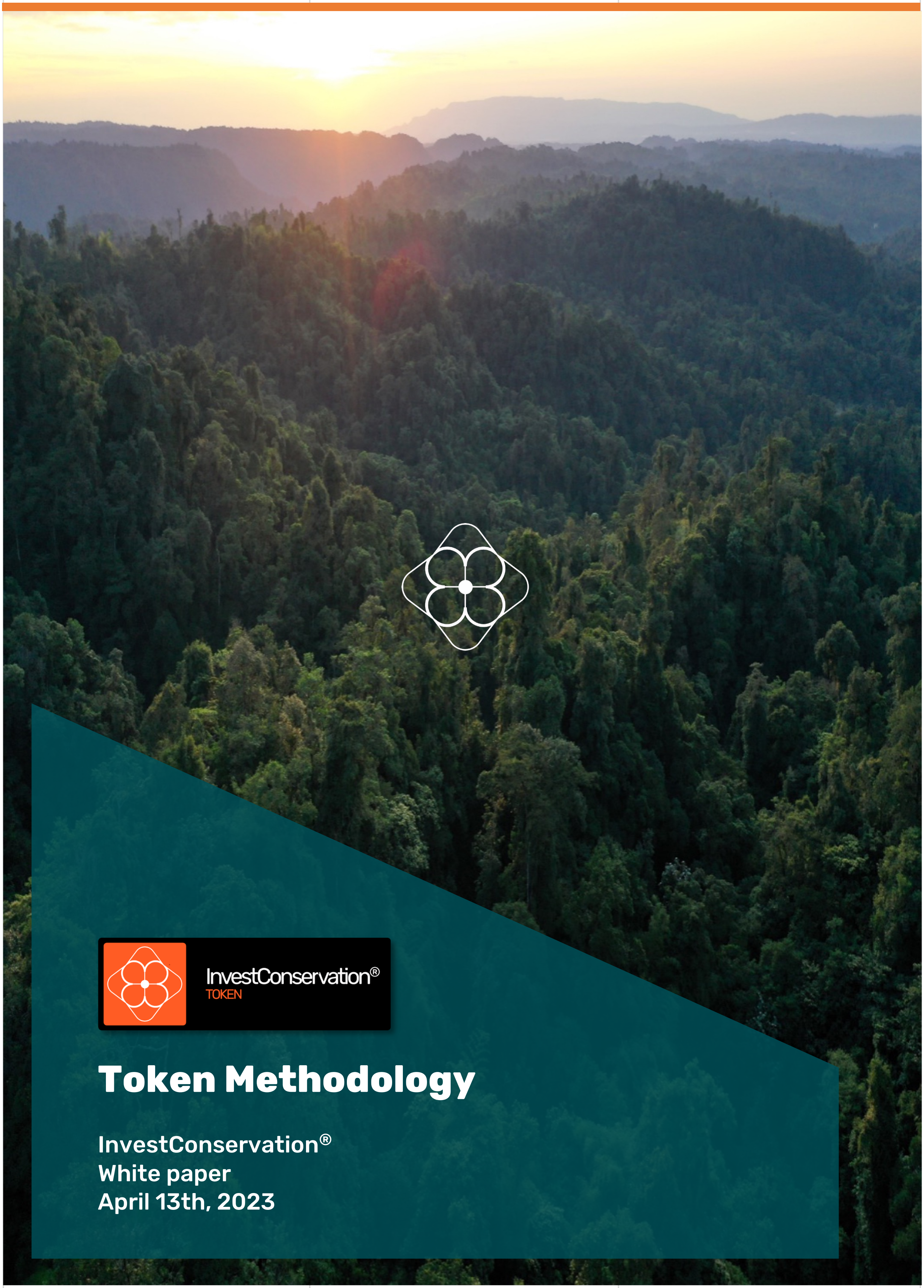

InvestConservation®
TOKEN

Token Methodology

InvestConservation®
White paper
April 13th, 2023

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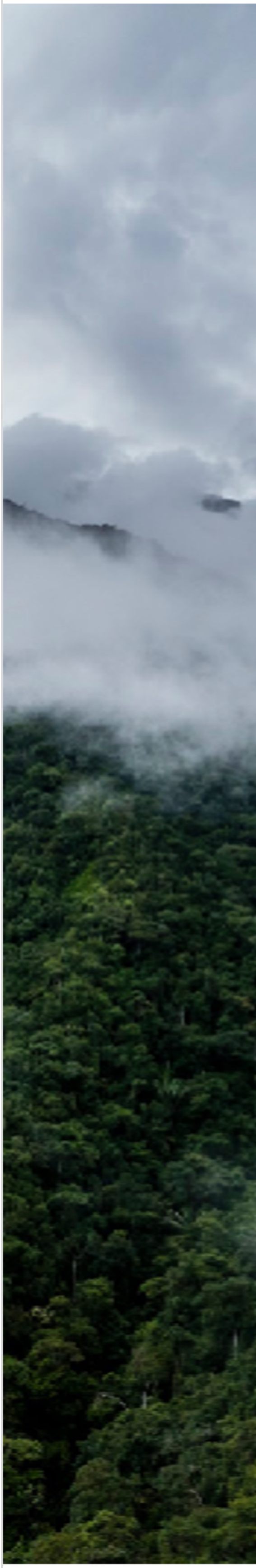
1.0 Overview

This White Paper details the methodology behind the InvestConservation® Token standard.

The standard has been developed with the specific aim of promoting the conservation of biodiversity hotspots in threatened tropical forests. Biodiversity hotspots, as defined by Conservation International (Mittermeier et al. 2004), cover just 2.5% of the world but hold 43% of threatened species. Tropical deforestation is the most important factor behind loss of biodiversity and species extinctions and 30 years of carbon markets have neither halted tropical deforestation nor created a price signal favouring tropical conservation.

The purpose of this paper is to define a methodology which reflects the biodiversity and climate impact from the conservation of tropical forests and to promote investments that fund tropical forest conservation projects with minimum diversion to consultants and market-makers.



1.1 The Climate Impact of Tropical Deforestation

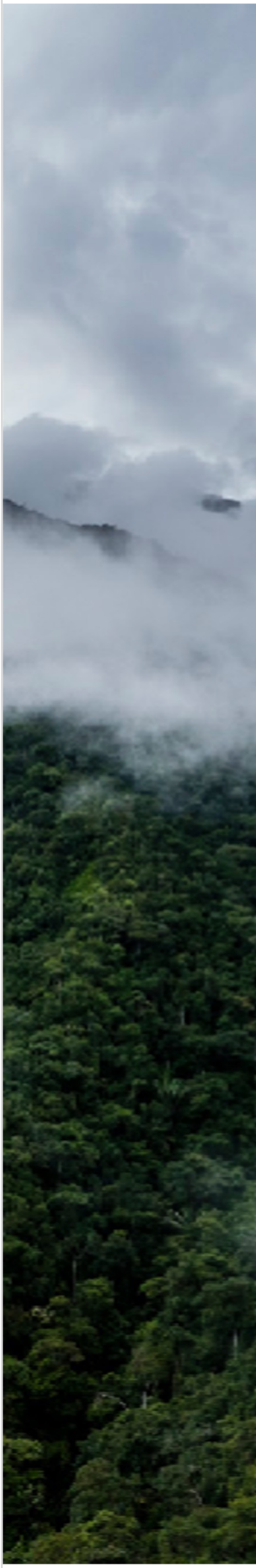
Continental wide peer-reviewed data indicates that tropical deforestation, at the deforestation frontier, in Latin America, Asia and most likely Africa too, has likely averaged around 1% per annum over the past few decades (see discussion in Section 5.3).

From a climate change perspective each ton of carbon is not equal; a ton of avoided deforestation in the tropics is 2.5 times more valuable than a ton conserved/sequestered in a temperate latitude (Lawrence, 2022). This is because biophysical feedback mechanisms magnify the impact of carbon emissions from tropical deforestation by approximately 50%, primarily through reduced long-term precipitation and increased fire risks (Leite et al, 2021, Lawrence 2022).

The focus of avoided deforestation carbon is typically on the above-ground stored carbon, however the more gradual loss of below-ground carbon that arises from conversion to plantations or agriculture also has a material impact, estimated to average approximately 50% of the lost above ground standing carbon (Ngo, 2013) (Novita, 2020) (de la Cruz-Amo, 2020).

Conserved forests will also see ongoing carbon sequestration from continuing forest restoration and regeneration in habitats that have had prior human impact (Spracklen, 2016).

We believe that combining avoided above-ground emissions, avoided below-ground emissions, biophysical feedback loops, and extrapolated sequestered carbon (from forest restoration) shows that the net impact of tropical forest conservation on climate could be modelled at over 2% per annum of the above ground standing carbon.



