.9%		3.9%		0.0%		21.0%		0.2%				100%

Source: REDD+ Matavén Project, GIS (file “monitoring.xlsx”, folder “ calculation_tables ”)

2. Baseline Emissions

The reference emissions in the Baseline correspond to those calculated previously.

The following stages were completed:

- Calculation of carbon stocks in above-ground tree biomass, below-ground tree biomass and organic soil
- Determination of unplanned deforestation within the DRR during the historical reference period (HRP), to estimate the threat of deforestation within the Project Area (PA)
- Calculation of changes in baseline carbon stocks and GHG emissions
- Baseline Emissions in the 2013 period
- Baseline Emissions in the period 2014-2015

Baseline Emissions 2013, 2014 – 2015 (Tables 100, 101, 102 of the PDD)

t	Year	ΔC BSL ,unplanned (t CO2-e)
1	2013	**5,151,681**
2	2014	4,742,981
3	2015	5,490,203
Total		**15,384,865**

3. Project Emissions (ex-post)

To calculate the project's emissions, the following stages were completed:

3.1 Calculation of carbon stock in Baseline by deposit/stratum
3.2 Calculation of carbon stock after deforestation in all pools by land use/stratum
3.3 Calculation of changes in net carbon stocks after deforestation in all pools by land use/stratum
3.4 Determination of the deforested area in the Project Area in all deposits by land use/stratum
3.5 Calculation of changes in net carbon stocks after deforestation in the Project Area, in all pools by land use/stratum

3.1 Calculation of carbon stock in Baseline by deposit/stratum

C $_{BSL,i}$ They are the subtotals from table 53 (PDD) for each stratum.

Baseline carbon stocks per deposit per stratum *i* (PDD Table 103)

	i=1 Helobiome	***i=2 Peinobiome***	***i=3 Litobiome***	***i=4 Zonobiome***
	t CO2 -e / ha	***t CO2 -e / ha***	***t CO2 -e / ha***	***t CO2 -e / ha***
C $_{BSL,i}$	*718.5*	*663.4*	*682.3*	*799.4*

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0007.xlsx", Sheet " P4 " Step4.2.1 forest C stock"

3.2 Calculation of carbon stock after deforestation in all pools by land use/stratum

Cpost,u ,i They are in table 73 (PDD) for each stratum:

Estimation of carbon stocks after deforestation for land use (*Cpost,u ,i*) (***t CO2 -e / ha***) (Table 104 of the PDD)

C Pool	***i=1 Helobiome***			***i=2 Peinobiome***			***i=3 Litobiome***			***i=4 Zonobiome***		
	VR	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***
Cpost,u ,i	258.2	203.6	149.3	329.6	240.4	219.4	341.5	246.5	231.1	333.0	242.1	222.7

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq6" CP,post ,u,i,t " and file "VMD0007.xlsx", Sheet " P4 Step4.2.2 postdef C stock"

3.3 Calculation of changes in net carbon stocks after deforestation in all pools by land use/stratum

Δ Cpools,Def ,u,i,t They are in table 74 (PDD) for each stratum:

Estimation of changes in net carbon stocks after deforestation for land use (*ΔCpools,Def,u,i,t*) (***t CO2 -e / ha***) (Table 105 of the PDD)

C Pool	***i=1 Helobiome***			***i=2 Peinobiome***			***i=3 Litobiome***			***i=4 Zonobiome***		
	VR	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***
Δ $_{Cpools,Def,u,i,t}$	460.3	514.9	569.2	333.8	423.0	444.0	340.8	435.8	451.2	466.4	557.3	576.6

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq5" Cpools,Def ,i,t "

3.4 Determination of the deforested area in the Project Area in all deposits by land use/stratum

Through cartographic review and field verification, Area of deforestation recorded in the Project Area (PA) stratum *i* (*ADefPA,u ,i,t*) converted into land use u in the periods 2013 and 2014-

2015 was identified. The results are:

Deforested area in PA by land use/stratum (ADefPA,u ,i,t , ha) (Table 106 of the PDD)

