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Evaluation of the Potential for FSC Certification in Chile & Indonesia on converted lands

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Acknowledgements

Executive summary

FSC® has restricted conversion of natural forests to plantations and non-forest use in its Principles and Criteria since its establishment in 1994. In the last few decades, growing demand for natural resources resulted in increased pressure to convert much of the remaining forest ecosystems to other land uses. Simultaneously, there has been increased awareness for the need to promote restoration of degraded ecosystems as a means to fight climate change and to avoid the loss of biological diversity. FSC Policy on Conversion is in development following a motion adopted by FSC membership in the General Assembly 2017, to clarify FSC's position on conversion and to provide a pathway for forest areas converted after 1994 to enter the FSC system upon demonstration of compliance with an FSC conversion remedy procedure. The policy would allow organizations that converted natural forests after 1994 and before the effective date of the policy to gain eligibility for forest management certification under certain conditions and scenarios.

FSC IC gave SmartCert the mandate to identify the potential for certification (area, volume) in Chile and Indonesia should the policy become effective. We assumed that conditions for certifying plantations established on post-1994 conversion would include the obligation to restore an area equivalent and proportionate to the area converted and to remedy social harm associated with the conversion. Using satellite imagery and Geographic Information System (GIS), SmartCert estimated the total area available for restoration and/or plantation development on post-1994 conversion in each country. Those are areas where forest removal was not followed by the forest regenerating, investments to develop infrastructure, agriculture, timber plantations or other industrial activity, and where the ecosystem has now converted to savanna, grassland, shrubland or cropland. While those ecosystems do retain some ecological value, they remain poor compared to the forest they replaced. These converted areas would benefit from restoration efforts, and the establishment of new certified plantations on part of those areas would likely have less impact than new conversions of natural forests, while providing more positive socio-economic impacts than the current degraded ecosystems.

We found that there are large areas where FSC policy compliant plantations and restoration could be established in post 1994 converted lands. Table i below gives estimates of the area affected by conversion between 1994 and 2019, and summarizes our main findings.

Table i: Summary of main findings

(All numbers in hectares)	A Forest area converted to timber plantations between 1994 and 2019	B Area currently available for new additional plantations and/or restoration	C Of B, potential for plantation development under 1:1 scenario	D Of B, potential for restoration under 1:1 scenario
Chile	100,000	500,000	200,000	300,000
Indonesia	3,250,000	580,000	0	580,000

In this scenario, we roll existing 1994-2019 plantations into FSC compliance and certification under a 1:1 plantation to restoration ratio. In Chile, where 100,000 ha of forest was converted to timber plantations between 1994-2019 (column A from the above table), an additional 500,000 ha was also converted from forest but remains available (column B). Under a 1:1 ratio, this 500,000 ha could see 200,000 ha of new plantations (column C) and the remaining 300,000 ha could be restored to compensate. At the end we would have 300,000 ha planted (already existing 100,000 ha + 200,000 ha new plantations on converted land) and 300,000 ha restored (column D).

In Indonesia, where already established plantations on converted land (3,250,000 ha – column A) cover a much larger area than the 580,000 ha available (column B) for development, we made the assumption that 580,000 ha of the existing plantations could be rolled in to FSC compliance and certification, and therefore we allocated the full 580,000 ha available for development to restoration (column D), in respect of the 1:1 plantation to restoration ratio. There is also a significant amount of degraded forest in both countries that do not meet the FSC definition of natural forest conversion but where restoration is desirable and could be possible. If FSC adopts a relatively liberal definition of areas-available-for-development, in Indonesia the whole area converted to timber plantation on post-1994 converted lands (3,250,000 ha) could be rolled to FSC compliance and certification if compensation through restoration is achieved in areas that do not meet the current definition of forest conversion.

We developed a theoretical scenario to estimate the FSC certified volumes that could be obtained from plantations on converted lands (300,000 ha in Chile and 3,250,00 ha in Indonesia) if they achieved FSC certification under the conversion policy. Our results show the total volume that these areas could potentially yield over 30 years (in 2050) would, in theory, be 97 Mm^3 for Chile and 596 Mm^3 for Indonesia.

We found that High Conservation Values (HCVs) were likely present before forest conversion in post-1994 converted areas in Indonesia and Chile. Some HCVs have the potential to be restored but others such as sacred sites and other social HCVs possibly cannot be restored once they have been destroyed. While the environmental benefits of restoration are evident, the case for restoration as a way to redress social harm is uncertain. Certification and restoration on post-1994 converted lands may be particularly challenging in countries where land conflicts exist with indigenous people and local communities.

We conclude that permitting FSC certification on post-1994 converted lands while requiring forest restoration does present significant opportunities and some challenges, and that the area available for restoration and plantation development may be limited if a restrictive definition of converted-forest-available-for-development is adopted.

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1. Introduction

Forest Stewardship Council® (FSC®) has established safeguards to minimize the significant conversion of natural forests within its sphere of influence. To be specific, through its policy for association FSC does not associate with organizations that are responsible for significant forest conversion.

> *"FSC will only allow its association with organizations that are not directly or indirectly involved in the following unacceptable activities: (...) Significant conversion of forests to plantations or non-forest use."*
> *– FSC Policy of association*

Furthermore, certification of plantations on lands converted after 1994 is currently not permitted by FSC Principle and Criteria.

> *"Management Units containing plantations that were established on areas converted from natural forest after November 1994 shall not qualify for certification, except where: a) Clear and sufficient evidence is provided that The Organization was not directly or indirectly responsible for the conversion, or b) The conversion affected a very limited portion of the area of the Management Unit and is producing clear, substantial, additional, secure long-term conservation[*] benefits in the Management Unit."*
> *– FSC Principles and Criteria (version 5-2)Criterion 6.10*

A new proposal on conversion and the mechanisms for its implementation are under development by the M7 Working Group and M7 Technical Working Group. The policy is planned to be submitted for conditional approval by the FSC Board of Directors and then enabled through a motion that would be voted on at the FSC General Assembly in October 2021 at the 4th GA.

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SmartCert has been commissioned by the Forest Stewardship Council (FSC) to collect and analyse data about forest conversion since 1994 and its impact on High Conservation Values (HCVs) and communities in Chile and Indonesia, for the purpose of informing FSC's current and expected conversion policy. More specifically:

- We did a high-level estimate of the total area converted from natural forest to other land use (anthropogenic use) in each country since 1994;
- Of that converted area, we report the area specifically converted to timber plantations;
- We identify the total area in each country where restoration and/or plantation development could be established (those are areas where forest removal was not followed by the forest regenerating, investments to develop infrastructure, agriculture, existing timber plantations or other industrial activity, and where the ecosystem has now converted to savanna, grassland, shrubland or cropland;
- We assessed whether or not HVCs are likely to have existed where natural forest conversion has occurred;
- We completed a literature review of the social impacts of forest conversion.

That information is meant to help answering the following questions:

1. What is the potential for certification of plantations and the associated potential for restoration in case the revised Conversion Policy becomes effective?

2. Did HCVs exist in areas where conversion has occurred?

3. How could the revised Conversion Policy influence the demand for plantation certification?

4. What are the effects of the Conversion Policy on growing global wood demand?

2. Method

2.1 DEFINITIONS

FSC's policy for association defines **forest conversion** as:

> "Rapid or gradual removal of natural forest, semi-natural forest or other wooded ecosystems such as woodlands and savannahs to meet other land needs, such as plantations (e.g., pulp wood, oil palm or coffee), agriculture, pasture, urban settlements, industry or mining. This process is usually irreversible."

The FSC IGI's definition describes the following categories of **natural forests**:

> "Forest affected by harvesting or other disturbances, in which trees are being or have been regenerated by a combination of natural and artificial regeneration with species typical of natural forests in that site, and where many of the above-ground and below-ground characteristics of the natural forest are still present..."
>
> "Natural forests which are maintained by traditional silvicultural practices including natural or assisted natural regeneration."
>
> "Well-developed secondary or colonizing forest of native species which has regenerated in non-forest areas."
>
> "...Natural forest may include areas described as wooded ecosystems, woodland and savanna."
>
> "... Does not include land which is not dominated by trees, was previously not forest, and which does not yet contain many of the characteristics and elements of native ecosystems. Young regeneration may be considered as natural forest after some years of ecological progression."
>
> "...Areas dominated by trees, mainly of native species, may be considered as natural forest."

Chile's official government definition of **native (natural) forest**:

> Mature forests are composed of native tree species with a height exceeding 8 meters with a canopy cover of ≥ 25%. Secondary forests are composed of native tree species exceeding 2 meters and a canopy cover ≥ 25%[1].

High Carbon Stock Approach (HCSA) toolkit definition of **forest** used in Indonesia:

> The HCSA Toolkit version 2.0[2] uses a minimum Canopy Closure of 30% to identify HCS forest areas. While this definition is not used by FSC, it remains a relevant definition for Indonesia[3]. Therefore it will be used in this assessment as a guideline for determining occurrence of natural forests/forested area.

Implications of these definitions:

- The first step to assess forest conversion was to assess forest loss for the period of the study. Obviously, a harvested forest which regenerates, even if just as a degraded forest, is not considered forest conversion. Therefore, the second step was to assess the current land-use to identify areas where forest loss has been followed by conversion to another land-use.

- To assess forest loss, SmartCert used the threshold of 30% canopy cover and combined it with the requirements of at least 5 m height for parcels of land. This threshold is used in Indonesia[2] and it is similar to the official government threshold in Chile[4]. We believe this threshold will lead to a realistic representation of "natural forest", as defined by FSC, for both countries covered by this assessment.

- Where forest has been lost and anthropogenically developed to another land-use or if it has developed into an ecosystem that is not dominated by trees (e.g. barren, grassland, shrubland, savanna or cropland), we considered that it was converted

2.2 FOREST CONVERSION

2.2.1. Forest loss

As a first step, we identified forest areas where forest cover had been lost in the study period. If forest was lost in any year since 2000, it is marked as forest loss. To conduct this analysis, we used the Hansen Global Forest Change v1.7 (2000-2019)[4] data set with a Canopy Cover density filter of ≥ 30%. We resampled the forest loss data from Hansen to 90m x 90m pixels. To increase accuracy, the height threshold of ≥ 5 m for parcels of land of at least 0.81 ha has been used for the period after 2000. Any parcel of land that met the above thresholds was considered to be forest.

To evaluate conversion between 1990 and 2000, we used the GFCC Forest Cover Change Multi-Year Global dataset, which provides estimates of changes in forest cover from 1990 to 2000 at a 30-meter spatial resolution[5]. This data was used with a Canopy Cover density filter of ≥ 30%. LiDAR derived data was not available in those years and consequently we were not able to use tree height for that period. Also, the GFCC dataset covers a 10-year period (1990 to 2000) and does not allow us to isolate forest conversion for 6 years from 1994 to 2000. These 4 years do not create a large bias in our study and consequently we mapped forest loss for the full period of 1990 to 2019. Reporting for the 1994-2019 period was done by removing, posteriori, 4 years (1990 to 1994) of conversion based on the average annual conversion assuming uniform distribution along the years.