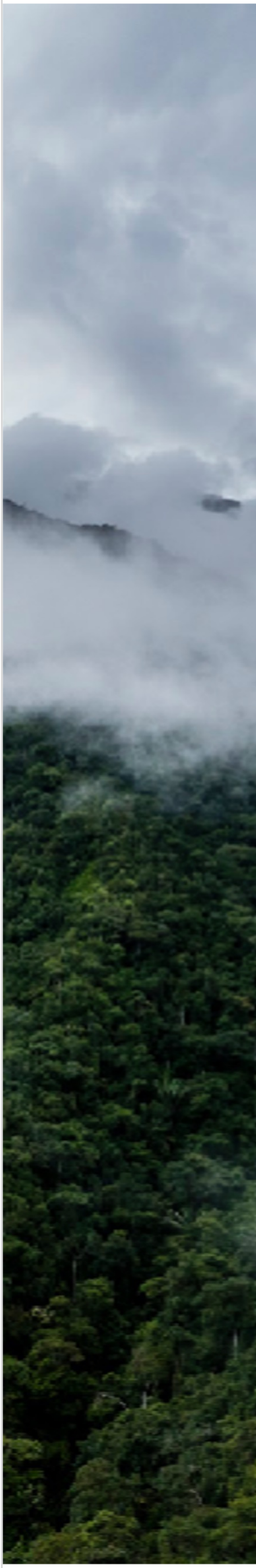
Therefore, conservation of tropical forests is particularly critical in terms of its impact on climate change. Funding conservation reserves can have two further multiplier effects on reducing carbon emissions.

- To the extent that the reserve is buffering other notionally protected areas from further encroachment, there will be a multiplier effect on avoided deforestation in those areas.

- By creating income for high conservation value forests, the InvestConservation® Token methodology will promote the creation and expansion of further reserves. The aim is that the income obtained through InvestConservation® token sales enable landowners to obtain reliable, long-term income from protecting forests. With sufficient income yield, it can make the protection of tropical forests more profitable than their destruction.

Conservation reserves are one of the few forms of environmental investment that provide this positive additionality i.e., each tonne of sequestered carbon will result in a greater than one tonne impact on climate since there is further carbon sequestration in both new reserves and better protected neighbouring areas.

Existing carbon standards do not adequately promote the conservation of tropical forests, which need investment in the range of U$19-32 billion per year (Deutz et al. 2020). Only 3% of carbon funding has been directed towards tropical forests (Gibbs, 2018) (Harris, 2018) and even then, it is unclear how much of this 3% is targeted to the protection of threatened forests with high biodiversity value (as opposed to remote forests facing few immediate threats or plantation species with little to no impact on conserving biodiversity and potential questions regarding whether net additionality is achieved).



1.2 The Biodiversity Impact of Conservation Reserves

The establishment of conservation reserves is the most effective strategy to protect biodiversity. It is based on a model of land sparing where land is set aside for biodiversity protection. Historically, land sparing has been a more effective conservation approach than alternative regimes integrating biodiversity conservation and food production on the same land (Phalan et al. 2011. Edwards et al. 2015).

Private reserves can be very effective in saving threatened species, even if these reserves are not extremely large (Wilson & Rhemtulla 2018). The criteria InvestConservation® uses are that reserves are large enough (>250 ha) to maintain populations of endangered species, situated in areas that are under immediate threat of deforestation, and /or buffer larger protected areas where effective protection may be lacking.

2.0 Methodology – General Principles

InvestConservation® Token methodology rests on clearly defined principles of :

1. **Strict Eligibility.**

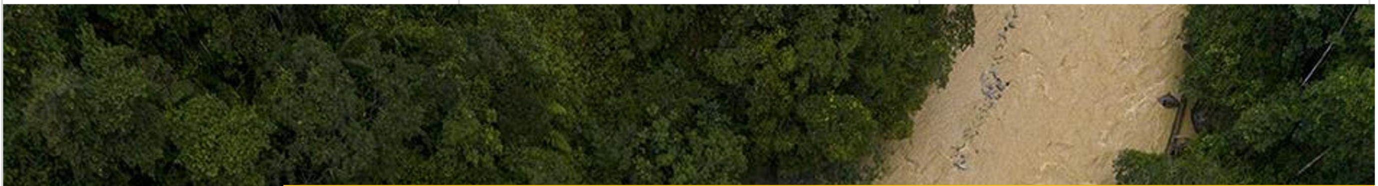
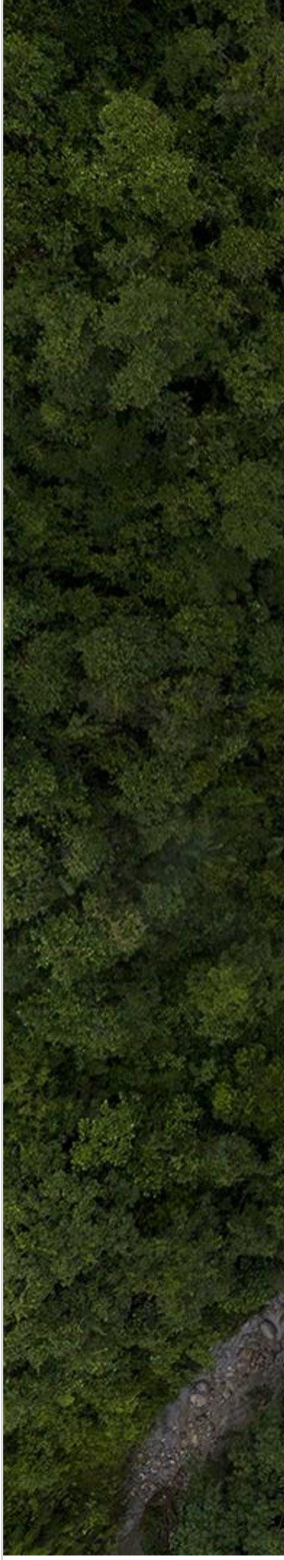
   Forests are required to be:
   - Tropical:
   - at the deforestation frontier
   - of high conservation value, i.e., within a biodiversity hotspot or mega-biodiverse region, such as the Amazon. This assessment is based upon published information (see Ferrer et al. 2019 for the Americas)
   - permanently conserved
   - larger than 250 ha contiguous area
   - privately or community owned – government reserves are better handled through NDCs at a supra-national level

2. **Accreditation:**

   The Conservation Advisory Board ("Advisory Board") in approving the eligibility of a reserve considers
   a) conservation capability and legal title of the landowner,
   b) conservation value and threat levels of the forest.

3. **Public accounting:**

   Tokens are issued and traded on the low energy Solana blockchain.

4. Auditing and Rectification:

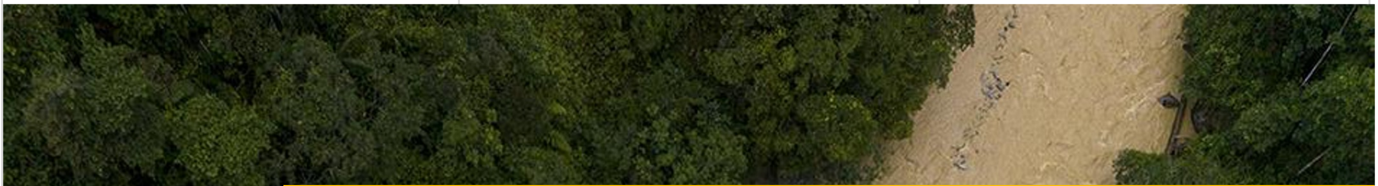
I. Satellite technology is employed to provide an annual update on the quality of the conserved forest confirming that forest destruction or degradation has not occurred.

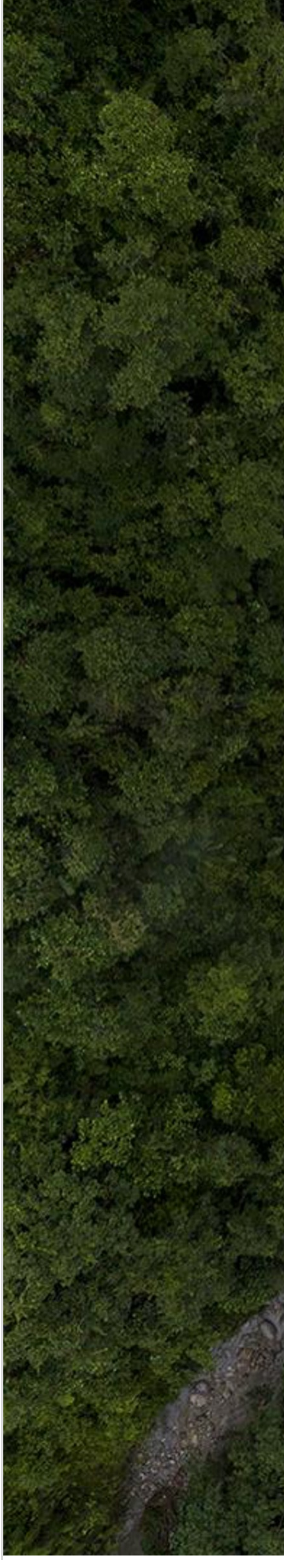
(1) In the event that destruction of a tokenized area has occurred then the landowner will be required to "rectify" the deforestation. If the landowner " rectifies " the problem through a management plan that is to the satisfaction of the Advisory Board including steps that will both prevent any further deforestation, and will allow the deforested area to fully recover, then token issuance may proceed providing that the area to be tokenized in that reserve will be reduced by an amount equal to 50 times the deforested area.