Periods	**i=1 Helobiome**			**i=2 Peinobiome**			**i=3 Litobiome**			**i=4 Zonobiome**		
	VR	**AAH**	**Q**	**VR**	**AAH**	**Q**	**VR**	**AAH**	**Q**	**VR**	**AAH**	**Q**
2013	1.2	96.0	0.1	0.0	16.5	0.0	0.0	0.0	0.0	0.7	110.5	20.9
2014-2015	98.6	302.7	0.9	19.1	25.9	0.0	0.5	6.7	0.0	66.0	262.3	1.5

Source: Deforested area in the Project Area in all pools for land use / stratum (ADefPA,u ,i,t) during 2013 and 2014-2015 by strata and land use, according to monitoring study , is in Folder " calculation_tables ", file "monitoring.xlsx" Sheets " Defor PA 2013", " Defor PA 2014-2015". Also , Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq3" CPDefPA,i ,t " Expost "

3.5 Calculation of changes in net carbon stocks after deforestation in the Project Area, in all pools by land use/stratum

Equation 3 of Annex 11 VMD0015 was used to calculate the change in net carbon stock as a result of deforestation in the project scenario in the Project Area in stratum *i* :

$$\Delta C_{P,DefPA,i,t} = \Sigma_{u=1}^{U} (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t})$$

ADefPA,u ,i,t	ha	Recorded deforestation area in project area stratum i converted to land use u at time t
Δ Cpools,P ,Def,u,i,t	t CO2 -e ha-1	Net changes in carbon stocks in all pools for project in land use u in stratum i at time t

Net change in carbon stock (*Δ CP,DefPA ,i,t*) as a result of deforestation in the project scene in the Project Area in stratum *i* . Period 2013 (Table 107 of the PDD)

	i=1 Helobiome			**i=2 Peinobiome**			**i=3 Litobiome**			**i=4 Zonobiome**		
	VR	**AAH**	**Q**	**VR**	**AAH**	**Q**	**VR**	**AAH**	**Q**	**VR**	**AAH**	**Q**
$\Delta C_{pools,Def,u,i,t}$	460.3	514.9	569.2	333.8	423.0	444.0	340.8	435.8	451.2	466.4	557.3	576.6
$A_{DefPA,u,i,t\ 2013}$	1.2	96.0	0.1	0.0	16.5	0.0	0.0	0.0	0.0	0.7	110.5	20.9
$\Delta C_{pools\ *\ ADefPA}$	533.1	49,410.5	37.8	5.0	6,971.0	0.0	0.0	0.0	0.0	316.9	61,556.1	12,053.5
$\Delta CP,DefPA,i,t$	$\Sigma_{i:1}$ =49,981			$\Sigma_{i:2}$ =6.976			$\Sigma i_{:3}$ =0			$\Sigma_{i:4}$ =73.927		

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq3 " CPDefPA,i ,t "Expost"

Net change in carbon stock (*Δ CP,DefPA ,i,t*) as a result of deforestation in the project scene in the Project Area in stratum *i* . Period 2014-2015 (Table 108 of the PDD)

	i=1 Helobiome			*i=2 Peinobiome*			*i=3 Litobiome*			*i=4 Zonobiome*		
	VR	*AAH*	*Q*	*VR*	*AAH*	*Q*	*VR*	*AAH*	*Q*	*VR*	*AAH*	*Q*
$\Delta C_{pools,Def,u,i,t}$	460.3	514.9	569.2	333.8	423.0	444.0	340.8	435.8	451.2	466.4	557.3	576.6
$A_{DefPA,u,i,t}$ 2014-2015	98.6	302.7	0.9	19.1	25.9	0.0	0.5	6.7	0.0	66.0	262.3	1.5
ΔC_{pools} * A_{DefPA}	45,365	155,852	490	6,384	10,949	0	185	2,926	0	30,761	146,175	865
$\Delta CP_{,DefPA,i,t}$	Σi:1 =201,709			Σi:2 =17,334			Σi:3 =3.111			Σi:4 =177,802		

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq3 " CPDefPA,i ,t " Expost "

Project emissions in the periods 2013 and 2014-2015: During monitoring, all steps in the M-MON module were followed to obtain the net greenhouse gas emissions in the project scenario.