If in any given year between 1990 and 2019 the above forest criteria were not met for a 0.81 ha parcel, the parcel was considered to be forest loss. The raster data of forest loss was converted to vector and projected to proper Albers projection type. We used South America Albers Equal Area Conic for Chile and Asia South Albers Equal Area Conic for Indonesia. The Datum were SAD69 for Chile and WG84 for Indonesia. We used UTM metrical coordinates for both countries.

2.2.2 Current land use

To assess current land use of the areas identified in the first step i.e. where forest loss occurred, we obtained infrastructure vector data from local sources[6], and then completed this data with 2018 road data available from Globio[7]. We used the 2017 Global Rural-Urban Mapping data to identify conversion from forest to urban areas[8].

To identify plantations for fiber, fruits, rubber and palm oil, we used the Global Forest Watch Planted Forest[9] dataset. In Indonesia we completed with data from the Ministry of Energy and Mineral (ESDM)[10].

Because there is uncertainty on whether some very small areas detected as forest conversion are human caused or not, we removed them before processing the Modis land classification analysis and the HCVs analysis. Those are very small (2 pixels, equivalent to 1.62 ha), isolated pixels scattered throughout the country and surrounded by unfragmented forest.

On the remaining areas that we could not classify using the above information, we used the Modis land cover type product available for 2019, which provides 17 classes of land cover (see Table 1 below) at a 500m resolution[11]. For the purpose of our study, we combined classes of the Modis output.

In areas where forest has been converted, we considered barren land, savanna, grassland, shrubland or cropland as being areas available for restoration or for the development of forest plantations. The rationale is that the opportunity cost may be too high to restore or develop plantations in areas developed for other purposes such as infrastructure or oil palm plantations.

Table 1: Reclassification of land classes from the Modis analysis output

CLASSIFICATION USED IN OUR STUDY	CLASSES OF LAND COVER FROM THE MODIS OUTPUT
Forest	• Evergreen needleleaf forest (Dominated by evergreen conifer trees canopy>2m. Tree cover>60%). • Evergreen broadleaf forest (Dominated by evergreen broadleaf and palmate trees canopy>2m. Tree cover>60%). • Deciduous needleleaf forest (Dominated by deciduous needleleaf (larch) trees canopy>2m. Tree cover>60%). • Deciduous broadleaf forest (Dominated by deciduous broadleaf trees canopy>2m. Tree cover>60%). • Mixed forest (Dominated by neither deciduous nor evergreen (40-60% of each) tree type canopy>2m. Tree cover>60%).
Barren, savanna, grassland, shrubland or cropland	• Closed shrubland (Dominated by woody perennials 1-2m height and >60% cover). • Open shrubland (Dominated by woody perennials 1-2m height and 10-60% cover). • Woody savannas (Tree cover 30-60% canopy>2m). • Savannas (Tree cover 10-30% canopy>2m). • Grassland (Dominated by herbaceous annuals <2m). • Barren (At least 60% of area is non-vegetated barren (sand, rock, soil) areas with less than 10% vegetation). • Cropland (At least 60% of area is cultivated cropland). • Cropland/Natural vegetation mosaics (Mosaics of small-scale cultivation 40-60% with natural tree, shrub, or herbaceous vegetation).
Other	• Urban and built-up lands • Permanent wetlands • Permanent snow and ice • Water bodies • Unclassified

Source: Modis user guide https://lpdaac.usgs.gov/documents/101/MCD12_User_Guide_V6.pdf

2.3 ASSESSING THE PRESENCE OF HCVS

This mandate requires us to assess the potential presence of HCVs in forests before they were converted. We used the results of our conversion analysis to assess the impact of conversion on HCVs. Our study did not assess the presence or loss of confirmed HCVs. Instead, we used HCV proxies to evaluate the risk that HCVs had occurred in the areas converted. The HCV proxies were selected based on the guidance from the HCVRN Common Guidance on Identification of HCVs (2014)[12] and the Guidance for identifying and prioritizing action for HCVs in jurisdictional and landscape settings[13]. The HCV proxies were mapped using the following data:

HCV 1. Species diversity: We obtained maps (polygons) of protected areas for both countries[14,15,16]. In Indonesia we obtained maps of the habitat of Borneo Orangutan[17], Sumatra Orangutan[18], Elephant[19], Tiger[20], Endemic bird and Important bird[21] areas. We did not locate maps of habitat of species at risk in Chile.

HCV 2. Landscape-level ecosystems and mosaics: We used the intact forest landscape (IFL) maps of 2000 for both countries[22].

HCV 3. Ecosystems and habitats: We mapped the Leuser ecosystem using the GFW map[23]. We did not locate data for Rare, threatened, or endangered ecosystems, habitats or refugia in Chile.

HCV 4. Ecosystem services: We used digital elevation models (DEM)[24] to map steep slopes ≥ 30 degrees to identify converted areas sensitive to erosion and we used national watercourse data which we completed with the Gaia dataset[25] to map water bodies. We added a 30 meter buffer to water bodies to evaluate conversion in riparian ecosystems. In Indonesia, we also used the available maps of Mangrove and peatlands[26].

HCV 5 and HCV 6. Community needs & Cultural values: In Indonesia we used data from customary communities that registered and this is the database of the communities registered[27] and data about Cultural areas[28]. In Chile we used maps of land titles and indigenous communities[29].

2.4 RESTORATION POTENTIAL

Our analysis assumed that 1 hectare of land available for plantation equals 1 hectare of restoration. Thus, the restoration potential of converted areas was calculated based on the exclusion of areas which have been converted into urban areas, infrastructure or other anthropogenic features that are incompatible with the development of restoration activities.

2.5 WOOD VOLUME FROM EXISTING PLANTATIONS

To identify areas currently converted into plantations for fiber production, we used the Global Forest Watch Planted Forest dataset. We obtained data of the main species used in the forest plantations and the respective area for each country. We compared our results with data obtained from scientific literature, local authorities, and forestry agencies to make sure they were consistent. Once information about species and area were obtained, we estimated the volume of wood based on the mean annual increment of the species in each country. We verified consistency by comparing theoretical wood volume with roundwood annual production for both countries. In addition, using the same methodology and the results from remote sensing, we determined the theoretical volume of wood available from the converted lands. We replicated the current species distribution to the area available for timber development.

3. Case study results for Chile

Figure 1: Political map of Chile. The different shades of blue help identify administrative divisions of Chile.

3.1 OVERVIEW

More than 90% of the forest in Chile is located between the Maule and Magallanes regions. According to the National Forestry Corporation (CONAF), native forests at national level cover 14.7 million ha. As of December 2018, Instituto Forestal (INFOR) reports a total of 2.3 Mha[30] of forest plantations. The radiata pine forest plantations cover the greatest surface with 55.8%, followed by eucalyptus plantations with 37.2%. In 2018 there were 23 FSC certified areas totaling 2.2 million ha[31].

In Chile almost all plantations are on private land. Approximately 55% of the Chilean plantation area is owned by 3 large companies. The remaining plantations are owned by more than 23,000 small and medium owners[32].

3.2 CONVERSION OF FOREST SINCE 1994 IN CHILE

We conducted a GIS analysis to identify the areas where forest was lost between 1990-2019 in Chile. The objective of this analysis is to evaluate the spatial distribution of areas disturbed in the period of interest. The draft conversion policy & remedy procedure is clear that remedy is not only about restoration on the same site but could also be on other sites. Consequently, we provide the post-1994 forest conversion statistics for the whole country regardless of site location.

3.2.1 Forest loss

For Chile, SmartCert's GIS analysis finds that 2.22 Mha has been affected by forest loss between 1990 to 2019. As our mandate consisted in covering the post-1994 period, we report our statistics by removing 4 years (1990 to 1994) based on the average annual forest loss (0.0766 Mha/year, for a total of 0.306 Mha for the 1990-1994 period) assuming uniform distribution along the years*. The result (1.91 Mha) is presented in Table 2 and the pie chart below.

For the corresponding period, we find slightly less forest loss than Global Forest Watch[33]. This is due to the use of different forest cover and height thresholds (30% forest cover and 5 meters) and to the fact that we resampled the data to a 90-meter resolution.

3.2.2 Current land use where forest loss has occurred

As shown in Table 2 and the chart below, of the overall area affected by forest loss between 1994 and 2019 (1.91 Mha), we find that 0.93 Mha has returned to forest. The area of interest for FSC is the 0.50 Mha in the form of barren savanna, grassland, shrubland and cropland and therefore available for plantation and restoration. The permanent anthropogenic restrictions include (0.32 Mha) urban areas, roads, railways and industrial agriculture. We also included protected areas in this category because they are incompatible with the development of forest plantations. The natural forest converted to forest plantations and to mixed forests since 1994 according to Chile's land and vegetation registry is 0.10 Mha[34]. The remaining forest loss (60 000 ha) is associated with other unclassified use.

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* *Based on CONAF native forest conversion statistics, the total annual conversion of native forest was on average 15,105 ha between 1990 and 1994 whereas the average for 1990 to 2019 was 11,289 ha per year. If forest loss followed the same trend as conversion of native forest, our results may be slightly overestimated. We used the uniform distribution for simplicity.*

Table 2: Current land classification of forest loss areas from 1994-2019 in Chile

LAND CLASS	AREA IN Mha (%)
Total area where forest loss occurred between 1994 and 2019	1.91
Current land use	
Forest converted to savanna, grassland, shrubland, cropland or cropland mosaic (available for restoration and/or plantation development)	0.50 (26%)
Permanent anthropogenic restrictions (not available for new plantation development or restoration) • Urban area, roads, railways, airports, protected area, agriculture plantations[36,36] • Timber plantations	0.32 (17%) 0.10 (5%)
Returned to forest	0.93 (49%)
Other or unclassified	0.06 (3%)

Total area of forest loss (1.91 Mha) in Chile between 1990 and 2019

Unclassified (0.06 Mha) **3%**

26% available for restoration and plantation development (0.50 Mha)

49% Regenerating forest (0.93 Mha)