(2) If the deforestation is not addressed the landowner will not be allowed to issue any further tokens over the reserve in question.

Since no more than 2% of land is tokenized each year, the impact for the investor is limited, while excising a 50 times larger area of the reserve represents a significant economic loss to the landowner. This approach motivates landowner to effectively protect their land, while reducing risks to investors.

II. Publicly available reports published by InvestConservation® allow third parties to assess the efficacy of different landowners in achieving their stated goals.



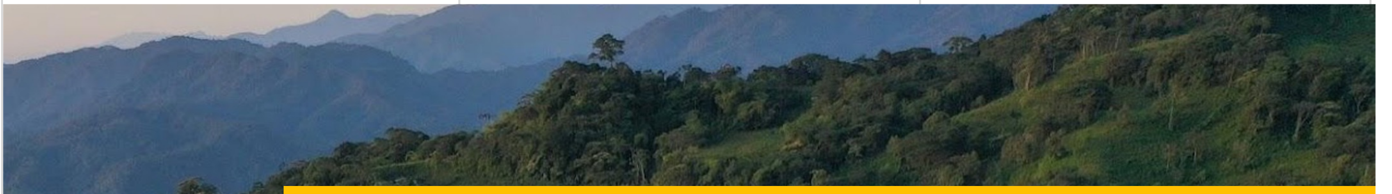


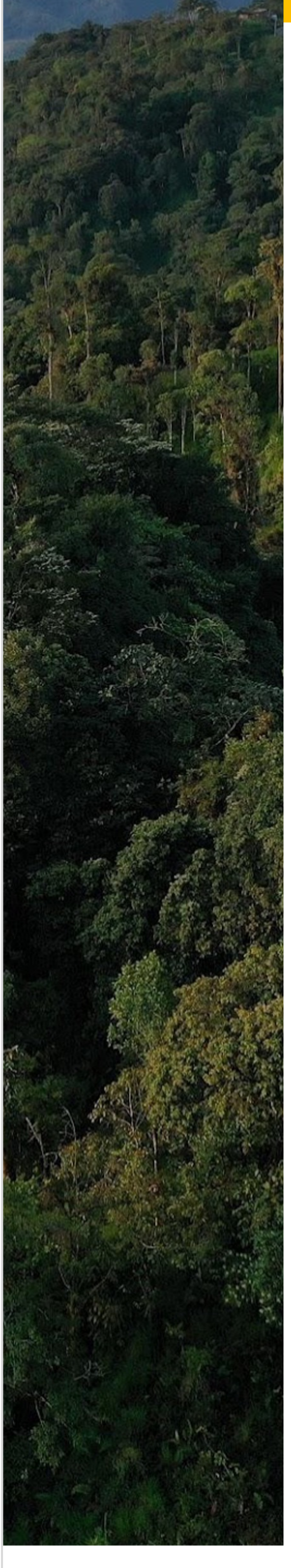
5. Objective carbon calculations:

I. Climate benefits through carbon sequestration resulting from regrowth, regeneration and active reforestation (“active sequestration”) or avoided deforestation calculated as the standing carbon in conservation reserves that would have been lost had the reserve not been established (“avoided deforestation”). These calculations reflect long-term data and impact on climate.

II. Standing carbon is assessed though satellite data or specific carbon assessments of the reserve or similar habitat.

III. Offset carbon from avoided deforestation is calculated as a function of standing carbon, assessed deforestation rate and is based on 50 years token issuance program.





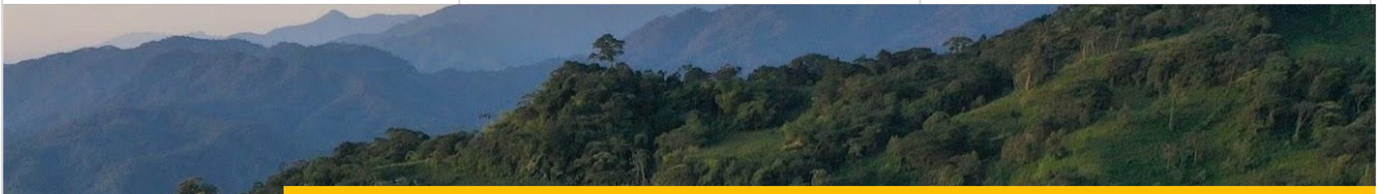
2.1 Reserve Eligibility

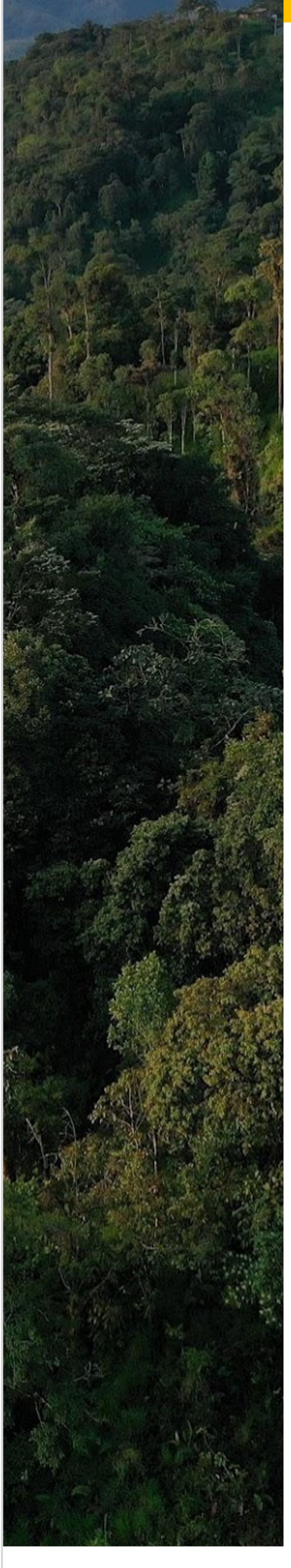
This standard is tailored for, and aims to address, tropical deforestation pressures. For a forest to be eligible for carbon calculation under the InvestConservation® Token standard, the following criteria must be satisfied:

2.1.1 Tropical Forest
The forest is located between 30oN and 30oS. These forests in aggregate have the greatest impact on global biodiversity and the greatest biophysical impact on climate change. Their relative quick growth on previously disturbed land also facilitates carbon uptake as well as accurate assessments of the effectiveness of protection.

The dominant habitat should be forest – the carbon imperatives behind grassland, wetland or paramo conservation will vary and are best dealt with under separate regimes or standards.

2.1.2 Deforestation Frontier
These are intact areas, highly susceptible to human pressures. Proxies for measuring susceptibility to human pressures are that the forest must be accessible by road or river, or close (within 30km), and reasonably accessible to, a material human settlement or be subject to logging (such as a logging concession). Accessibility by road is consistently among the strongest drivers of deforestation (Curatola et al. 2015). The purpose of this standard is to encourage effective and rapid conservation, not the creation of national reserves in areas with low threats.





2.1.3 High conservation value

The forest must have sufficient ecological integrity that it still protects high levels of biodiversity and/or globally threatened species and/or has sufficiently low fragmentation that it will be of increasing value as the forest regenerates/restores. This judgement will be made by the Advisory Board based on IUCN threat categories for species and global datasets such as Conservation International's biodiversity hotspots, Key Biodiversity Areas (https://www.keybiodiversityareas.org/), Half Earth and others.

2.1.4 Permanent conservation

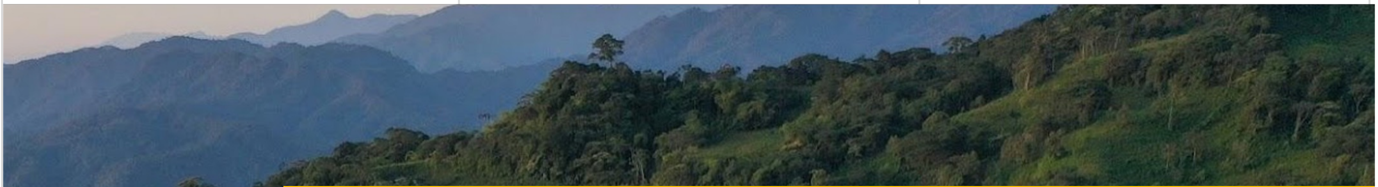
Landowner is committed to conserving area on a permanent basis.