Net GHG emissions in the Project scenario (PA) (*ΔCp*), 2013 (Table 109 of the PDD)

Stratum	$\Delta C_{pDef,PA,i,t}$	$\Delta C_{pDeg,PA,i,t}$	$\Delta C_{pDist,PA,i,t}$	$GHG_{p-E,i,t}$	$\Delta C_{p,Enh,i,t}$	TOTAL ΔCp _
Helobiome	49,981	0	0	0	0	49,981
Peinobiome	6,976	0	0	0	0	6,976
Litobiome	0	0	0	0	0	0
Zonobiome	73,927	0	0	0	0	73,927
TOTAL	130,884	0	0	0	0	130,884

Source: Annex 11 VMD0015, Table 14; File "monitoring.xlsx" section 7.3 and File "VMD0015.xlsx", sheet " Eq3 CPDefPA,i ,t Expo st " (folder " calculation_tables ")

Net GHG emissions in the Project scenario (PA) (*ΔCp*), 2014-2015 (Table 110 of the PDD)

Stratum	$\Delta C_{pDef,PA,i,t}$	$\Delta C_{pDeg,PA,i,t}$	$\Delta C_{pDist,PA,i,t}$	$GHG_{p-E,i,t}$	$\Delta C_{p,Enh,i,t}$	TOTAL ΔCp _
Helobiome	201,709	0	0	0	0	201,709
Peinobiome	17,334	0	0	0	0	17,334
Litobiome	3,111	0	0	0	0	3,111
Zonobiome	177,802	0	0	0	0	177,802
TOTAL	399,956	0	0	0	0	399,956

Source: Annex 11 VMD0015, Table 14; File "monitoring.xlsx" section 7.3 and File "VMD0015.xlsx", sheet " Eq3 CPDefPA,i ,t Expo st " (folder " calculation_tables ")

Net GHG emissions in the Project scenario (PA) (ΔCp), 2013 and 2014-2015 (Table 111 of the PDD)

Stratum	$\Delta C_{pDef,PA,i,t}$	$\Delta C_{pDeg,PA,i,t}$	$\Delta C_{pDist,PA,i,t}$	$GHG_{p-E,i,t}$	$\Delta C_{p,Enh,i,t}$	TOTAL ΔCp _
Helobiome	251,690	0	0	0	0	251,690
Peinobiome	24,310	0	0	0	0	24,310
Litobiome	3,111	0	0	0	0	3,111
Zonobiome	251,729	0	0	0	0	251,729
TOTAL	530,840	0	0	0	0	530,840

Source: Based on Annex 11 VMD0015, Table 14; File "monitoring.xlsx" section 7.3 and File "VMD0015.xlsx", sheet " Eq3 CPDefPA, i ,t Expost " (folder " calculation_tables ")

4. Leak Emissions

To calculate emissions due to leaks, the following stages were completed:

4.1 Calculation of the area deforested by immigrants in the Project Area and the Leakage Belt, in the project scenario
4.2 Calculation of the total area deforested by immigrants in the Baseline and in the project scenario
4.3 Calculation of the area deforested by immigrants outside the Project Area and Leakage Belt
4.4 Calculation of net CO_2 emissions due to unplanned deforestation displaced outside the Leakage Belt
4.5 Determination of the deforested area in the Leakage Belt in all deposits by land use/stratum
4.6 Calculation of net changes in carbon stocks after deforestation in the Leakage Belt, in all deposits by land use / stratum
4.7 Net $CO_{2\ emissions}$ due to unplanned deforestation displaced from the Project Area to the Leakage Belt
4.8 Leaks in the 2013 Period
4.9 Leaks in the 2014-2015 Period
4.10 Leaks in the Periods 2013 and 2014-2015

4.1 Calculation of the area deforested by immigrants in the Project Area and the Leakage Belt, in the project scenario

Equation 8 of Annex 12 VMD0010 was used to calculate the area deforested by immigrants in the Project Area and the Leakage Belt in the project scenario in the periods 2013 and 2014-2015:

$$A_{LK\text{-}ACT\text{-}IMM,t} = PROP_{IMM} * (\Sigma_{i=1}^{M} A_{DefPA,i,t} + A_{DefLB,it})$$

Where:

PROPIMM = 0.0976: Proportion of resident / migrant population that deforests in PA and LB = 402 migrants / 4,121 municipal population (Source: File "VMD0010.xlsx" Sheet " S2 defor inm " – Folder " calculation_tables ")

(ADefPA,i ,t) deforested area in the Project Area and (ADefLB,it) deforested area in the Fugas Belt during 2013 and 2014-2015 by stratum and land use, according to the monitoring study, are in the folder " calculation_tables ", file "monitoring.xlsx" Sheets " Defor PA 2013", " Defor PA 2014-2015", " Defor LB 2013" and " Defor LB 2014-2015". Also, File "VMD0010.xlsx" Sheet " S4 ADef,PA ,LK " – " calculation_tables " folder. Also ADefPA,i ,t and ADefLB,it are in table 95 of the PDD.