17% not available for plantation nor restoration (0.32 Mha)
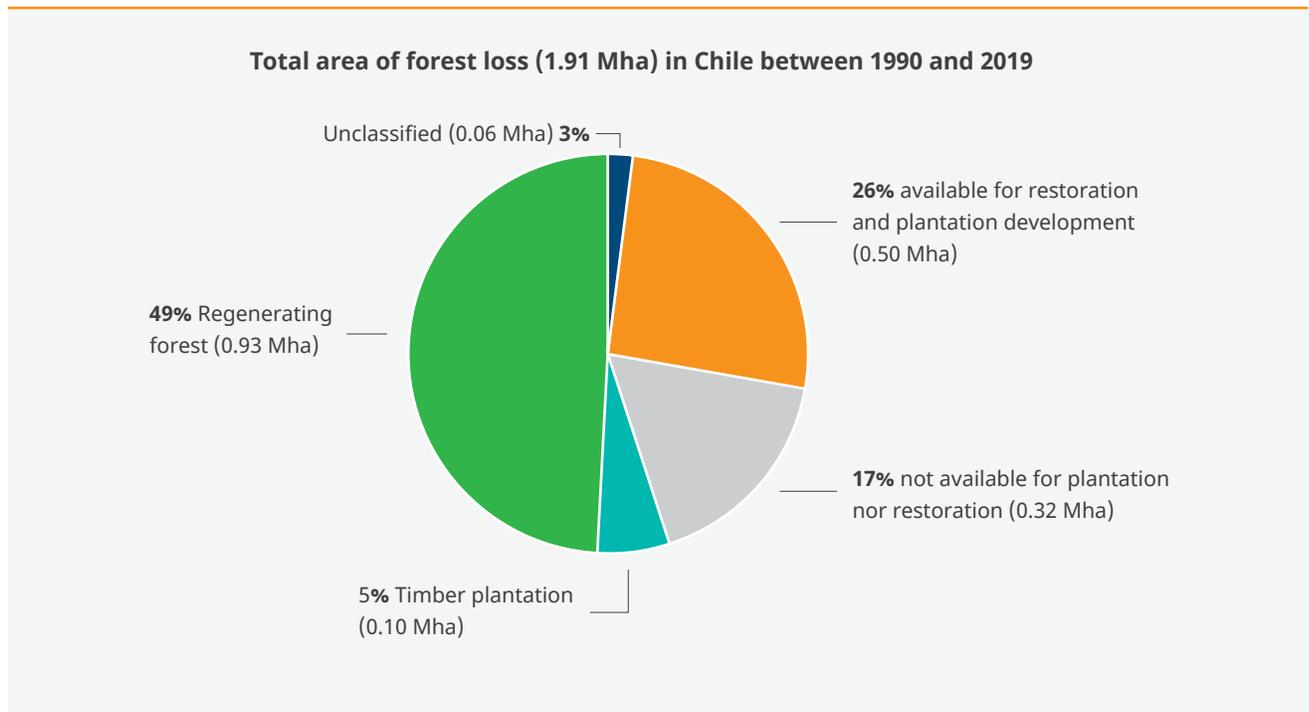
5**%** Timber plantation (0.10 Mha)

Figure 2 : Current land classification of areas where forest loss occurred from 1994-2019 in Chile (1.91 Mha)

We find significantly more "forest conversion" (0.50 Mha) than what is officially reported. The Chilean authorities report 0.165 Mha native forest loss to other land use (other than the 0.10 Mha converted to plantations) between 1994 and 2019. This discrepancy is likely due to differences in the definitions and tools used to assess conversion. Our results should rather be seen complementary than contradictory to the official data. They indicate that existing opportunities for restoration or plantation development may be greater than what is officially reported. Our conversion results are also in the same order of magnitude as what is reported by Miranda et al. (2017)[37]. This study found conversion to shrubland to be the most common result of forest conversion in Chile. It is important to keep in mind that the forest loss and conversion to shrubland are not only caused by logging but also by disturbances such as fires.

Another interesting aspect of our results is that a large proportion of forest loss that occurred since 1994, as captured in our analysis, has regenerated back to forest. It is very likely that these forests remain degraded and would benefit from restoration efforts. However, because they are not considered permanent conversion they do not qualify, for the purpose of this study, as potential restoration areas.

3.3 PRESENCE OF HCVS IN CONVERTED AREAS IN CHILE

We used data that can serve as proxies of HCVs to estimate the presence of HCVs inside the area that is available for restoration and plantation development. Table 3 provides the statistics resulting from the overlap between this available area and the mapped HCV proxies. The overlaps suggest that social and environmental HCVs were likely present in converted areas which are available for restoration and/or plantation development.

While we did not superimpose maps of the habitats of threatened species in Chile, studies indicate that forest loss poses a risk to several endangered and endemic species. In fact, Chile is a biodiversity hotspot with 1,569 endemic species but also has a very high extinction rate[38]. One of the main causes of extinction is habitat destruction[39]. Although it is not quantified in Table 3, it is reasonable to conclude that forest conversion has had a direct impact on the habitat of some sensitive endemic, rare and endangered species.

Table 3: Overlap between the area converted (available for restoration and/or plantations development) and HCV proxies in Chile

CATEGORY	HCV PROXY DESCRIPTION	OVERLAP WITH AVAILABLE CONVERTED AREAS*
HCV 2	Intact forest landscapes in 2000 Source: http://www.intactforests.org/	3,208 ha
HCV 4	Riparian areas (buffered (30m) hydrology and water bodies). Sources: http://gaia.geosci.unc.edu/rivers/	3,300 ha
	Steep slopes (≥30 degrees slopes using DEM data) Source: Nasa's Shuttle Radar Topography Mission (SRTM)	3,144 ha
HCV 5-6	Indigenous communities Source: http://siic.conadi.cl/	13 villages
	Indigenous land titles Source: http://siic.conadi.cl/	2,061 ha

Areas may overlap because they contain more than one High Conservation Value.

3.4 THEORETICAL RESTORATION POTENTIAL AND TIMBER PLANTATION DEVELOPMENT ON CONVERTED LANDS IN CHILE

As reported in Table 2 and laid out in Table 4, we find 0.60 Mha of natural forest has been affected by conversion from 1994 to 2019. Of that, 0.10 Mha was converted to timber plantations, and 0.50 Mha remains potentially available for plantation and restoration.

Table 4: Plantation area and restoration potential in areas converted from 1994-2019 in Chile

	A	B	C	D
(All numbers in hectares)	**Forest area converted to timber plantations between 1994 and 2019**	**Area currently available for new additional plantations and/or restoration**	**Of B, potential for plantation development under 1:1 scenario**	**Of B, potential for restoration under 1:1 scenario**
Chile	100,000	500,000	200,000	300,000

In this scenario, we roll existing plantations into FSC compliance and certification to the extent that a 1:1 plantation to restoration ratio permits. In Chile, where only 100,000 ha of plantations (column A) were established during the study period but 500,000 ha of degraded converted (previously forest) is available (column B), 200,000 ha of new plantations (column C) could be established and the resulting total of 300,000 ha of plantations (already existing 100,000 ha + new 200,000 ha on converted land) would be compensated by the restoration of the remaining 300,000 ha (D).

3.5 WOOD VOLUME FROM EXISTING PLANTATIONS ON POST-1994 CONVERTED AREAS IN CHILE

A preliminary note before diving into wood volume calculations: Planted trees do not cover the whole plantation area because set-asides are needed to meet regulation and certification requirements for plantations. FSC certified plantations are required to set aside areas of natural forests representing at a minimum 10% of the forest management unit (criteria 6.5 of the International Generic Indicators)[40]. Infrastructure and inoperable areas within plantation areas also reduce the production area. The set-asides will be variable in size, but for the purpose of estimating the wood volume, we believe that 20% of set-asides are a conservative estimate. Consequently, in Table 5 below we used 80,000 ha (100,000 ha from Table 4 above * 80%) as the production area of the existing timber plantations developed on converted lands between 1994 and 2019. In Table 6 below we used 160,000 ha (200,000 ha * 80%) as the production area of future plantation developments in existing converted lands.

According to INFOR (2018)[41], forest plantations cover a total area of 2.3 Mha in Chile. Radiata pine (*Pinus radiata*) represents most of the planted area with 55.8%, followed by *Eucalyptus globulus* (25.3% - known to be invasive) and *Eucalyptus nitens* (11.9%). Additional species include *Atriplex spp.* (2.4%), *Pinus ponderosa* (0.9%), and others (3.0%). From 2007 to 2012, it is possible to observe a stabilization of the radiata pine surface to about 1.47 Mha; from 2013 this surface starts to shrink until it falls sharply in 2017 as consequence of important wildfires that year. This tendency was then slightly reverted in 2018. On the other hand, the surface planted with eucalyptus showed a significant increase each year with a peak in 2016 and the subsequent years showing a slight reduction. Despite the uneven growth in both species, overall trend shows for each hectare of eucalyptus planted, there is approximately 1.5 hectares of radiata pine.

The country has seven different growing zones. For radiata pine, the average volume per stand varies between 99.4 m³/ha and 254.1 m³/ha, while for eucalyptus it varies between 29.8 m³/ha and 141.0 m³/ha. To determine the theoretical wood volume for the existing timber plantations on converted areas, we focused our analysis on the average volume (m³/ha) of the five most important regions in terms of forest plantation area: Biobío, La Araucanía, Maule, O'Higgins, and Los Ríos. Those five regions represent over 70% of forest plantations on converted lands for the period of this study. Table 5 shows the average volume by specie/ha for the country and the available existing volume on converted lands.

Table 5: Harvest volumes for main species cultivated in Chile from 100,000 ha of existing plantations on land converted between 1994 and 2019

SPECIES	Average volume (m³ ssc/ha)	Total current plantation area (ha)	Productive area (ha) (20% set aside)	Available volume (Mm³ ssc)
Pinus radiata	172.2	62,500	50,000	8.61
Eucalyptus spp.	76.5	37,500	30,000	2.30
Total		**100,000**	**80,000**	**10.91**

*m³ ssc/ha: solid cubic meters without bark

The potential available volume considers the actual age class distribution. According to INDUFOR (2018), 60.4% of radiata pine plantations and 42.1% of the eucalyptus plantations are in juvenile/adult stage (more than 11 years old).

For the theoretical volume potential, the first step was to estimate the area available for plantation per species. We assumed the same overall ratio of 2:3 would be maintained (1 ha of eucalyptus for 1.5 of radiata pine). To simplify the analysis, the average of the minimum and maximum MAI* was determined for the country for each species. We did not consider other management activities than the final harvest of the plantations to forecast volumes until 2050 (Table 6). Typical rotation lengths in large-scale plantations in Chile are between 18 and 28 years[42] for radiata pine and 15 to 16 years for eucalyptus[43,44]. However, for short rotations with objectives such as energy or pulp, E. globulus rotation may vary between 8 and 12 years. With this in mind, for this study we adopted a conservative rotation period of 23 years for radiata pine and 14 years for eucalyptus.

Table 6: Total volume yield from new plantations by 2050 considering 1 ha restored for each hectare planted

SPECIES	MAI (m³/ha/year)	Total area available (ha)	Area available after 20% set asides (ha)	Rotation (yrs)	No. of rotations	Total volume by 2050 (Mm³)
P. radiata	21	125,000	100,000	23	1.3	62.79
E. globulus	15.86	50,000	40,000	14	2.1	18.65
E. nitens	26.57	25,000	20,000	14	2.1	15.62
Total		**200,000**	**160,000**			**97.06**

*MAI: mean annual increment in cubic meters by hectare by year.

Our analysis suggests that the potential exists for an increase in plantations on converted lands with a 1:1 plantation to restoration scenario.

3.6 SOCIAL IMPACT OF FOREST CONVERSION IN CHILE

3.6.1 Identification of communities affected by the conversion in Chile

Based on the literature, the establishment of plantations has affected primarily indigenous communities. In Chile, according to the 2017 Census[45], 12.8% of the population consider themselves indigenous. The main indigenous group of Chile are the Mapuche (9.9%). Other groups include the Aimara, Rapa Nui (also referred to as Pascuenses), the Atacameños, Quechuas, Collas and Diaguita (north of the country), the Kawashkar (also called the Alacalufe), and Yamana (also called Yagan).