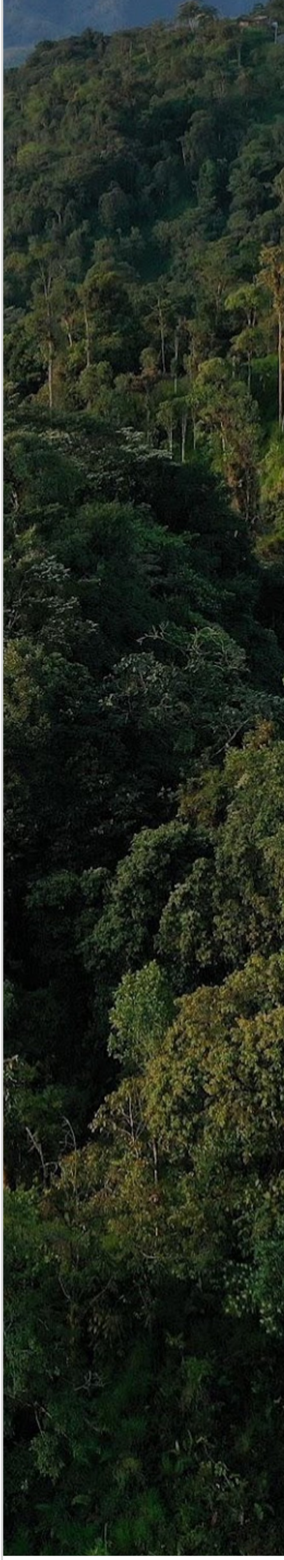
2.1.5 Sufficient size

Land area (including separate but contiguous reserves and national parks) is larger than 250 ha. Commercial and conservation objectives both preclude, focusing on very small areas, as these tend to lose species over time due to stochastic events.

2.1.6 Private or Community Ownership

Land is owned by private sector parties that can commit to the conservation of the land. This precludes government owned national parks which can be accredited through NDC obligations at a governmental and inter-governmental level.





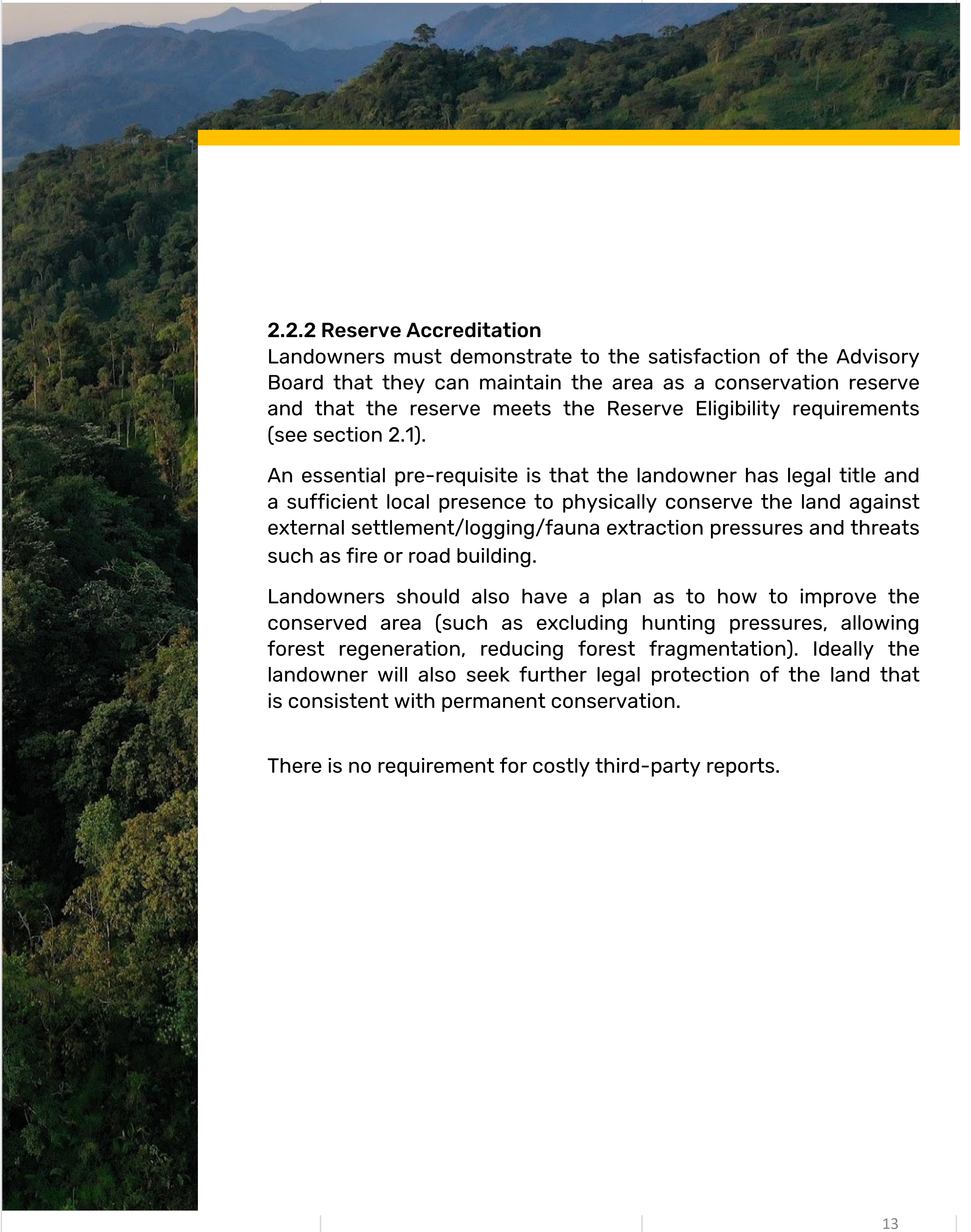
2.2 Accreditation

2.2.1 Conservation Advisory Board

The Advisory Board is responsible for approving the eligibility of a reserve. Its objective is to protect the integrity of the InvestConservation® Token methodology and maintain a focus on the conservation of the world's most threatened habitats and species. The board is chaired by an eminent conservation biologist.

The larger role of the Advisory Board is to ensure that the roll-out of the InvestConservation® Token standard prioritizes biodiversity hotspots and regions to maximise conservation impact with the available resources (demand for tokens).

The Advisory Board will assist in developing high quality projects, confirming conservation bona fides of landowners and advising landowners on appropriate long-term conservation plans and strategies including the use of funds received from the InvestConservation® Token program. For Token Investors, the Advisory Board role is to ensure that token purchases allow funds to flow to projects with disproportionate impact for meeting global conservation priorities.



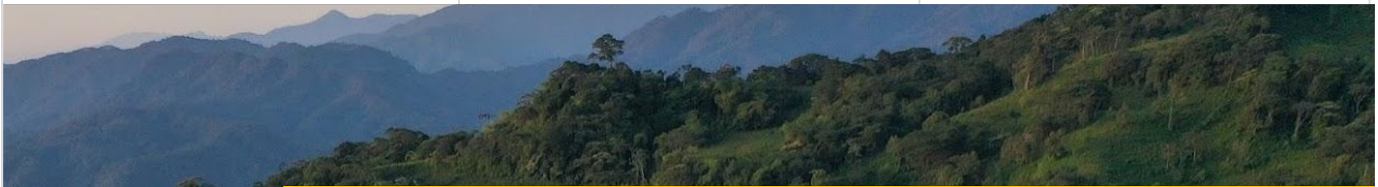
2.2.2 Reserve Accreditation

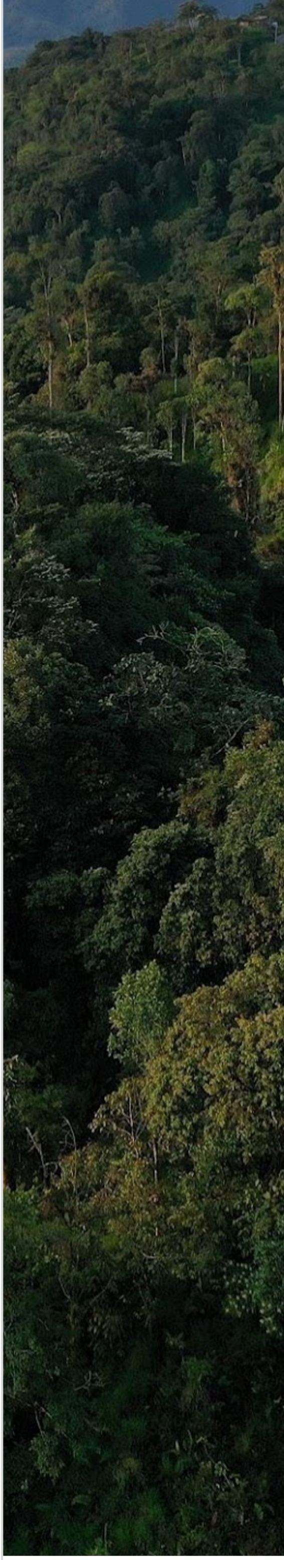
Landowners must demonstrate to the satisfaction of the Advisory Board that they can maintain the area as a conservation reserve and that the reserve meets the Reserve Eligibility requirements (see section 2.1).