Area deforested by immigrants in the Project Area and Leakage Belt (*ALK -ACT- IMM,t*) (Table 112 of the PDD)

Period	$A_{LK\text{-}ACT\text{-}IMM,t}$	$PROP_{IMM}$	$A_{DefPA,i,t}$	$A_{DefLB,it}$
2013	59.0	0.0976	245.7	358.8
2014-2015	170.7	0.0976	788.5	960.1

Source: File "VMD0010.xlsx" Sheet " S4 Eq8 ALK -ACT- IMM,t " – Folder " calculation_tables "

4.2 Calculation of the total area deforested by immigrants in the Baseline and in the project scenario

Equation 7 of Annex 12 VMD0010 was used to calculate the total area deforested by immigrant agents in the Baseline and in the project scenario in the periods 2013 and 2014-2015:

$$A_{LK\text{-}IMM,t} = PROP_{IMM} * A_{BSL,PA,unplanned,t}$$

Where:
ABSL,unplanned ,i,t (PA): Projected area of unplanned baseline deforestation in the Project Area : Annex 10 VMD0007, Table 35 and file "spatial_model_results.xlsx" Sheet " PA " - Folder " calculation_tables ".

Total area deforested by immigrant agents in Baseline and project (*ALK- IMM,t*) (Table 113 of the PDD)

Period	$A_{LK,IMM,t}$	$PROP_{IMM}$	$A_{BSL,PA,unplanned,t}$
2013	1,199	0.0976	12,276
2014-2015	2,367	0.0976	24,249

Source: File "VMD0010.xlsx" Sheet " S4 Eq7 ALK- IMM,t " – " calculation_tables " folder

4.3 Calculation of the area deforested by immigrants outside the Project Area and Leakage Belt

Equation 9 of Annex 12 VMD0010 was used to calculate the area deforested by immigrants outside the Strip and Project zone in the periods 2013 and 2014-2015.

$$A_{LK-OLB,t} = A_{LK,IMM,t} - A_{LK-ACT-IMM,t}$$

ALK,IMM ,t	ha	Total area deforested by migrant agents in the baseline and project scenarios in year t
ALK -ACT- IMM,t	ha	Area deforested by immigrants in the project area and flight belt according to the project scenario in year t

Area deforested by immigrants outside the Leakage Belt and the Project Area (*ALK- OLB,t*) (Table 114 of the PDD)

Period	$A_{LK-OLB,t}$	$A_{LK,IMM,t}$	$A_{LK-ACT-IMM,t}$
2013	1,140	1,199	59
2014-2015	2,197	2,367	171

Source: File “VMD0010.xlsx” Sheet “ S4 Eq9 ALK- OLB,t ” – “calculation_tables” folder

CO_2 emissions due to unplanned deforestation displaced outside the Leakage Belt

CO2 emissions due to unplanned deforestation displaced outside the Leakage Belt in the periods 2013 and 2014-2015:

$$\Delta C_{LK-ASU,OLB} = C_{OLB} * (\Sigma_{t=1}^{t} * A_{LK-OLB,t})$$

Where:

***COLB** : Average CO2 (tCO2 -e/ha) in the humid tropical forest. Source: (Phillips, et al., 2011), page 51, Table 3.1 Average Carbon for Tropical Humid Forest 132.1 ton C / ha = 484.4 tCO2 -e / ha **ALK- OLB,t** from table 114.*

Net CO2 emissions due to unplanned deforestation outside the Leakage Belt (*ΔCLK- ASU,OLB*) (PDD Table 115)

Period	$\Delta C_{LK-ASU-OLB}$	C_{OLB}	$A_{LK-OLB,t}$
2013	551,946	484.4	1,140
2014-2015	1,064,006	484.4	2,197