3.6.2 Economic and social conditions before and after conversion

Several studies assess the impacts of the forest plantations on communities. SmartCert approaches the question of impacts of forest conversion with no preconceived ideas, and finds that there are nuances in the literature: all impacts are not negative.

3.6.2.1 Positive impacts of conversion on economy and livelihood

The forest sector is one of the main exporting sectors in Chile. In some regions, such as Biobío, Maule, and Araucanía, the forest industry is one of the main providers of employment[46] and accounts for a major proportion of GDP. For example, in Biobío the forest sector accounts for 15.8 percent of the regional GDP.

The forest sector, which relies almost exclusively on forest plantations, is important for the livelihood of Chileans in several regions. In the past decades, poverty has been significantly reduced in Chile. This coincides with increases in GDP and in the capacity of the state to fund social services. Being a significant contributor to the state's finances, the forestry sector can be considered to indirectly help reducing poverty.

Given the demand for timber from the forest industry, forest plantations can reduce harvesting pressure on native forests. Although the biodiversity present in plantations will never achieve that of natural forests, plantations established in areas that are already deforested or degraded do improve biological diversity[47].

3.6.2.2 Negative impacts on economy and livelihood

Although forestry is an important driver of regional GDP, a study has shown that local communities have not economically benefitted from forest plantations. In fact, in 2005, regions with more forest plantation cover were the ones with the lowest human development index values[48]. Cerda et al. 2020[49] found that in the Ñuble and Bio regions, where the proportion of timber plantations increased, poverty increased and population decreased. Reyes, R. (2013)[58] pointed out that forest plantations are exempt from land tax and have a low contribution to municipal income[50]. The Chilean tax system is structured on the basis of direct and indirect taxes. The most important taxes, which also represent the largest amounts, are the valued added tax ("Impuesto al Valor Agregado")[51] and the income tax ("Impuesto a la Renta")[52]. In Chile, taxpayers including corporate agents pay their taxes centrally. Municipality income tax[53] and the land tax[54] are the exception. The municipal income tax is the only tax to be influenced by the place of operations (plantations or factories). The municipality income tax law establishes a distribution criterion that considers the number of workers who work in each county.

3.6.2.3 Negative impacts on the Mapuche people

Several studies describe the impacts of forest conversion to timber plantations on the Mapuche people in Chile. Plantations do not create a large number of jobs and a high percentage of the Mapuche's economic activity is at the level of self-subsistence. This has forced a significant percentage of the Mapuche to migrate to other areas of the country in search of better prospects (UNDP 2018)[55].

Some authors have reported that conversion threatens the cultural heritage of the Mapuche people (Aedo and Larraín, 2004)[56]. Forest conversion leads to the destruction of resources of traditional food collected from the forest[57] such as *Digueñes*, a fungus that grows in the *Nothofagus* trees, as well as *Coulle* (mushrooms) and *Nalkas* (wild strawberries)[57]. The loss of native vegetation also leads to the loss of medicinal plants (lpiche, el cachalague, el natre, el chilco, boldo, palo santo, laurel, sage) and of sacred places such as cemeteries and Ngillatuwe (ceremonial spaces). Sacred sites are in most cases lost forever once they have been destroyed[58].

In the Mapuche culture, the territory is made up of spaces that have their own spiritual forces[57]. The loss of the native forest therefore has an impact on the relations of the Mapuche with the spirit world.

3.6.2.4 Negative environmental impacts affecting communities.

Environmental impacts of conversion include the loss of biodiversity[59], notably because of the loss of native forest that support a more diversified species community than forest plantations. One study on birds found that only 52.4% of the birds present in the native forest of the Biobío region were also in the plantations. Impacts on soil can include nutrient depletion, degradation and erosion[60,61]. Some papers associate land conversion and forest plantations with water scarcity[62,63]. This was also identified as a consequence of forest plantations by a Mapuche leader interviewed as part of this study. He explained that communities are observing changes of patterns in precipitations, and a growing water shortage or deficit throughout the year. This is a multifactorial change which is likely related to the broader context of climate change, but is perceived as being related to the presence of plantations (P. Huaiquilao, personal communication, 2020). The reduction of water yield in watersheds where native forest has been significantly converted to plantations is documented in the literature (Little et al. 2009[64]; Alvarez-Garreton et al. 2019[65]).

3.7 LEGAL/GOVERNMENTAL REQUIREMENTS, CONDITIONS AND OBLIGATIONS RELATED TO CONVERSION AND RESTORATION, AS WELL AS THEIR ENFORCEMENT FOR CHILE

3.7.1 The issue with community land security

There is a historical land conflict in Chile arising from the Spanish colonial period when Mapuche were dispossessed of their lands. Chilean state policies for privatization of land and incentives to afforestation in the late 1970's have caused the development of plantations on a significant portion of Mapuche lands and have exacerbated the conflict[66]. A large proportion of the plantations are owned by three large forestry enterprises that own approximately 55% of the plantations in Chile. These companies are also the large FSC certificate holders in Chile. Millamán *et al.* (2016), reported that FSC certified plantations overlap with lands that were granted to the Mapuche by the State, but subsequently taken away.

3.7.2 Safeguards/requirements for forest and plantation management

In Chile, forest plantations were established on private lands and afforestation was subsidized. Decree Law 701 providing this afforestation incentive system is now abandoned. Since 2008, plantations development on private lands where natural forest exist are regulated by the 2008 native forest law (Ley de Recuperación del Bosque Nativo y Fomento Forestal)[34]. This law regulates the management and conversion of native forests. It allows forest conversion in 25% of the areas with less than 45° slopes. It also offers incentives for small to medium sized owners to manage native forest. CONAF and its officials enforce the forestry law in Chile.

3.7.3 Headwind for plantation development in Chile

New forest plantations are limited by the availability of suitable lands (sensitivity to erosion and water availability). Private lots are fragmented, and the owners do not have the technical know-how and the financial capacity to develop plantations. In recent years, extreme climate conditions have reduced growth and productivity and increase vulnerability to fires and pests. These challenges may have a negative effect on the development of plantations[67].

The perceptions of plantations appear polarized in Chile. On one hand the government and the forest industry argue that plantations are needed for socio-economic development. On the other hand, Mapuche organizations explain that plantations on their lands reduce the quality of their environment and destroy their way of life. Environmental groups and scholars make the argument that the ongoing plantation development is destroying biodiversity. It will be a fine line to walk for FSC to deploy a policy that allows certification of plantations on lands that have been converted after 1994. In fact, FSC has already faced criticism for FSC certified plantations on Mapuche historical lands[70].

3.7.4 Legal requirements for restoration

The native forest law includes incentives for sustainable management of native forest by woodlot owners, but it does not include provision for restoration per se. The decree law 701 (D.L. 701) promulgated in 1974 established forestry incentives for the management of plantation. It was a major catalyzer for plantation development by large corporations in Chile.[68] D.L. 701 expired in 1997 but it was extended until recently mainly for small and medium landowners. The government is currently preparing new legislation to establish incentives for small or medium forest companies.

Ministerial Decree No. 12 promulgated in 2016 provides guidelines for the period 2015-2035. It includes objectives to increase the quantity, quality and productivity of sustainably managed plantations owned by small and medium producers. It includes objectives to restore degraded lands owned by small or medium landowners.

This policy and its targets are reflected under the commitments made by Chile to comply with international mechanisms and frameworks addressing forest, land degradation, climate change and biological diversity (Paris Agreement, NDCs, UNFCCC, UNFCCD, CBD, Bonn Challenge):

- Restoring 500,000 ha under the 20x20 Initiative, meaning the recovery of degraded land with the afforestation of 100,000 ha, mainly with native species, in the period 2020-2030, as a contribution to increasing the capture and reduction of GHG and restoring 400,000 ha of degraded land for agriculture and livestock through the Incentive System for the Recovery of Degraded Soils.

- The National Climate Change and Vegetation Resources Strategy (ENCCRV) 2017-2025 sets a target of 30,000 hectares of native forest restoration, which is related to the Nationally Determined Contribution (NDC) target of the Land Use, Land Use Change and Forestry Sector (LULUCF).

- Chile has committed 300,000 ha as target for the Land Degradation Neutrality (NDT) by 2025 to the UNCCD.

- Linked to the NDC, Chile committed to the recovery of 200,000 hectares of native forest, 200,000 ha of forestation, of which 100,000 ha correspond to permanent vegetative cover (70,000 ha with native species).

- The recently approved NDC commits to the implementation of the National Plan for Landscape Restoration by 2021, considering the incorporation of 1,500,000 hectares of landscapes to the restoration processes by 2030.

3.7.5 Existing initiatives of restoration.

There are several restoration initiatives in Chile. The list below is non-exhaustive but demonstrates that there is significant interest for forest restoration from both the private sector and authorities.

- In 2012, the three largest forest companies, Forestal Masisa S.A, CMPC (Forestal Mininco S.A) and Arauco, agreed to restore natural forests in a ratio of 1 hectare restored for 1 hectare of forest converted between 1994 and 2009. The conversion of natural forest and arborescent brushes to plantations was evaluated by experts in collaboration with WWF Chile. On the lands privately owned by Arauco, 17,484 ha of native forest and 13,998 ha of arborescent scrub were converted[69]. For Masisa 1,666 ha of native forest and 1,064 ha of arborescent scrub were converted[70]. For CMPC about 8,942 ha of native forest has been converted[71]. In total, the 3 companies pledged to restore 35,000 hectares. It was one of the first projects of its kind and it was a catalyst for positive changes in the Chilean forestry sector. Universities began to carry out related studies, changes were made in the curricular programs of universities, partnerships were developed between universities, NGOs and companies and they started to work together on restoration, among many other changes. Since the agreement, these large companies have been implementing restoration plans such as the Native Forest Restoration Plan (ARAUCO, 2018)[72] and the Ecological Restoration Plan (CMPC, 2017)[73].

- There are also specific examples of forest restoration in Chile such as the restoration of native forest in the private protected area of Leones valley of Aysen. This project, in which 250,000 native trees were planted since 2006, was mainly privately funded.

3.8 RECAP OF THE CHILE CASE STUDY

- Plantations are mostly located on private lands. Over half of the plantation area is owned by three large companies, the remainder being shared among over 23,000 small and medium owners.

- We calculated 0.50 Mha of forest converted and available for restoration and/or plantation development.

- Before conversion, social and environmental high conservation values were likely present in those available 0.50 Mha.

- We found that 0.1 Mha of existing timber plantations have been developed in post-1994 conversion. The plantations development potential and the restoration potential are respectively 0.2 Mha and 0.3 Mha

- Our analysis suggests that the potential exists for an increase in plantations on converted lands with a 1:1 restoration scenario, generating 97.06 Mm^3 total volume by 2050.

- Potential positive impacts of conversion to plantations are increases in GDP and national tax revenues for social services. Negative impacts are related to the absence of local tax revenues; loss of traditional foods, medicinal plants, sacred places and spiritual sites for the Mapuche; and loss of biodiversity.

- There are Mapuche land claims, including on currently FSC certified plantations.

- There is increased regulation and debate surrounding conversion of natural forests to plantations.