An essential pre-requisite is that the landowner has legal title and a sufficient local presence to physically conserve the land against external settlement/logging/fauna extraction pressures and threats such as fire or road building.

Landowners should also have a plan as to how to improve the conserved area (such as excluding hunting pressures, allowing forest regeneration, reducing forest fragmentation). Ideally the landowner will also seek further legal protection of the land that is consistent with permanent conservation.

There is no requirement for costly third-party reports.





2.3 Public Accounting

The use of blockchain technology will ensure a transparent and permanent record of token issuance and trading. Tokens are issued on (https://store.investconservation.com/).

Once issued, they can be traded on the low energy Solana blockchain. Token ownership can be tracked on the public and decentralized ledger that is the blockchain.

2.4 Auditing

Satellite technology and analysis is employed to provide an annual update on the quality of the conserved forest, confirming that forest destruction or degradation has not occurred.

Within the conservation reserve, the investors can elect (subject to commercial agreement) for the monitoring to provide a combination of camera traps, live audio and live video that will allow investors to monitor, in close to real-time, the conservation performance of the reserve. Data will be collected in such a form such that AI will be used to identify species observed in the reserve, so that scientific data is continuously improving.

2.5 Carbon Calculations

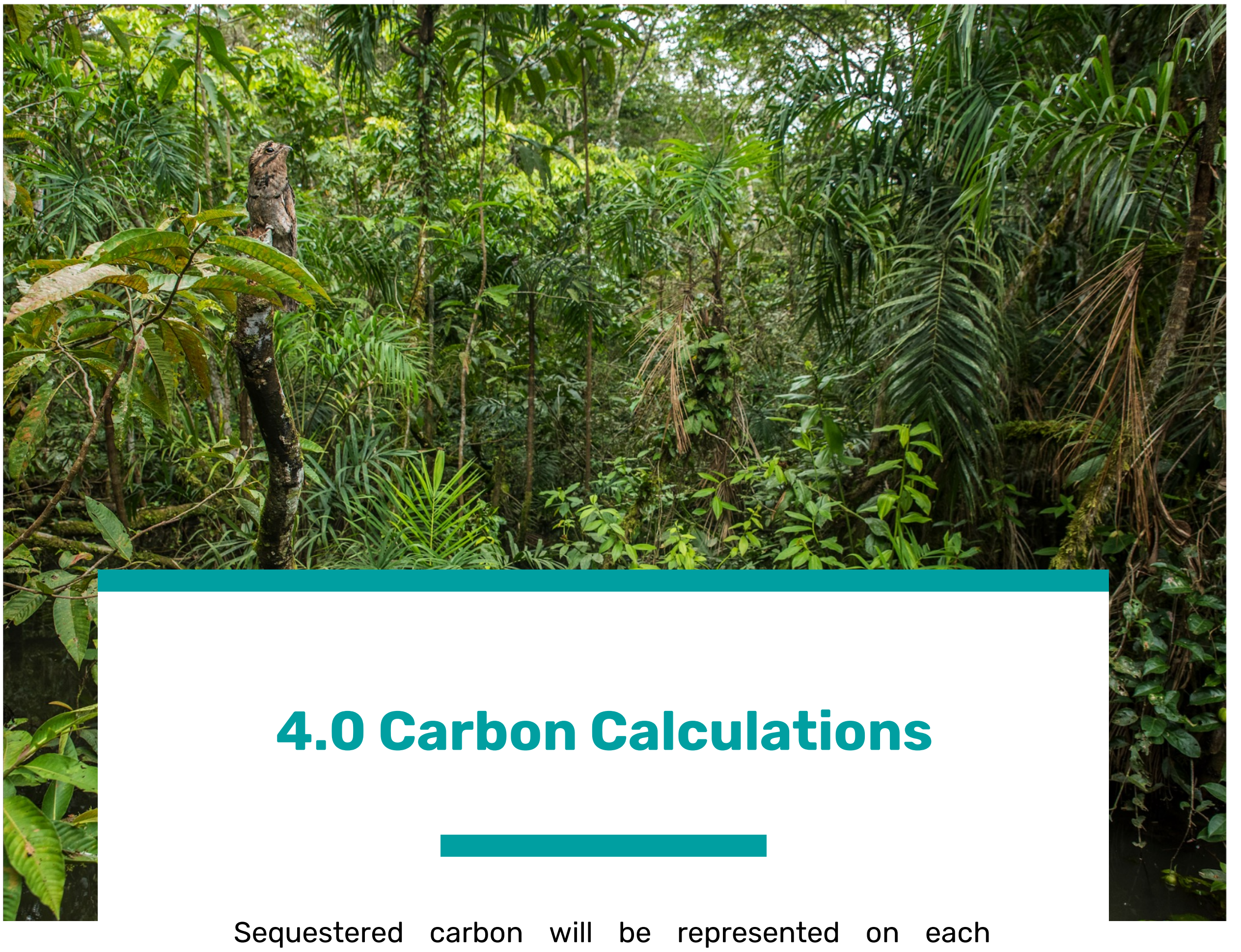
Carbon sequestration will be reported based on either the Avoided Deforestation or Sequestered Carbon methodologies outlined in sections 4.1 and 4.2 respectively.

3.0 Reporting and use of funds

Annual, publicly available reports, published by InvestConservation® will allow third parties to assess the efficacy of different landowners and different reserves in achieving their stated goals. Reports will include a conservation report from the landowner and an independent satellite audit review.

Landowner reports include an annual summary of activities carried out, a conservation update, including sightings of threatened species, and of the overall intactness of the reserve.

Funding from Token sales will pay for the operating costs of the reserve, including staff salaries, infrastructure development and maintenance, and reserve expansion as appropriate.

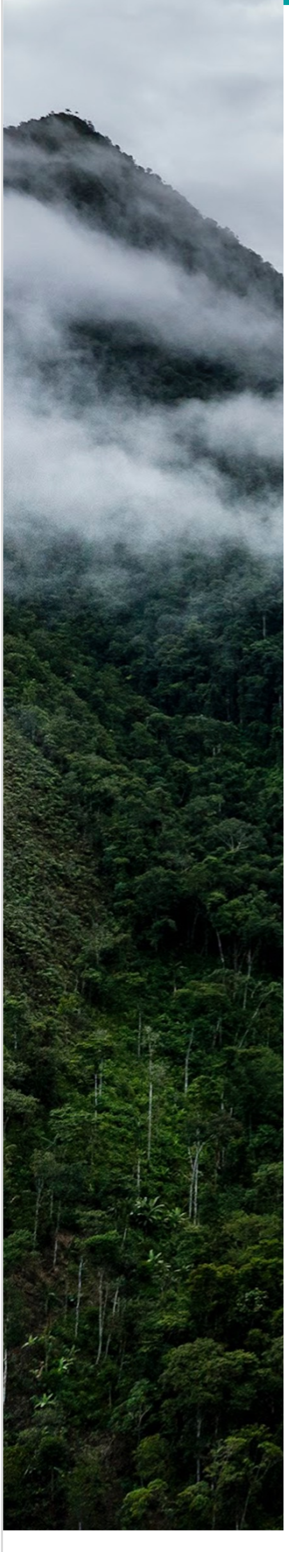


4.0 Carbon Calculations

Sequestered carbon will be represented on each token. Carbon will be calculated as either a function of standing carbon and assessed deforestation rates (avoided deforestation) or as a function of independently assessed carbon sequestered over time and by habitat type and age class (sequestered carbon).

The cost and time of undertaking property specific carbon surveys that pick up both the standing carbon and the carbon from forest restoration/regeneration has been a major impediment to the widespread accreditation of carbon sequestered from avoided deforestation (REDD+ projects).

Despite that being the case, these specific surveys have failed to shield investors from false claims as revealed by various sources, e.g.(https://www.theguardian.com/environment/2023/jan/18/revealed-forest-carbon-offsets-biggest-provider-worthless-verra-aoe).



To ensure that the standing carbon of all qualifying conservation reserves can be evaluated, satellite imagery, global databases and prior published data will be used, where feasible, to provide independent data to the satisfaction of the Advisory Board.