Source: File “VMD0010.xlsx” Sheet “ S4 Eq11 CLK- ASU,OLB ” – “ calculation_tables ” folder

4.5 Determination of the deforested area in the Leakage Belt in all deposits by land use/stratum

Through cartographic review and field verification: Deforestation area recorded in the Leakage Belt (LB) stratum *i* (*ADefLB,u ,i,t*) converted to land use *u* in the periods 2013 and 2014-2015:

Table 116. Deforested area in the Leak Belt in all deposits for land uses/stratum (*ADefLB,u ,i,t* , *ha*)

Periods	i=1 Helobiome			i=2 Peinobiome			i=3 Litobiome			i=4 Zonobiome		
	VR	AAH	Q	VR	AAH	Q	VR	AAH	Q	VR	AAH	Q
2013	43.6	75.8	0.0	2.6	27.3	3.2	0.0	25.0	3.4	21.8	132.8	23.3
2014-2015	48.9	65.8	0.0	126.0	156.9	42.0	16.6	464.7	0.0	0.0	0.0	38.2

Source: Deforested area in the Leakage Belt in all pools for land use / stratum (ADefLB,u ,i,t) during 2013 and 2014-2015 by strata and land use, according to monitoring study , is in Folder " calculation_tables ", file "monitoring.xlsx" Sheets " Defor LB 2013", " Defor LB 2014-2015". Also , Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq4" CPDefLB,i ,t " Expost "

4.6 Calculation of net changes in carbon stocks after deforestation in the Leakage Belt, in all deposits by land use / stratum

Equation 4 of Annex 11 VMD0015 was used to calculate the net carbon stock change as a result of deforestation in the project scene in the vanishing belt in stratum *i* :

$$\Delta C_{P,DefLB,i,t} = \sum_{u=1}^{U} (A_{DefLB,u,i,t} * \Delta C_{pools,P,Def,u,i,t})$$

ADefLB,u ,i,t	ha	Recorded deforestation area in vanishing belt stratum i converted to land use u at time t
Δ Cpools,P ,Def,u,i,t	t CO_2-e ha^{-1}	Net changes in carbon stocks in all pools for project in land use u in stratum i at time t

Net change in carbon stock (*Δ CP,DefLB ,i,t*) as a result of deforestation in the project scenario in the Leak Belt in stratum *i* . Period 2013 (Table 117 of the PDD)

	i=1 Helobiome			*i=2 Peinobiome*			*i=3 Litobiome*			*i=4 Zonobiome*		
	VR	*AAH*	*Q*	*VR*	*AAH*	*Q*	*VR*	*AAH*	*Q*	*VR*	*AAH*	*Q*
$\Delta C_{pools,Def,u,i,t}$	460.3	514.9	569.2	333.8	423.0	444.0	340.8	435.8	451.2	466.4	557.3	576.6
$A_{DefLB,u,i,t}$	43.6	75.8	0.0	2.6	27.3	3.2	0.0	25.0	3.4	21.8	132.8	23.3
$\Delta C_{pools} * A_{DefLB}$	20,071.0	39,033.1	0.0	875.3	11,546.1	1,428.1	0.0	10,884.7	1,542.0	10,149.7	74,017.2	13,412.9
$\Delta C_{P,DefLB,i,t}$	$\Sigma_{i:1}$ =59.104			$\Sigma_{i:2}$ =13,850			$\Sigma_{i:3}$ =12.427			$\Sigma_{i:4}$ =97,580		

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq4 " CPDefLB,i ,t " Expost "

Net change in carbon stock (*Δ CP,DefLB ,i,t*) as a result of deforestation in the project scenario in the Leak Belt in stratum *i* . Period 2014-2015 (Table 117 of the PDD)

	i=1 Helobiome			***i=2 Peinobiome***			***i=3 Litobiome***			***i=4 Zonobiome***		
	VR	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***	***VR***	***AAH***	***Q***
$\Delta C_{pools,Def,u,i,t}$	460.3	514.9	569.2	333.8	423.0	444.0	340.8	435.8	451.2	466.4	557.3	576.6
$A_{DefLB,u,i,t}$	48.9	156.9	0.0	65.8	42.0	0.0	0.0	16.6	0.0	126.0	464.7	38.2
$\Delta C_{pools} * A_{DefLB}$	22,529.3	80,781.3	0.0	21,950.8	17,764.3	0.0	0.0	72,41,6	0.0	58,755.5	258,965	22,042.4
$\Delta C_{P,DefLB,i,t}$	$\Sigma_{i:1}$ =103,311			$\Sigma_{i:2}$ =39.715			$\Sigma_{i:3}$ =7.242			$\Sigma_{i:4}$ =339,763		