- A 2016 Ministerial Decree provides guidelines for the period 2015-2035 with objectives to increase the quantity, quality and productivity of sustainably managed plantations owned by small and medium producers and to restore degraded lands owned by small or medium landowners.

- Ongoing restoration initiatives demonstrate that there is significant interest for forest restoration from both the private sector and authorities.

4. Case study results for Indonesia

Figure 3: Political map of Indonesia. The different shades of blue help identify administrative divisions of Indonesia.

4.1 OVERVIEW

According to the FAO (2020)[74], Indonesia has 91 Mha of tree cover, which represents about 50% of the total land area of the country. Concessions currently occupy 34.18 Mha, of which 18.8 Mha are natural forest timber while about 11.27 Mha are allocated for industrial timber plantations[75]. There are 37 FSC FM/CoC certificates totaling 3.1 million ha in the country. Most of Indonesia's forest is owned by the state (86.9%) and the remainder is so-called titled forest. A titled forest is a forest located on land on which the land title is registered by private organizations or individuals. The vast majority of the production forests are owned by the state, but directly managed by private corporations and institutions based on forest concessions[81].

4.2 CONVERSION OF FOREST SINCE 1994 IN INDONESIA

We conducted a GIS analysis to identify the areas where forest was lost between 1990 and 2019 in Indonesia. Our mandate being to cover the post-1994 period, we report the adjusted statistics for this period. The objective of this analysis is to evaluate the spatial distribution of areas disturbed in the period of interest. The draft of the conversion policy & remedy procedure permits restoration in the same tenure or other tenures. Consequently, we provide the conversion and restoration statistics for the whole country regardless of site location.

4.2.1 Forest loss

For Indonesia, the GIS analysis conducted by SmartCert reveals that forest loss has occurred on 23.21 Mha since 1994 (Table 7). For the corresponding period, we find slightly less forest loss than Global Forest Watch[76]. This is due to the use of different forest cover and height thresholds (we used 30% forest cover and 5 meters) and to the fact that we resampled the data at a different resolution (90 m) than Global Forest Watch.

4.2.2 Current land use of converted areas

Of the overall area affected by forest loss between 1994 and 2019, we found that 16.3 Mha are now urban areas, roads, mines, industrial agriculture (e.g. palm oil), fruit farms, timber plantations and protected areas (see Table 7)[77,78,79]. In Indonesia, other studies showed that timber plantations account for 14% of forest loss identified with the Hansen data from 2001 to 2016[80]. Based on this, we estimate that 3.25 Mha of timber plantations have been developed between 1994 and 2019.

Table 7: Current land classification of areas where forest loss occurred between 1994 and 2019 in Indonesia

LAND CLASS	AREA IN Mha
Total area where forest loss occurred between 1994 to 2019	23.21
Current land use	0.58 (2.5%)
Converted to savanna, grassland, shrubland or cropland	
Permanent anthropogenic restrictions (not available for new plantation development or restoration) • Anthropogenic conversion including urban areas, roads, mines, agriculture plantations and protected areas. • Timber plantations	13.05 (56.2%) 3.25 (14%)
Regenerating forest	4.68 (20.2%)
Other or unclassified	1.62 (7%)

Total area of forest loss (23.21 Mha) in Indonesia (1994-2019)

Unclassified (1.62 Mha) **7%**

Available for restoration and plantation development (0.58 Mha) **3%**

Regenerating forest (4.68 Mha) **20%**

Timber plantation (3.25 Mha) **14%**

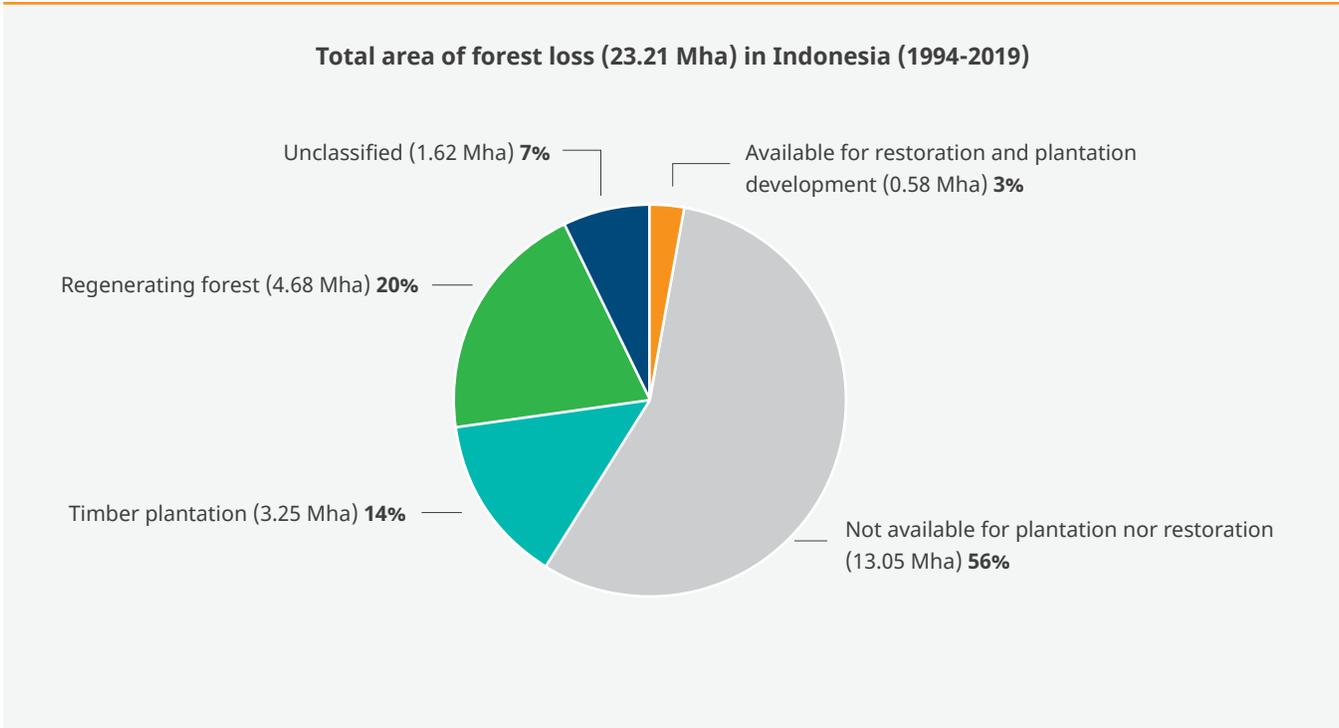Not available for plantation nor restoration (13.05 Mha) **56%**

Figure 4 : Current land classification of areas where forest loss occurred between 1994 and 2019 in Indonesia (23.21 Mha)

The land classification of the forest loss area (Table 7) suggests that the vast majority is used for agriculture and timber plantations, and that another large proportion regenerated back into forest. Only a small proportion remains converted to savanna, grassland, shrubland and cropland. 7% of the area could not be classified.

In addition to our GIS analysis, we identified supplementary opportunities for restoration. For example, most forest concessions in Kalimantan consist of approximately 5 – 10 % non-productive areas and at a much larger extent of young or old shrub and low-density forest (Peter de Haan, Personal communication, 2021). In 2020, the licenses for ecosystem restoration including peat, mangroves and mineral land covered 0.62 Mha. These areas are degraded and would benefit from restoration, but as the forest cover isn't completely lost, they are not captured in our analysis.

4.3 PRESENCE OF HCVS IN CONVERTED AREAS IN INDONESIA

We used data that serve as proxies of High Conservation Values (HCVs) to estimate the presence of HCVs inside the identified area available for restoration and/or plantation development. Table 8 provides the statistics resulting from the overlap between this available area and the mapped HCV proxies. The overlaps suggest that social and environmental HCVs were likely present in converted areas which are available for restoration/plantation development. Because of the overlap between HCV categories themselves, adding the total area of all HCVs would not provide accurate results. However, due to the very high biodiversity and indigenous population in this tropical region, we can assume a relatively high proportion of lost HCVs within the 0.58 Mha converted forest.

Table 8: Overlap between the area converted (available for restoration and/or plantations development) and HCV proxies in Indonesia

CATEGORY	HCV PROXY DESCRIPTION	OVERLAP WITH AVAILABLE CONVERTED AREAS*
HCV 1	Borneo Orangutan Sumatra Orangutan Sumatra Tiger Sumatra Elephant Important bird area Endemic bird area *Sources: birdlife and IUCN*	118,500 ha 384 ha 197,937 ha 82,004 ha 74,031 ha 396,181 ha
HCV 2	Intact forest landscapes (2000) *Source: http://www.intactforests.org/*	10,306 ha
HCV 3	Leuser forest *Source: Global Forest Watch*	34,305 ha
	Kalimatan HCV 3 including mangrove and intertidal swamp, coastal beach forest, riparian forest, mixed dipterocarp forest on alluvial, mixed or hill dipterocarp forest on various substrates, forest on ultrabasic forest, karst forest limestone, heath forest, peat swamp, freshwater swamp, grass and reed swamps, open wetlands and lakes, Montane or cloud forest on limestone, montane grass land on various substrates (see Guidelines for identification in Indonesia for a more detailed list). *Source: Regional Physical Planning Project for Transmigration (RePPProT) in Indonesia*	420,035 ha
HCV 4	Karst forest *Source: Regional Physical Planning Project for Transmigration (RePPProT) in Indonesia*	12,337 ha
	Cloud forest *Source: Regional Physical Planning Project for Transmigration (RePPProT) in Indonesia*	60,651 ha
	Mangrove *Source: Regional Physical Planning Project for Transmigration (RePPProT) in Indonesia*	99,821 ha
	Peatland *Source: Regional Physical Planning Project for Transmigration (RePPProT) in Indonesia*	379,872 ha
	Riparian areas (Buffered (30m) hydrology and water bodies). *Sources: http://gaia.geosci.unc.edu/rivers/* *Indonesia Geospatial Portal, BIG, 2020*	17,776 ha
	Steep slopes (≥30 degrees slopes using DEM data) *Source: Nasa's Shuttle Radar Topography Mission (SRTM) https://www2.jpl.nasa.gov/srtm/*	9,339 ha
HCV 5-6	Indigenous territories and cultural areas Source: https://brwa.or.id/ and Indonesia Geospatial Portal, BIG, 2020	60,651 ha

* Areas may overlap because they contain more than one High Conservation value

4.3 THEORETICAL RESTORATION POTENTIAL AND TIMBER PLANTATION DEVELOPMENT ON CONVERTED LANDS IN INDONESIA

As reported in Table 7, we found 3.83 Mha of converted forest between 1994 and 2019. Of that, 3.25 Mha was converted to timber plantations that could qualify for FSC certification under the new Policy on Conversion and 0.58 Mha remains potentially available for restoration and/or plantation development.