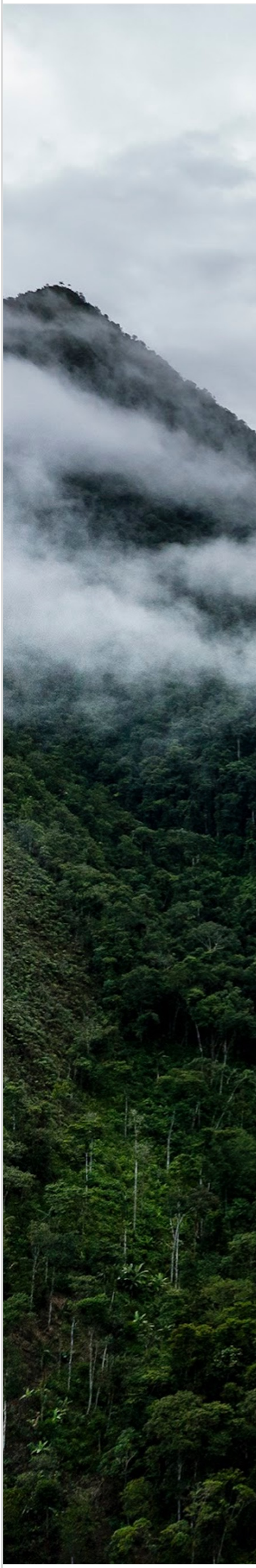
The methodology explicitly prioritizes accessibility and speed of action rather than pursuing potentially spurious rigor in carbon calculations. The costs of site-specific evaluations are typically borne by both the conservation organizations and the investors and slow the speed of implementation. If investors prefer or require such evaluations, then these could be funded prior as part of a commercial agreement.

4.1 Avoided Deforestation Calculation Methodology

Carbon from avoided deforestation is a function of standing above ground carbon, assessed rate of deforestation in a reference area, and the rate of token issuance.

4.1.1 Standing Above Ground Carbon
First and preferred source of data are published or independently contracted assessments. If such a study has been carried out in a reserve, then this will be used. If no such assessment has been carried out, the Advisory Board will seek to make a judgement using published data in forests with a similar structure (e.g. rainfall, latitude, altitude, forest composition).

Second source of data is from satellite analysis of standing above ground carbon. Over time these data sources are expected to continue to improve in accuracy.



Third source of data is from global databases, maintained by the World Bank and the Smithsonian Institute.
(https://datacatalog.worldbank.org/search/dataset/0040227; https://forc-db.github.io/).

The final conclusion as to standing carbon per hectare will be at the discretion of the Advisory Board.

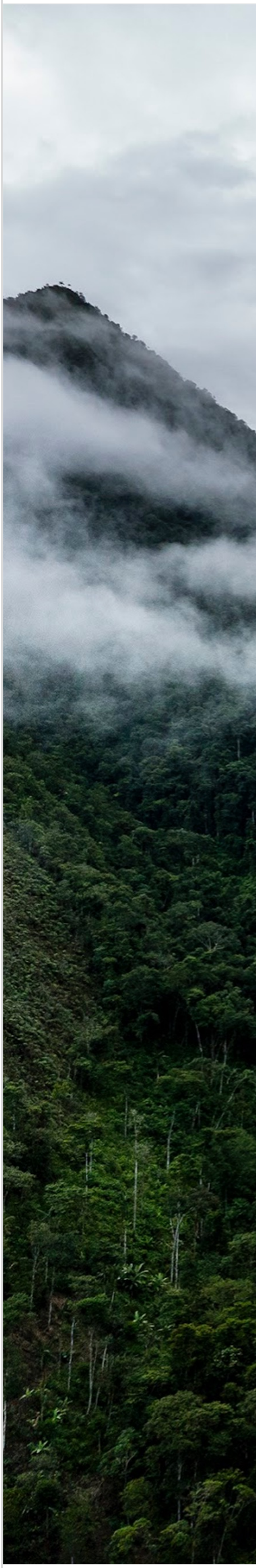
4.1.2 Rate of Deforestation

Using satellite analysis, Advisory Board will determine the rate of deforestation within a 150 km radius of the focal area. The measurements exclude land with timber plantation, land that has already been cleared or that is formally protected. Natural forests are included only within a band of 500m above and below the focal area, as deforestation rates can vary tenfold depending on elevation (Tapia-Armijos et al. 2015). To assess deforestation rates, which fluctuate according to market developments, the Advisory Board measures the rate of clearance of natural forests over a 10 year period.

If investors require a regular five-year update of deforestation rates, the assessed carbon measurements for new tokens issued will be adjusted accordingly.

4.1.3 Rate of Token Issuance

Tokens will be issued over a period of 50 years i.e., 2% of the reserve will be tokenized each year. The assessed carbon will then be calculated as the standing carbon adjusted for the variation between deforestation rate and the rate of token issuance. For instance, a 1% deforestation rate would result in the following calculation:



Assessed Carbon	= Standing Carbon X Deforestation rate / Token = Standing Carbon X 1% / 2% Issuance rate = 50% or Standing Carbon

Note 1: A corollary is that at a 1% deforestation rate only half of the standing carbon will be assessed over 50 years. The remaining standing carbon will be an effective buffer comprising the carbon from avoided deforestation beyond a 50-year horizon.

Note 2: Where a reserve includes early-stage regeneration or has cleared lands then the tokenizable area will need to be reduced (unless the carbon calculations have already been reduced with reference to these areas) for the model of avoided deforestation.

4.2 Sequestered Carbon Calculation Methodology

Where there is a published or independently contracted assessment of annually sequestered carbon, then this may be used as an alternative to the avoided deforestation methodology.

If sequestered carbon is used, then there can be no benefit from double counting the avoided deforestation (although there is a strong case that the benefits double up).

Where full carbon sequestration has been estimated with reasonable precision, then the sequestration number shall not be limited to above ground carbon but may also include the increments from soil and below ground carbon that are important where peatland is present.

In most sequestration regimes, there are varying sequestration rates by age class of forest. In calculating the annual sequestration over time, the Advisory Board will adjust calculations over time to reflect the changing composition and growth rate of plants.

If sequestration gradually declines over time the Advisory Board may choose to use an average sequestration number or an asymptotic model to estimate annual carbon uptake.

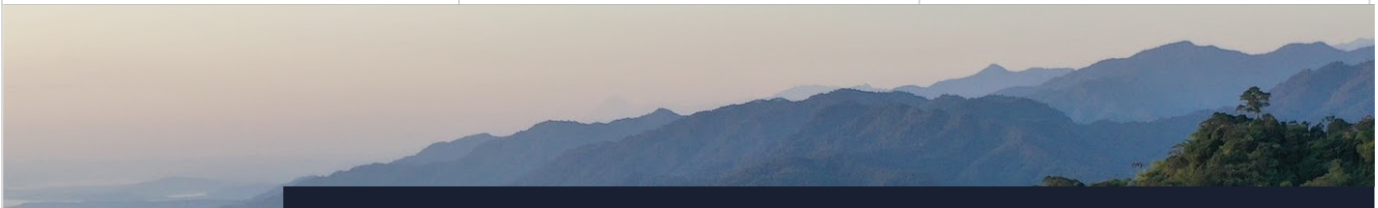
5.0 Supporting Information on Impact of Tropical Deforestation

IC-Tokens® are being issued to investors, seeking to make maximum impact through their carbon and /or biodiversity programs. Published data discussed below show the outsized influence that tropical deforestation has had on climate.

5.1 Tropical deforestation as a prime driver of climate change

In any attempts to address climate change, halting tropical deforestation will be a key component. If tropical tree cover loss continues at the current rate, it will be nearly impossible to keep warming below the pledged two degrees Celsius (3.6 degrees Fahrenheit) (Gibbs, 2018). To put it differently, if tropical deforestation were a country, it would rank third in carbon dioxide-equivalent emissions, only behind China and the United States of America and larger than all of Europe (Gibbs, 2018).

To date forests have received just 3 percent of available climate mitigation finance, despite being capable of providing 23 percent of the solution (Gibbs, 2018) (Harris, 2018) . Since nearly 95% of the world's deforestation occurs in the tropics (Curtis, 2018), the focus on halting deforestation should also be concentrated in the tropics.



5.2 Tropical deforestation and biodiversity loss

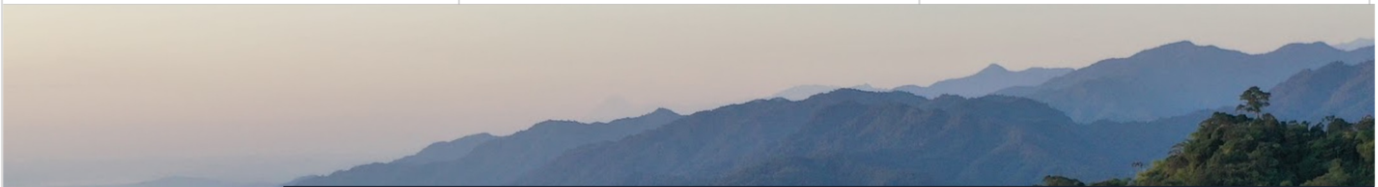
Tropical forests support around two-thirds of life on earth despite covering less than 10% of the earth's surface (Raven, 1988).