Source: REDD+ Matavén Project. Folder " calculation_tables " file "VMD0015.xlsx", Sheet " Eq4 " CPDefLB,i ,t "Expos "

4.7 Net $CO_{2\ emissions}$ due to unplanned deforestation displaced from the Project Area to the Leak Belt

CO2 emissions due to unplanned deforestation displaced from the Project Area to the Leak Belt in the periods 2013 and 2014-2015:

$$\Delta C_{LK\text{-}ASU\text{-}LB} = \Delta C P_{,LB} - \Delta C_{BSL,LK,unplanned}$$

Where:

ΔCP ,LB *from table 117 (2013) and table 118 (2014-2015)*
Δ CBSL,LK ,unplanned *: REDD+ Matavén Project. Folder " calculation_tables " File "VMD0007.xlsx", Sheet " P4 Step4.3 Eq24 (LK)C stck chng "*

Net CO2 emissions (*ΔCLK -ASU-LB*) unplanned deforestation shifted from PA to LB. Period 2013 (Table 119 of the PDD)

	i=1 Helobiome	***i=2 Peinobiome***	***i=3 Litobiome***	***i=4 Zonobiome***	***Subtotal***
	t CO2 -e / ha	*t CO2 -e / ha*	*t CO2 -e / ha*	*t CO2 -e / ha*	*t CO2 -e / ha*
$\Delta C_{P,DefLB,i,t}$	59,104	13,850	12,427	97,580	182,960
$\Delta C_{BSL,LK,unplanned}$	119,531	837	0	1,247,094	1,367,463
$\Delta C_{LK\text{-}ASU\text{-}LB}$	**-60,427**	**13,012**	**12,427**	**-1,149,514**	**-1,184,502**

Source: REDD+ Matavén Project. File "VMD0010.xlsx" Sheet " S3 Expost Eq1 CLK- ASU,LB " – " calculation_tables " folder

If ***ΔCLK -ASU-LB<0*** , then ***ΔCLK -ASU-LB=0***

Since ***ΔCLK -ASU-LB*** in 2013 ***<0*** (-1,184,502), then

ΔCLK -ASU- LB *(2013)* = 0

Net CO2 emissions (*ΔCLK -ASU-LB*) unplanned deforestation shifted from PA to LB. Period 2014-2015 (Table 120 of the PDD)

	i=1 Helobiome	*i=2 Peinobiome*	*i=3 Litobiome*	*i=4 Zonobiome*	*Subtotal*
	t CO2 -e / ha	*t CO2 -e / ha*	*t CO2 -e / ha*	*t CO2 -e / ha*	*t CO2 -e / ha*
$\Delta C_{P,DefLB,i,t}$	103,311	39,715	7,242	339,763	490,030
$\Delta C_{BSL,LK,unplanned}$	2,817,428	1,590	547	60,218	2,879,783
$\Delta C_{LK-ASU-LB}$	**-2,714,117**	**38,125**	**6,695**	**279,544**	**-2,389,753**

Source: REDD+ Matavén Project. File "VMD0010.xlsx" Sheet " S3 Expost Eq1 CLK- ASU,LB " – " calculation_tables " folder

If **ΔCLK -ASU-LB<0** , then **ΔCLK -ASU-LB=0**
Since **ΔCLK -ASU-LB** in 2014-2015 **<0** ((-2,389,753), then
ΔCLK -ASU- LB *(2014-2015)* = 0

4.8. Leaks in the 2013 Period

$$\Delta C_{LK-AS,unplanned} = \Delta C_{LK-ASU-LB} + \Delta C_{LK-ASU,OLB} + GHG_{LK,E}$$