Table 9: Converted areas and restoration potential in Indonesia

	A	B	C	D
(All numbers in hectares)	Forest area converted to timber plantations between 1994 and 2019	Area currently available for new additional plantations and/or restoration	Of B, potential for plantation development under 1:1 scenario	Of B, potential for restoration under 1:1 scenario
Indonesia	3,250,000	580,000	0	580,000

In this scenario, we roll existing plantations into FSC compliance and certification to the extent that a 1:1 plantation to restoration ratio permits. In Indonesia, where already established plantations on converted land (3,250,000 ha – A) cover a much larger area than the 580,000 ha available (B), we made the assumption that 580,000 ha of existing plantations would be rolled in to FSC compliance and certification, and allocated the full 580,000 ha to restoration, in respect of the 1:1 plantation to restoration ratio. To allow the certification of more existing plantations on lands converted between 1994 to 2019 restoration could be achieved in ecosystems that do not meet our definition of forest conversion but where restoration is needed (see 4.2.2).

A preliminary note before diving into wood volume calculations: Planted trees do not cover the whole plantation area because set-asides are needed to meet regulation and certification requirements for plantations. FSC certified plantations are required to set aside areas of natural forests representing at a minimum 10% of the forest management unit (criteria 6.5 of the International Generic Indicators)[44]. Infrastructure and inoperable areas within plantation areas also reduce the production area. The set-asides will be variable in size, but for the purpose of estimating the wood volume, we believe that 20% of set asides is a conservative estimate. Consequently, in Table 10 below we used 2.60 Mha (3.25 Mha of Table 9 above * 80%) as the production area of the existing timber plantations developed on converted lands.

4.4 WOOD VOLUME FROM EXISTING PLANTATIONS ON POST-1994 CONVERTED AREAS IN INDONESIA

To determine theoretical wood volume for the existing timber plantation on converted areas (2.60 Mha), we focused our analysis on the average volume (m³/ha) of the six species corresponding to 81% of wood production in Indonesia (acacia, hevea, eucalyptus, teak, pine, and sengon)[81]. The "Global Forest Watch Planted Forest dataset" was used as reference to determine the species composition in the existing forest plantations in Indonesia.

Information on growth rates vary from numerous sources under different conditions and sites in Indonesia. In general, for acacia, projected stand volume at 8 years rotation varies from 232.9[82] to 325[83] m³/ha. For eucalyptus, rates vary from 81.15 m³/ha to 302.17[84] m³/ha. Rubber trees (*Hevea brasiliensis* (Willd.) Muell.Arg.) are essentially cultivated for latex production, but they also produce timber for industry, and logging residues can be used for power generation. Balsiger, et al. report volumes found in the literature ranging from 140 m³ ha to 200[85] m³ ha. For teak, pine, and sengon (*Paraserianthes falcataria*), volumes are respectively[86]: 127-268 m³ /ha, 100-197 m³ ha, and 139-166 m³ ha.

Table 10: Harvest volumes for main species cultivated in Indonesia from 3.25 Mha of existing plantations on land converted between 1994 and 2019

SPECIES	Average volume (m³/ha)	Total current plantation area (Mha)	Productive plantation area (Mha) (20% set aside)	Available volume (Mm³)
Acacia	278.95	1.78	1.42	396.11
Hevea	170.00	1.35	1.08	183.60
Eucalyptus	191.66	0.0625	0.05	9.58
Teak	197.50	0.025	0.02	3.95
Pine	148.50	0.0125	0.01	1.49
Sengon	152.50	0.0125	0.01	1.53
Total		**3.25**	**2.60**	**596.26**

4.5 SOCIAL IMPACT OF FOREST CONVERSION IN INDONESIA

4.5.1 Description of communities affected by forest conversion in Indonesia

In Indonesia, two-thirds of the estimated 240 million people (2013 census) live on the fertile island of Java with only 2.3 percent of primary forest land cover remaining (in 2016).The rest of the population is distributed among many other islands across the archipelago that have higher forest cover (BPS, 2013)[87]. Assuming that in 2016, 46.3 percent of the population lived in rural areas and directly engaged with forests, the average ratio of forest area per capita was only 1.2 ha. The assumption is that all 130 million ha of forest are distributed among the rural population. Other references suggest this distributed area to be 92 Mha. Regardless of the exact number, in any case, Indonesian forests are under pressure.

An October 2019 report[88] conducted by a coalition of Indonesian organizations and the Environmental Paper Network has found that a single company, Asia Paper & Pulp (APP), is involved in hundreds of conflicts with communities across the Indonesian islands of Sumatra and Borneo. The research results show that in just five provinces of Indonesia, at least 107 villages or communities are in active conflict with APP affiliates or its suppliers. Another example is in the province of West Sumatra alone, where 25 indigenous community that lost their land to Wilmar International Ltd (Patrick Anderson, personal communication, 2021). Extrapolating these situations to the whole country suggests that communities negatively affected by conversion are the norm.

4.5.2 Economic and social conditions before and after conversion

Many studies assess the impacts of deforestation and conversion on communities. Recent reports focus more on forest conversions for palm oil development. Both positive and negative impacts have been identified, and are summarized here.

4.5.2.1 Positive impacts of conversion on economy and livelihood

A research such as that of Clough et al. (2016)[89] and another by Drescher et al. (2016)[90] found that rainforest conversion and land use intensification lead to substantial loss of biodiversity and related ecosystem functions, including decrease in above and below-ground carbon stocks. On the other hand, rainforest conversion to agriculture provided increased income and access to education. Both studies were carried out in Indonesia's Jambi Province. The increase in income is also confirmed by a third study by Langston et al. (2017)[91] on a different island (the Sintang District of West Kalimantan), where communities found that converting forest land to agriculture (mono-crop farms) was economically more interesting than managing or conserving forests. In West Sumatra the Kapa community, upon being asked what they would want to do if they got their land back from oil palm plantation company Wilmar International Ltd., said part of it could actually stay as oil palm and the part along the coastline would be restored[97] (it was originally a coastal peatland marsh). Research discussing the positive impacts of conversion of natural forests to timber plantations in Indonesia are more difficult to find. It can however be assumed that, similar to the case of Chile, they do provide some employment and government revenue through taxation.

However, many other research showed significant negative impacts of conversion on communities, especially when it comes to human rights (see section 4.5.2.3 below).

4.5.2.2 Negative impacts of conversion and degradation

As access inside forests increased through road building by companies, encroachment and subsequent degradation increased. Highly degraded forests are caused by uncertainty of tenure, lack of ownership and/or management[92]. Indonesia experienced a decline in forest concessions, which resulted in the absence of forest management at the site level. Consequently, with no protection nor management, the forests are encroached, and illegal activities further degrade the forests left by the concessionaires. Increasing rates of deforested and degraded land have major consequences for the national economy, community livelihoods, as well as global forest biodiversity and GHG emissions. The most significant impact on the national economy has stemmed from diminishing timber production from natural forests[101].

Forests in Indonesia are home to 16 percent of the world's bird species, 11 percent of the plant species and 10 percent of mammal species[101]. It is estimated that 20-30 percent of Indonesia's biodiversity is lost every year, which also includes mammals, such as orangutan, elephant and tiger[101]. Other ecological impacts include soil erosion, degraded watersheds, vulnerability to fires during the drought season and high probability of severe floods during the wet season. All of these factors have caused a significant direct and indirect economic cost to society, not only in Indonesia, but also in neighboring countries and at the global level. At the local level, forest and land degradation has directly or indirectly disrupted the livelihoods of 10-20 million forest-dependent people in Indonesia[101]. Other estimates suggest that between 6-30 million people have been affected[101]. Important forest products and services used by local people have been impacted due to biodiversity losses and the destruction of ecological systems including most non-timber forest products important for local livelihoods. Deforestation and land degradation in Indonesia have contributed to global GHG emissions and the country is one of the world's ten largest emitters[101]. In 2005, Indonesia's annual GHG emissions were 2.2 giga tons (Gt), expected to rise to 3.2 Gt by 2030 under the 'do nothing' scenario[93]. Forest restoration in Indonesia is not important just for the country's economy and local people's livelihoods, but also for the global climate.

4.5.2.3 Human Rights Impacts of Deforestation

The Forest Peoples Program (FPP) has compiled case studies and information from FPP partners in Indonesia, Malaysia, Colombia, Peru, Paraguay, Guyana, Liberia, Cameroon, and the Democratic Republic of Congo, into a 2018 synthesis paper[94] that provides an overview of the impacts of deforestation on human rights. These impacts are not derived from Indonesia only, but show community resistance to land grabs and forest clearing frequently results in violence being used against them, including forced evictions, police harassment, intimidation, death threats and violent attacks, arbitrary arrests, retaliatory litigation and criminalization of community leaders, human rights defenders and activists.

Industrial timber plantation conflicts

A study from 10 years ago[95] showed that Indonesia had the highest number of industrial timber plantation conflicts worldwide. Most of these conflicts arise from land grabbing. A 2019 paper by FPP[96] suggests this is an on-going problem. In Indonesia, while customary rights to land are recognized by the Constitution, in practice they are ineffectively protected by other laws and regulations. The Basic Forestry Law claim state ownership over all forests in Indonesia, and lacks consideration for customary rights and local institutions, except for Customary Forest Land which is specifically excluded from State Forest. Recent changes in regulations and a revamped process for titling customary lands started in 2019. See section 4.7.1 below for a discussion on the legal framework for conversion and restoration in Indonesia.

Indonesia is home to about 50 to 70 million indigenous people, about a quarter of the country's population. A research conducted in 2019[97] looked specifically at the impact of large-scale oil palm plantations on two communities in West Kalimantan, and in Jambi. For these communities, the removal of the forest means not being able to forage, gather, do their traditional agriculture and move when they want. They now have limited access to water, and often go hungry for days. The forest fruits and roots they used to gather, and the animals they used to hunt disappeared when the forest was removed. "They now live in plastic tents and rely on scavenging palm nuts that they boil or sell to buy rice or instant noodles"[98].

In summary, communities, and in particular indigenous communities, their culture and way of life, are indeed threatened by forests conversions to plantations.

4.6 RESTORATION TO REDRESS SOCIAL HARM

This section briefly discusses whether restoring the forest, and managing it in accordance with FSC could contribute to redressing social harm, whether the changes in the cultural landscape are reversible and to which extend social harm persists in the land where conversion occurred.

The idea of restoring natural forests, if achieved, could certainly deliver environmental benefits in the medium to long term. But the idea that bringing back forests will bring back a people's culture has more to do with wishful thinking than reality. The attraction of monoculture cash crops such as oil palm is strong for poor, rural communities, and once engaged in that path, as suggested in Sirait[98] 2009's research, damage to the culture and social fabric can be difficult, if not impossible, to repair.

An article by Langston et al. (2017)[100] presents the example of a West Kalimantan village on the frontier of the agricultural market economy, where natural forests remain managed by the indigenous and local community, but economics further

intrude on forest use decisions. This research shows conservation values are declining and the future of the forest is uncertain. As such, the community is ultimately attracted to more economically attractive uses of the land for local development: oil palm or rubber mono-crop farms. The research identifies poverty as a threat to community-managed conservation success in the face of economic pressures to convert forest to intensive agriculture and provides evidence that lucrative alternatives will challenge community-managed forests when prosperity through conversion seems achievable. To alleviate this trend, the researchers identify formalized traditional management and landscape governance solutions to nurture a more sustainable landscape transition.