The rate of tropical deforestation is the primary driver behind the human induced ongoing sixth mass extinction. It is estimated that if tropical deforestation was to proceed linearly at the current rate, then rates of extinctions would be at "two or more orders of magnitude higher than extinction rates associated with four of the five previous mass extinction events (Ordovician, Devonian, Permian, and Triassic), comparable to the rate associated with the Cretaceous event, and ~2,000–20,000 higher than the background rate of extinctions (Giam. 2017).

5.3 Average Rates of Tropical Deforestation at the Deforestation Frontier

For tropical forests, the deforestation frontier is a major threat to biodiversity and survival of species. The deforestation frontier is defined as intact areas highly susceptible to human pressures, and a 1% deforestation rate over the past few decades is consistent with conservative reports of deforestation on a local and regional level.

From 2001-2012, continental averages for deforestation were 5.4% for Latin America, 3.9% in Africa and 8.1% in Asia i.e. annual continental deforestation rates of 0.5%, 0.35% and 0.75% respectively (Fritz, 2022). However, within these averages there are much lower deforestation pressures in remote intact forests well removed from roads and population centres. The implication of this is that there is a much higher deforestation rate close to roads and population centres. Moreover, the loss of tropical forests has doubled when comparing more recent data (2015-2019) with those reported during 2001-2005 (Feng et al. 2022).



For the Amazon as a whole, 1.8% of tree cover was lost during the 10 years from 2008 to 2018; an effective deforestation rate approximating 0.18% per annum (Butler, 2018). The Amazon forests comprise approximately 5.5 million km^2 or approximately 65% of the total 8.45m km2 of neotropical forests (FAO, Global Forests Resource Assessment, 2020). So average neotropical deforestation rates outside of the Amazon are approximately 1.1%. Even this number is likely to be too conservative as an estimate of deforestation pressures at the deforestation frontier (as it also includes relatively remote forests in the denominator).

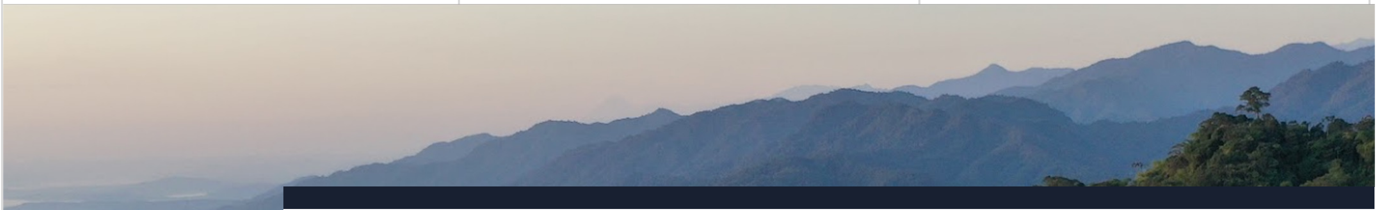
Continental average deforestation = 'Amazon as % of neotropical forests' x 'Amazon deforestation + Other Neotropical forests as % of neotropical forests' x 'Neotropical deforestation'.

Therefore, 0.5% = 65% x 0.18% + 35% x neotropical deforestation (excl. Amazon); solving for Neotropical deforestation = 1.09%.

It would also seem reasonable to assume that those parts of the Amazon that are on the deforestation frontier, presumably comprising significantly less than 20% of the Amazon – Conservation International report that approximately 50% of the Amazon is in protected areas (Conservation International, n.d.) – would have a similar 1% annual deforestation rate (comprising nearly all the observed 0.18% per annum Amazon wide deforestation).

A similar calculation would likely show that relatively low deforestation pressures in the Congo basin lowers the African continental average deforestation rate to 0.4% per annum. Forests at the deforestation frontier may well show a similar 1.0% deforestation rate. Asia's much higher 0.8% per annum continental average deforestation likely is also a function of a relatively lower percentage of forests that are truly remote and removed from deforestation pressures compared to Latin America. Again 1% would seem to be a conservative estimate as to the actual deforestation rate at the deforestation frontier.

Continental average deforestation = 'Amazon as % of neotropical forests' x 'Amazon deforestation' + 'Other Neotropical forests as % of neotropical forests' x 'Neotropical deforestation'.

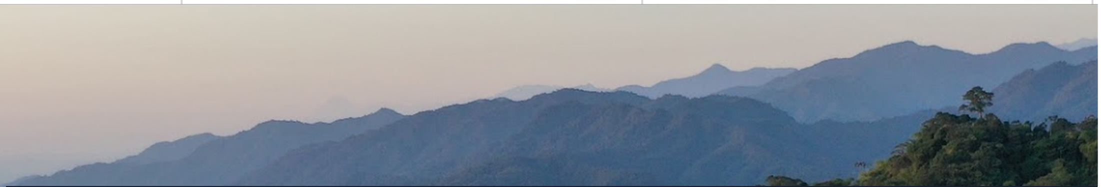


Therefore, 0.5% = 65% x 0.18% + 35% x 'neotropical deforestation (excl Amazon)';solving for Neotropical deforestation = 1.09%.

These continent-wide deforestation rates are supported by more localized assessments that vary widely by geography, time and methodology. Methodology is particularly important. For instance, the United Nations Food and Agriculture Organization only includes areas with less than 10% of tree cover as 'deforested' (FAO, https://www.fao.org/3/I8661EN/i8661en.pdf, 2020); the removal of up to 90% of the tree cover is a very poor outcome for both biodiversity and carbon retention. Examples of assessed Brazilian and Ecuadorian deforestation rates are cited in the table below:

Table 1: Primary Forest Deforestation Rates

Area	Time Period	Deforestation Rate	Source
Mato Grosso, Brazil	1998-1999	1.3%	(Fearnside, 2009)
	2006-2007	0.4%	
Mato Grosso, Brazil	2001-2004	0.4%	(Morton, 2006)
Amazon, Brazil	1976-2010	0.4%	(Reddington, 2015)
	2002-2004	0.2%	
	2009-2011	0.2%	
Brazil	2016-2017	0.6%	(www.globalforestwatch.org, n.d.)
	2018-2019	0.4%	
	2020-2021	0.4%	
Ecuador	1986-2001	0.9%	(Gonzalex-Jaramillo, 2016)
	2001-2008	1.9%	
Southern Ecuador	1976-1989	0.75%	(Tapia-Armijos, 2015)
	1989-2008	2.86%	
	1976-2008	2.01%	
Coastal West Ecuador	1990-2018	1.12%	(Rivas, 2021)
	2000	0.95%	
	2008	1.38%	
	2014	0.94%	
	2016	1.5%	
	2018	1.23%	
Ecuador (Colombia Border)	1973-1996	0.95%	(Viña, 2004)
Colombia (Ecuador border)	1973-1996	1.90%	
North-west Ecuador	1983-1995	2.03%	(Stallings, 1998)

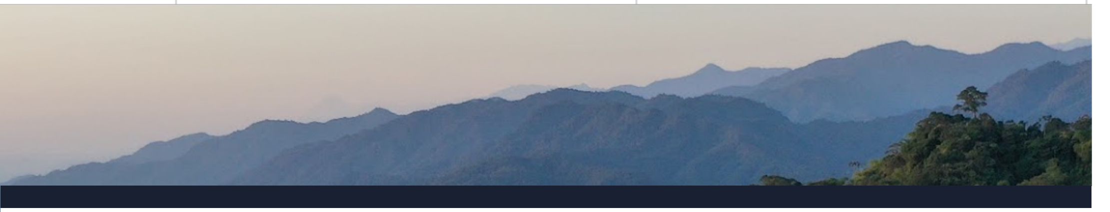


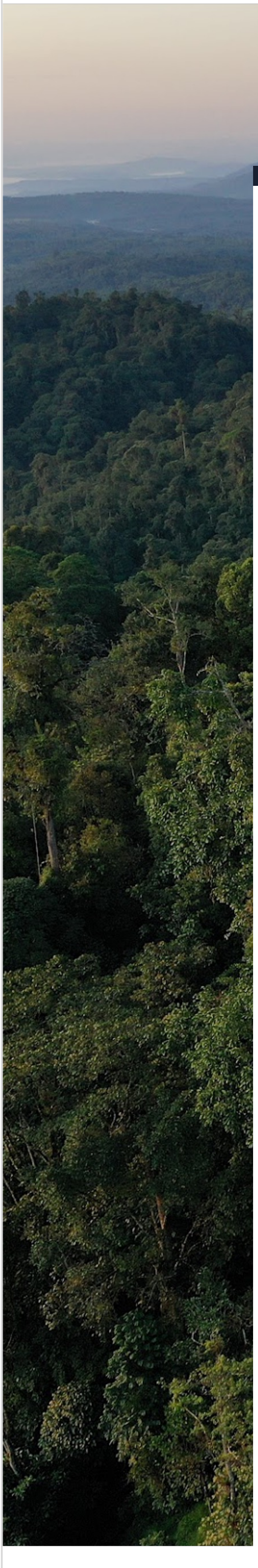
The process of local deforestation often occurs through a stepped process of initial access (road construction), then degradation (selective logging, followed by unsustainable logging) and then finally wholesale conversion to pasture or monoculture. Thus, site-specific analyses of deforestation can underestimate the rate during the early parts of this process and over-estimate the rate as the final clearing of heavily degraded forests occurs. A robust methodology should adopt a consistent average assumed deforestation rate that accords with decades of data.