Eq.16 VMD0010 LK -ASU

$\Delta C_{LK-AS,unplanned}$	$t\ CO_2$-e ha^{-1}	Net greenhouse gas emissions due to leakage due to change in activity for projects that prevent unplanned deforestation Net CO2 emissions
$\Delta C_{LK-ASU-OLB}$	$t\ CO_2$-e ha^{-1}	Net CO2 emissions due to unplanned deforestation displaced outside the Flight Belt
$\Delta C_{LK-ASU-LB}$	$t\ CO_2$-e ha^{-1}	CO2 emissions due to unplanned deforestation displaced from the project area to the Runaway Belt
$GHG_{LK,E}$	$t\ CO_2$-e ha^{-1}	Greenhouse gas emissions as a result of leakage from activities to prevent deforestation

Net GHG emissions due to leaks due to changes in activity in projects that avoid CO2 emissions due to unplanned deforestation. 2013 (PDD Table 121)

$\Delta C_{LK-ASU-LB}$	$\Delta C_{LK-ASU,OLB}$	$\Delta C_{LK-ASU-PEAT}$	$GHG_{LK,E}$	$\Delta C_{LK-AS,unplanned}$
0	551,946	0	0	551,946

Source: Annex 12 VMD0010, Table 15; File "monitoring.xlsx" section 7.4 and File "VMD0010.xlsx", sheet " S7 Eq16 CLK- AS,unp Expost " (folder " calculation_tables ")

4.9 Leaks in the 2014-2015 Period

Net GHG emissions due to leaks due to changes in activity in projects that avoid CO2 emissions due to unplanned deforestation. 2014-2015 (Table 122 of the PDD)

$\Delta C_{LK-ASU-LB}$	$\Delta C_{LK-ASU,OLB}$	$\Delta C_{LK-ASU-PEAT}$	$GHG_{LK,E}$	$\Delta C_{LK-AS,unplanned}$
0	1,064,006	0	0	1,064,006

Source: Annex 12 VMD0010, Table 15; File "monitoring.xlsx" section 7.4 and File "VMD0010.xlsx", sheet " S7 Eq16 CLK- AS,unp Expost " (folder " calculation_tables ")

4.10 Leaks in the Periods 2013 and 2014-2015

Net GHG emissions due to leaks due to changes in activity in projects that avoid CO2 emissions due to unplanned deforestation. 2013 and 2014-2015 (Table 123 of the PDD)

$\Delta C_{LK-ASU-LB}$	$\Delta C_{LK-ASU,OLB}$	$\Delta C_{LK-ASU-PEAT}$	$GHG_{LK,E}$	$\Delta C_{LK-AS,unplanned}$
0	1,615,952	0	0	1,615,952

Source: Annex 12 VMD0010, Table 15; File "monitoring.xlsx" section 7.4 and File "VMD0010.xlsx", sheet " S7 Eq16 CLK- AS,unp Expost " (folder " calculation_tables ")

5. Net GHG emissions reductions 2013

(Annex 9 VM0007, REDD-MF)
GHG Emissions Reduction Summary

$$NER_{REDD} = \Delta C_{BSL-REDD} - \Delta C_{WPS-REDD} - \Delta C_{LK-REDD}$$

Eq.2 VM0007 REDD-MF

NER_{REDD}	t CO2e	Total net GHG emission reductions of the REDD project activity up to year t*
$\Delta C_{BSL-REDD}$	t CO2e	Net GHG emissions in the REDD baseline scenario up to year t*
$\Delta C_{WPS-REDD}$	t CO2e	Net GHG emissions in the REDD project scenario up to year t*
$\Delta C_{LK-REDD}$	t CO2e	Net GHG emissions due to leakage REDD project activity up to year t*

Total net GHG reductions from the activities of the REDD+ Matavén Project. 2013 (Table 124 of the PDD)

	Baseline emissions or removals (tCO_2e) $\Delta C_{BSL,unplanned}$	Project emissions or removals (tCO_2e) ΔC_{WPS}	Emissions from leaks (tCO_2e) $\Delta C_{LK-AS,unplanned}$	Net reductions or removals of GHG emissions (tCO_2e) NER_{REDD}
2013 period	5,151,681	130,884	551,946	4,468,852

Source: File "monitoring.xlsx", section "7.5 GHG Emission Reductions and Removals " 2013 (folder " calculation_tables ")

Uncertainty analysis 2013:
(Annex 16 VMD0017, Uncertainty)
Uncertainty analysis was performed to fit NERREDD .