Sirait (2009)[99] has similar findings and suggests assisting indigenous people in their efforts to retain part of their land, labor and capital from absorption into the oil palm sector. Apart from conflict resolution efforts, three other strategies are suggested:

a. Strengthening government policies at local, provincial and national level that could protect indigenous peoples from further deprivation;

b. Supporting indigenous people engaged with oil palm concessions to strengthen their bargaining position through highlighting their basic rights and the rights of indigenous women, so as to slow down the process of loss of livelihood options for women and marginalized members of the community that often follow oil palm expansion;

c. Developing alternatives to oil palm plantations that could assist indigenous peoples in maintaining economic livelihoods on their ancestral land. Alternatives could include rubber mix gardens and producing other non-timber forest products that maintain and improve the indigenous peoples' fallow management.

SmartCert has not found research literature on large scale industrial plantation restoration. There are intentions in that field, notably the Indonesian government's Low Carbon Development Initiative[99] for 2020-2024, but it is unclear whether this is being implemented at this time. More commonly discussed solutions rather focus on slowing down conversion or saving what forest is left. Restoration of forests and their eventual management in accordance with FSC requirements does of course remain an important tool to fight climate change, erosion and to maintain biodiversity.

4.7 LEGAL/GOVERNMENTAL REQUIREMENTS, CONDITIONS AND OBLIGATIONS RELATED TO CONVERSION AND RESTORATION IN INDONESIA, AS WELL AS THEIR ENFORCEMENT.

4.7.1 Impetus required to achieve community land security

In Indonesia, while customary rights to land are recognized by the Constitution, in practice they are ineffectively protected by other laws and regulations. The Basic Forestry Law of 1967 and the revised Forestry Law of 1999 both claim state ownership over all forests in Indonesia and lack consideration for customary rights and local institutions. Recent changes in regulations and a revamped process for titling customary lands started in 2019. According to FPP (2019)[13], these "… ambitious targets for land reform and for recognizing indigenous and other peoples' rights in lands and forests are far from being realized. If it is serious about meeting its targets and securing land for the poor, the government must simplify the currently over-complex and highly bureaucratic regulations. Inter-Ministerial coordination must be stepped up. Budgets for land rights recognition must be increased. Land security must be extended to the thousands of communities who have had industrial concessions handed out over their lands without regard for their prior rights. The government must ensure that these rights are enforceable first by not issuing further concessions over areas recognized as indigenous territories and, secondly, by affording them legal power to sue for lands seized without their consent."

4.7.2 Loopholes in the current moratorium on conversion

A temporary moratorium on granting permits to clear primary forests and peatlands for plantations or logging was first issued in 2011 by the Indonesia's president before being made permanent in 2019. In a 2019[100] article, Mongabay reports several loopholes in the moratorium that allow developers to continue exploiting forest areas without consequence.

Nevertheless, the moratorium should be seen a major governance effort from the government to stop (or probably, more realistically, reduce) deforestation. But the FPP (2019)[101] notes that the government's policies are contradictory. On the one hand, the government says it wants to resolve conflicts and help the rural poor have secure access to lands, but, on the other hand, it is promoting infrastructure and mining projects which override their rights. Mongabay[12] also mentions "The policy explicitly prohibits the issuance of new plantation and logging permits for carbon-rich primary forests — but not for secondary forests, defined under Indonesian law as those that have previously been logged to any extent. As a result, some parties are deliberately clearing areas of primary forest within moratorium zones for the express purpose of degrading them. Once that happens, these areas are recognized as secondary forest, and thus fall out of the scope of the moratorium". Finally, this article also cites Greenpeace saying another shortcoming of the moratorium is that large tracts of primary forest are not covered by it and are thus vulnerable to exploitation. 333,000 km^2 of primary forest and more than 65,000 km^2 of peatland (some forested), are completely open to development.

4.7.3 Other safeguards/requirements for forest and plantation management

Beyond the new moratorium, the earlier legal safeguards remain i.e., strict requirements for issuance of concession/ or plantation license. According to the law, timber plantation (HTI) licenses shall only be issued if the proposed areas have timber stocks of less than 30 m^3/Ha, in which case the existing vegetation can be removed and replaced with the preferred commercial species (typically fast-growing ones). Meanwhile the areas with relatively good forest cover condition (above 30 m^3/ha) can be issued Natural Logging Concession (HPH) licenses.

Once a HTI (timber plantation) license is issued, the requirements the license holder has to comply with include setting aside areas:

- At least 10% for conservation;
- At least 10% for community livelihood. In this particular area the company is required to plant multi-purpose tree species after proper consultation with the communities;
- 5% areas planted with endemic/local species;
- 5% for infrastructure to support the operation.

The remainder of the total concession then can be planted with the preferred fast-growing species.

Meanwhile, for HPH (natural logging) licenses, concession holders are required to retain the forest cover through selective logging, opening as little permanent roads and infrastructure as possible and immediately restoring both permanent and temporary forest opening by replanting some specific tree species.

4.7.4 Absence of legal requirements for restoration

There are no legal requirements for the restoration of oil palm or timber plantations in Indonesia. Companies are not required to bring back forests after they have been converted to plantations, merely because oil palm plantations are by law only allowed to be developed outside forest areas (in spatial planning term know as APL or other land use). However, in practice oil palm is routinely planted on forest land.

4.7.5 Restoration of degraded natural forests is at standstill

Harrison, Swinfield et al. (2020)[102] found that even though restoration licenses were first introduced to Indonesia in 2004, to date restoration business plans in these natural but degraded forests due to selective logging followed by the absence of management remain largely aspirational. Most concessions have made only limited progress toward realizing revenue streams. High operating costs and overregulation impede the development of viable restoration business models.

4.7.6 Diminished protection of peatlands

Existing regulations, issued in the wake of devastating fires in 2015, require that plantation companies and other concession holders, whose land includes areas with peat layers 3 meters (10 feet) or deeper, restore and conserve those areas. However, since 2019 a new regulation issued by the Ministry of Environment and Forestry redefines the area that must be protected, essentially opening up large areas of peatlands to exploitation. Under the regulation, concession holders are now only required to protect peat domes, which are landscapes where the peat layer is so thick that the center is topographically higher than the edges. Areas beyond these domes will once again be open for exploitation, even if they meet the 3-meter peat layer requirement that would have qualified them for protection under the previous regulations[103].

4.8 NON-GOVERNMENTAL INITIATIVES COMBATING CONVERSION

4.8.1 Organizations in Indonesia combating conversion

Indonesia has a very large number of environmental and social NGOs, big and small, local, regional and international, focusing on deforestation and conversion. Wahana Lingkungan Hidup Indonesia (WALHI) is one of the big environmental organizations in Indonesia with a membership of 487 smaller social and environmental organizations. *Eyes on the Forest* is another coalition of NGOs that "investigates those who clear forests and grab land they do not own in Indonesia". The coalition also informs those who buy products made from commodities grown on these lands (such as palm oil and pulp), and those parties that regulate the use of these lands. Its founders are: WWF-Indonesia Central Sumatra Programme, Jikalahari ("Riau Forest Rescue Network") and Walhi Riau (Friends of the Earth Indonesia). Its network members include: KKI Warsi, Environmental Law Clinic, Lembaga Gemawan, Jari Indonesia Borneo Barat, Kontak Rakyat Borneo, POINT, Swandiri Institute, Yayasan Titian, Gapeta Borneo and WWF-Indonesia West Kalimantan Program. The Rainforest Action Network (RAN), Greenpeace, Forest Peoples Programme, and a multitude other national and local NGOs like Planet Indonesia, etc. are all active in one or many ways, exposing plantation companies practices and human rights violations with regards to conversion.

4.9 ANALYSIS OF RSPO COMPENSATION AND REMEDIATION REQUIREMENTS

SmartCert was given the task of comparing the FSC policy with how conversion is addressed by the Roundtable on Sustainable Palm Oil (RSPO), particularly with regards to compensation measures. FSC also tasked SmartCert to analyze how similar compensation measures could be eligible for FSC.

4.9.1 How is conversion addressed by RSPO?

The RSPO (https://rspo.org) has developed a set of environmental and social criteria which companies must comply with in order to claim their product as Certified Sustainable Palm Oil. In accordance with the first RSPO P&C 2007, RSPO growers (certificate holders) must complete HCV assessments prior to clearing lands for the establishment of new plantations after November 2005. The intention is that areas of land under the control of RSPO growers that contain or support HCVs are not cleared for planting after that date. The RSPO P&C 2018 include new requirements to ensure the effective contribution of RSPO to halting deforestation: Land clearing shall not damage HCVs or High Carbon Stock Forests (HCS) after November 15, 2018. Where land clearing does not meet these requirements, the RSPO Remediation and Compensation Procedure (RaCP) applies.

The RaCP procedure (link to RaCP) requires growers to first disclose any new land development that took place without prior HCV assessment, to calculate environmental liabilities through a Land Use Change (LUC) analysis, and to carry out onsite or offsite remediation for the affected sites, and remediation if there are affected parties. Growers who disclose non-compliant land clearance need to complete the RaCP before obtaining RSPO certification.

4.9.2 What compensation measures does RSPO require?

Growers are not required to compensate for land clearance that can be demonstrated to be non-corporate clearance (for subsistence farming, government public works, etc.).

For land cleared for plantations (called corporate clearance), growers who enter into compensation processes have two options:

1. compensate the total cleared area used without conducting a LUC analysis; or

2. conduct a Land Use Change Analysis (Link to LUC analysis) relating to all individual cases of land clearance since November 2005 without prior HCV assessment.

The LUC analysis helps determine remediation needs and compensation liabilities for all lands cleared without prior HCV assessment. The procedure has adopted a proxy-based approach for calculating conservation liability based on satellite imagery analysis of past vegetation cover. Areas cleared without prior HCV assessment are classified into four categories representing the forest/habitat types and other land uses. They represent a sliding scale of habitat quality, ecological and conservation value, which are assigned coefficients between 1 and 0 and are used as multipliers in the calculation of conservation liability (for details see: Link to categories of land cleared without prior HCV assessment). Where such evidence is not available and the satellite imagery is not distinctive, the higher coefficient category is selected, in line with the precautionary principle.

There are two options for compensation available to growers in order to meet the final conservation liability (which can be used in combination with each other), expressed in hectares:

Option 1: An area of land equal to the final conservation liability is managed primarily to conserve biodiversity by the company and/or by a third party within or outside areas managed by the company.

Option 2: The company provides funding to a third party for projects or programs contributing to achieving conservation objectives outside the areas managed by the company. The total amount of funding equals the final conservation liability in hectares multiplied by USD2,500.

In both options, growers remain responsible for the demonstration of the delivery of conservation outcomes as per the compensation package chosen, taking into consideration any issues that are beyond the control of growers, such as zoning, population pressure, etc.