5.4 Carbon Equivalent Impacts on Climate from Tropical Deforestation

5.4.1 Impact of Biophysical Effects

The impact of tropical deforestation on climate change is even greater than the net contribution of carbon emissions (Lawrence, 2022). Tropical deforestation leads to strong net global warming because of both CO2 and biophysical effects. Biophysical effects include the fact that forests retain humidity and increase cloud cover and cloud formation on a regional scale (see e.g. Leite et al. 2021 for the Amazon), a feedback loop that has implications for both regional and global climate and for regional forest persistence. In areas such as the southern Amazon basin this impact is often popularly cited as creating a “tipping point” for both biodiversity and climate change. For tropical forests between 30°N and 30°S the biophysical effect on global warming was around 50% and in the same direction (warming) as that from CO2. In the temperate zone of 30°N to 40°N biophysical cooling offset about 40% of the CO2 impact on global warming and the biophysical cooling offset 85% between 40°N and 50°N (Lawrence, 2022).



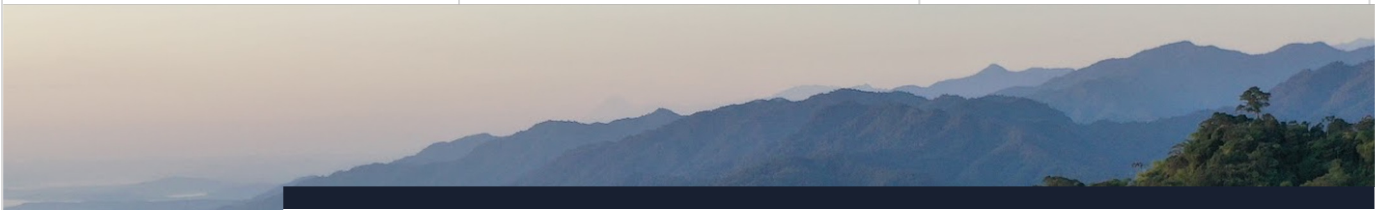


From a climate change perspective each ton of carbon is therefore not equal; a ton of avoided deforestation in the tropics is 2.5 times more valuable than a ton conserved/sequestered in a temperate latitude. This is of particular significance as much natural carbon traded under existing standards has been from temperate countries such as Europe, United States, New Zealand and southern Australia. This is summarized in Table 3 below:

Table 3: Varying Climate Impact of Deforestation

	CO2 plus Biophysical Impact	Ratio to Tonne of Temperate Forest CO2
Tropical Forests 30°S to 30°N	1.5	2.50
Temperate Forests 30°N to 40°N	0.6	1.00
High Temperate Forests 40°N to 50°N	0.15	0.25

Most carbon schemes do recognize a varying impact on climate from different greenhouse gases rather than adopting a single minded approach to carbon itself e.g. Sulphur Hexafluoride is explicitly targeted, as it is a potent greenhouse gas with 22,800 times the impact of one tonne of CO2 (EPA, n.d.) even though it contains no carbon. Using one tonne of CO2 emitted from burning of fossil fuels as a base unit, the impact of a tonne of avoided tropical deforestation emissions, would be worth 1.5x while a tonne of sequestered carbon in a temperate forest would be discounted to just 0.6x.



5.4.2 Below Ground and Soil Organic Carbon

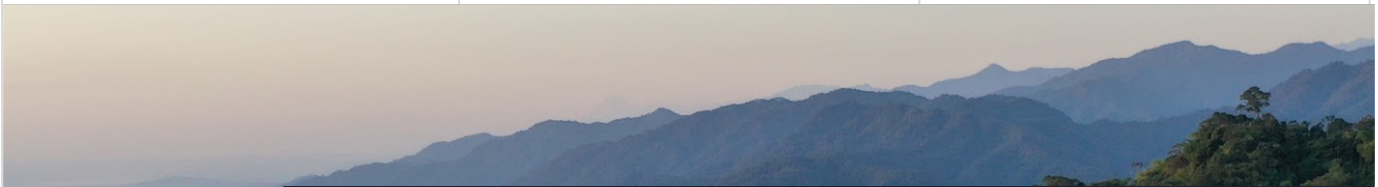
Below ground carbon is the carbon sequestered in the roots of trees with additional carbon contained as minerals in the soil (soil organic carbon). As a general heuristic, the total below ground carbon is approximately equal to the above ground carbon (meaning that there is as much of a tree below the ground or rotting in the ground as there is above the ground). Soil organic carbon is highly variable but is particularly significant in peatlands (either high altitude montane peatlands or lowland peat swamps). Indeed, in peatland forest, there may be as much as 4 times the carbon stored below the ground as there is above the ground (Novita, 2020).

Some data points are illustrated in the table below:

Table 2: Above and Below Ground Carbon in Primary Tropical Forests

Area	Above Ground Carbon (CO2E)	Below Ground Carbon (CO2E)	% Total Carbon Below Ground	Source
Singapore – Bukit Timah	617.5	617.5	50%	(Ngo, 2013)
Indonesia – Tanjung Putung Peatland forest (Pasalat primary)	755	3,050 (below & soil organic)	80%	(Novita, 2020).
Ecuador and Peru – Tropical Montane Forest	315-322	260-308 (below) 300-403 (soil organic)	45-49% (below) 95-125% (soil)	(de la Cruz-Amo, 2020)

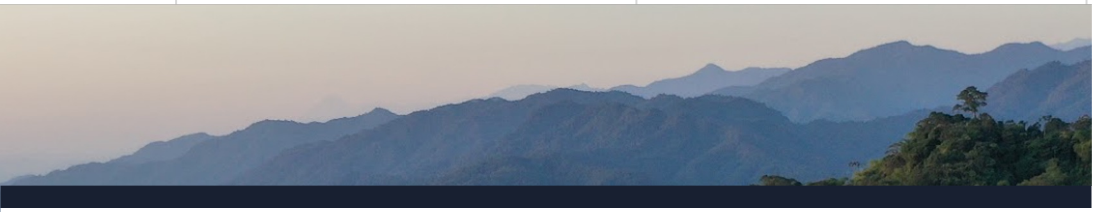
Below ground (non-soil) carbon would be expected to gradually rot and over a long period, perhaps decades, fall to zero. In addition, Wei et al, calculate that for tropical forests approximately 41% of soil carbon is lost upon conversion of forest to agricultural lands (Wei, 2014). Tropical deforestation at a 1% annual rate, is therefore highly likely to contribute a similar level of carbon loss below ground to that observed above ground, but will do so over a number of decades. Given a 20-30 year horizon it is likely that loss of below ground carbon will incrementally add another 50% to the above ground carbon lost.



5.4.3 Forest Regeneration and Restoration

Most tropical forests close to, or near to, the deforestation frontier have had some influence from past human use. In each of Latin America, Africa and Asia nearly all forests close to a deforestation frontier will have had some low-level artisanal logging of larger trees, small-scale prior agricultural use, or selective commercial logging. Conservation of these areas will allow ongoing forest restoration and result in positive carbon sequestration. Therefore, even in seemingly good forest there is often material potential for ongoing carbon sequestration that would not be reflected in stand-alone avoided deforestation measurements.

Regenerating 15 ->40 year old secondary montane forest in Ecuador was found to sequester 1.3–1.7 Mg/ha/year, representing approximately 1% per annum carbon accumulation on >40 year old forests that had standing carbon of 119 Mg/ha and 158Mg/ha respectively (Spracklen, 2016). To the extent that there is a greater percentage of younger regenerating forests then the rate of carbon accumulation, as a function of standing carbon, would be greater than 1% per annum (indeed 3-4 times greater for younger than 12-year-old regenerating forest).




5.4.4 Climate Impact Calculations: Summary

The outsized influence of tropical deforestation upon climate is summarized below:

Table 3:
Historical climate Impact as a percentage of above ground carbon lost due to deforestation.

Tropical deforestation at the deforestation frontier (continent wide averages)	1.00%
Add Below-Ground Carbon (discounted 50% for time value)	0.50%
Add biophysical impact on climate	0.50%
Add extrapolated impact of secondary forest up to restoration/regeneration	0.50%
Net average carbon impact (as % of standing carbon)	2.0% to 2.50%

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