Adjusted_NER $_{REDD}$ *= 4,468,851.93 *(100% - 15% + 15 %) = 4,468,851.93 t* CO_2 *-e*

Uncertainty does not exceed 15%, it is ***8.4%.*** (*File "VMD0007.xlsx", sheet "Selva Matavén soils", folder " calculation_tables "*)

Buffer 2013:
(Annex 9 VM0007, REDD-MF)

A final discount was made due to Buffer for Risk of Non-Permanence
Equation 9 of the VCS VM0007 REDD-MF was used, the same as it was applied in the Baseline

Thus, the final result is:
UNPLANNED Buffer = ((5,151,681.43– 0) – (130,883.97– 0)) * 17% = 853,536 t CO2 -e UNPLANNED Buffer = 853,536 t CO2 -e

VCUs 2013:
Equation 13 VCS VM0007 REDD-MF was used, the same as it was applied in the Baseline

Number of Carbon Units Verified in the period 2013 (Table 125 of the PDD)

	NER $_{REDD}$	*Adjusted NER* $_{REDD,t}$	*Buffer* $_{UNPLANNED}$	*VCU* $_t$
2013 period	4,468,852	4,468,852	853,536	3,615,316

Source: Based on File "monitoring.xlsx", section "7.5 GHG Emission Reductions and Removals / VCUt " (" calculation_tables " folder)

6. Net GHG emissions reductions 2014-2015

(Annex 9 VM0007, REDD-MF)
GHG Emissions Reduction Summary

Total net GHG reductions from the activities of the REDD+ Matavén Project. 2014-2015 (Table 126 of the PDD)

	Baseline emissions or removals (tCO_2 e) ΔC BSL $_{,unplanned}$	**Project emissions or removals (tCO_2 e) ΔC $_{WPS}$**	**Emissions from leaks (tCO_2 e) ΔC $_{LK-AS,unplanned}$**	**Net reductions or removals of GHG emissions (tCO_2 e) NER $_{REDD}$**
Period 2014-2015	10,233,184	399,956	1,064,006	8,769,222

Source: File "monitoring.xlsx", section "7.5 GHG Emission Reductions and Removals " 2014-2015 (" calculation_tables " folder)

Uncertainty analysis 2014-2015:
(Annex 16 VMD0017, Uncertainty)
Uncertainty analysis was performed to fit NERREDD .

Adjusted_NER $_{REDD}$ *= 8,769,222.07 *(100% - 15% + 15 %) = 8,769,222.07 t* CO_2 *-e*

*Uncertainty does not exceed 15%, it is **8.4%.*** (*File "VMD0007.xlsx", sheet "Selva Matavén soils ", folder " calculation_tables "*)

Buffer 201 4-2015:
(Annex 9 VM0007, REDD-MF)

$_{UNPLANNED}$ Buffer = ((10,233,183.83– 0) – (399,955.71– 0)) * 17% = 1,671,649 t CO2 -e $_{UNPLANNED}$ Buffer = 1,671,649 t CO2 -e

VCUs 2014-2015:

Equation 13 VCS VM0007 REDD-MF was used, the same as it was applied in the Baseline

Number of Carbon Units Verified in the period 2014-2015 (Table 127 of the PDD)

	NER $_{REDD}$	***Adjusted NER*** $_{REDD,t}$	***Buffer*** $_{UNPLANNED}$	***VCU*** $_t$
Period 2014-2015	8,769,222	8,769,222	1,671,649	7,097,573

Source: Based on File "monitoring.xlsx", section "7.5 GHG Emission Reductions and Removals / VCUt " (" calculation_tables " folder)

Number of Carbon Units Verified in the period 2014-2015 (Table 129 of the PDD)

	NER $_{REDD}$	***Adjusted NER*** $_{REDD,t}$	***Buffer*** $_{UNPLANNED}$	***VCU*** $_t$
2013 period	4,468,852	4,468,852	853,536	3,615,316
Period 2014-2015	8,769,222	8,769,222	1,671,649	7,097,573
Total	13,238,074	13,238,074	2,525,184	10,712,890

Source: Based on File "monitoring.xlsx", section "7.5 GHG Emission Reductions and Removals / VCUt " (" calculation_tables " folder)