Growers need to provide evidence to demonstrate they do not have outstanding social liability under the RSPO RaCP. In such cases where they do have liability, growers need to provide remediation for HCVs 4-6. Furthermore, the RSPO RaCP requires lands cleared without a prior HCV assessment to be returned to a state of compliance. In addition to HVCs, compliance requires remediation for plantations established in other prohibited areas such as conservation areas (HCS forests, peatland conservation areas, riparian areas, steep slopes, fragile and problem soils, etc.). In most cases, this will involve ending cultivation of palm trees and returning these areas to natural vegetation cover. But fulfilling the remediation requirements is not part of meeting the compensation liability. When remediation is required, it is in addition to compensation. See link for more details.

4.9.3 Would similar compensation measures be eligible for FSC, and how might they influence the application of the Policy on conversion?

The intention of RSPO's conversion policy is for areas of land under the control of RSPO members that contain or support HCVs not to be cleared for palm oil plantations.

While FSC can certainly consider adopting a similar compensation system, FSC is concerned with conversion of all forests and not only those which contain HVC and high carbon stocks. Therefore, should FSC adopt a system inspired by RSPO's conversion policy, a system that covers a broader scope should be taken into consideration.

Another important thing for FSC to consider, is the fact that RSPO members are probably able to invest more than FSC certificate holders when it comes to compensating and restoring forests. Palm oil is a valuable commodity in high demand, and plantations are generally established on richer soils in the limited number of countries who can produce it. Timber plantations, however, will often find themselves on poorer soils. Indonesia timber plantations mostly produce pulp, which is a commodity that has competition from all the other forest regions of the world. In that context, it can be assumed that forest companies will not be able to afford compensation or restoration at the level that palm oil producers can, considering the areas they have impacted are larger and generate less revenue than palm oil.

4.10 RECAP OF THE INDONESIA CASE STUDY

- The vast majority of the production forests are owned by the state but are directly managed by private corporations and institutions based on forest concessions.

- Using our GIS analysis we calculated 0.58 Mha of forest converted since 1994 and available for restoration and/or plantation development. We also identified significant opportunities of restoration in degraded forests that do not meet the FSC definition of natural forest conversion and in other ecosystems such as peatlands.

- We estimate that 3.25 Mha of forest has been converted to plantation since 1994. In order to roll these plantations into FSC compliance, all the 0.58 Mha will need to be restored in addition to other areas that are known to require restoration but do not meet the FSC definition of conversion since 1994.

- Before conversion, social and environmental high conservation values were likely present in those available 0.58 Mha.

- Our analysis suggests that the potential exists for restoration on converted lands with a 1:1 restoration to certified plantation scenario, for 598.33 Mm^3 total volume by 2050.

- Road building by companies and subsequent decline of concessions has led to forest encroachment and degradation, with impact on the economy from lessened timber production, on community livelihoods, biodiversity, ecosystem services and GHG emissions.

- Conflicts and violence arise from plantations established following some form of land-grabbing.

- To counteract the strong economic pressure to convert forests to unsustainable land uses, various policy, rights-related, or alternative-uses strategies can be implemented.

- Both plantation and natural logging licenses come with some form of requirements to ensure some natural forest cover.

- Restoration licenses exist for degraded forests but are not implemented due to cost and regulatory burden.

- There is a significant constellation of NGOs of various size that focus on deforestation and conversion. However, due to lack of appetite for green labels in the market for Indonesian plantation wood, they are not likely to drastically change their level of influence on plantation companies to obtain adoption of FSC compared to what it has been historically.

- RSPO's approach to conversion can be effective within its scope, but differences between palm oil and pulpwood production and market contexts make it difficult to transpose its relatively costly approach to FSC certification.

5. Discussion

5.1 WHAT IS THE POTENTIAL FOR CERTIFICATION AND ASSOCIATED POTENTIAL FOR RESTORATION IN CASE THE REVISED CONVERSION POLICY COMES TO FORCE?

Our results suggest that the areas currently available for establishing certifiable plantations (0.50 Mha Chile, 0.58 Mha Indonesia), in association with restoration of proportional areas as per the new FSC conversion policy, are relatively modest in comparison to the forest area of each country (Table 11).

Table 11: Comparison of the forest area and converted area available for restoration and/or plantation development in Chile and Indonesia

COUNTRY	Whole country natural forest area (Mha)	Existing plantations developed on converted lands between 1994-2019 (Mha)	Post-1994 forest conversion (Mha)	Potential for FSC certified plantations in post-1994 conversion under the new policy (Mha)	Additional FSC certified plantation wood volume available by 2050 as result of new FSC policy
Chile	15.03[104]	0.10	0.50 (3% of whole country natural forest area)	0.30 (assuming 0.2 Mha plantation development and 0.3 Mha restoration)	98 Mm^3
Indonesia	92.13	3.25	0.58 (0.6% of whole country natural forest area)	3.25 (assuming 0.58 restoration in post-1994 conversion and restoration of other ecosystems that don't fall under the FSC definition of post-1994 natural forest conversion.	596 Mm^3

Our results show that by 2050, a volume of 198 Mm^3 for Chile (Table 6) and 596 Mm^3 for Indonesia (Table 11) could be available.

The area available for restoration and/or development of plantation reported in Table 14 is relatively low in comparison to the natural forest area of both countries. This is because the FSC definition of "conversion" requires permanently converted lands. As shown by our study, the amount of permanently converted lands determined on the basis of our criteria is relatively small. However, there is a much greater opportunity to restore degraded forests or other natural ecosystems such as mangroves or peatlands. These degraded or damaged areas are not considered "conversion" in our study and are likely captured in our regenerating forest classes. We believe that the type of ecosystem that can be restored as part of the conversion policy is a critical consideration that will be decisive for the success of the policy.

5.2 HOW MUCH OF HCVS WERE LIKELY LOST THROUGH CONVERSION AND COULD THEY BE RESTORED?

Our study finds that HCVs were impacted by conversion in both countries. With time, species habitat and ecosystem services, such as protection of soils prone to erosion and riparian buffers to protect water resource, could be restored. However, social harm of conversion can be permanent. Social HCVs (categories 5 and 6) are less likely to be restored.

5.3 HOW COULD THE NEW FSC CONVERSION POLICY INFLUENCE DEMAND FOR PLANTATION CERTIFICATION?

Forest plantation expansion faces significant headwind in Chile, particularly where land is fragmented into a multitude of small and medium landowners. These landowners do not have the means to manage plantations and restoration. They are currently not organized under an umbrella marketing board or other organization which could take on a group certification project. In this scenario, it is unlikely that small landowners in Chile would have the means to achieve restoration and certification. There are a handful of large corporations that own more than half of planted forests in Chile. These companies are producers but also buyers of wood in Chile and therefore they control the demand for wood. They would gain interest in certification/restoration if it has the potential to improve productivity because there is a foreseeable shortage of timber in Chile.

In Indonesia, timber plantations are mostly located on state owned land and managed by large producers.

For large producers in both Chile and Indonesia, our case studies finds issues that could dampen the impetus for establishment of FSC policy conformant plantations-restorations:

- Forest restoration is a long-term, risky and costly project. In the case of Indonesia, it has little precedent, whereas some projects are ongoing in Chile;

- Some HCVs have the potential to be restored but others, such as sacred sites and other social HCVs, possibly cannot be restored once they have been destroyed;

- While the environmental benefits of restoration are evident, the case for restoration as a way to redress social harm is uncertain, as demonstrated in the literature reviewed by SmartCert;

- Certification on converted lands after 1994 represents a reputational risk for FSC, especially in countries where land conflict exists with indigenous people and where points of view about forest plantations are polarized. This, however, can be mitigated through rigorous FPIC type consultation of local stakeholders and other standard FSC requirements such as having undisputed land titles, etc.;

- If the policy allows planters to compensate by restoring and preserving in one area while establishing the plantations in other areas, communities neighboring the plantations might not see the benefits, which could result in low social acceptability/support for certification.

Considering the above, SmartCert finds that while there are large areas where FSC policy compliant plantations and restoration could be established, restoration is a risky and long-term endeavor, social harm redress might not materialize, and company uptake is uncertain. On the positive side, the potential environmental benefits of a restored forest are appealing, and maybe even essential in sensitive areas where native vegetation is needed in order to deliver critical ecosystem services (riparian areas, steep slopes, wetlands, critical habitats, etc.).

5.4 WHAT ARE THE ENVIRONMENTAL FORCES THAT WILL INFLUENCE THE IMPACT OF THE CONVERSION POLICY?

The scenarios that we have developed for volumes of harvested wood on lands converted between 1994 and 2019, indicate that, theoretically, an increase in production of certified volume in plantation established after 1994 is possible in both countries. Below, we outlined some considerations about the macro environmental context, and the forces that will create opportunities and threats to the development of FSC plantations and restoration.

Demography: Rural exodus is a global phenomenon that exists in Chile[105] and Indonesia[106]. It may lead to a reduction of the workforce in rural areas where plantations are developed and where forests need to be restored. It will also likely reduce the number of people that depend on forests for their livelihood. It could also increase land abandonment.

Economy and political: In the upcoming years, the growing global demand for wood will continue to put pressure on supply in both countries. In this context, it is unlikely that the development of plantations on converted lands will stop. At the same time, there is significant pressure from civil society to improve conservation and stop natural forest conversion. Governments of both countries will likely seek a balance between both of these issues. By providing a framework to develop plantations and to restore degraded natural forests, FSC offers a solution that may be welcome by governments if there is buy-in from industry and civil society.

Ecology: Climate change affects the resilience of natural forests and the productivity of plantations. Its impact is expected to get worse. In that context, restoring the considerable amount of natural forest that has been degraded (as seen in Chile and Indonesia) is critical but it could be more challenging. At the same time, this should increase the willingness of forest plantation managers to carefully plan the development of plantations and to manage them sustainably.

Technology: Mechanized forestry is prevalent in Chile while harvesting remains partially manual in Indonesia. It is likely that the trend towards more automation will continue in the forest sector of both countries, which should increase the efficiency of forestry, particularly in plantations. At the same time, it creates a barrier to entry for small producers because it requires large scale plantations and large investments. In a country like Chile where forests are privatized and fragmented, this could be a factor that reduces the development of new plantations.

Socio-cultural: The continuous encroachment on nature, the general urbanization of the world's population and the growing ecological awareness and acknowledgement of indigenous people land rights are factors that will increase the pressure towards sustainable land stewardship.

5.5 SOURCES OF UNCERTAINTIES AND LIMITATIONS IN THIS STUDY

5.5.1 Forest conversion, HCVs analysis and qualitative literature review

To conduct this analysis, we used various data sources that have different resolution i.e. the Hansen data was resampled at 90 meters, the Modis data has a 500 meter resolution and shapefiles were developed with various resolutions/scales. These differences are inherent uncertainty in the data.

Although the Hansen Global Forest Change v1.0 (2000–2012), v1.7 (2011–2019) data sets and the GFCC Forest Cover Change Multi-Year Global dataset are amongst the best forest loss data available, it is important to recognize their limitations when interpreting our results. The accuracy of forest loss detection varies for each data set and has improved during the period of the study. According to Hansen et al. (2013) the overall accuracy of the forest loss data is greater than 80%[108].

In our analysis, areas converted before 1990-2019 that were covered with trees at the beginning of this period are considered forests including forest plantations and fruit plantations from natural forests. This means that if plantations were harvested between 1990 - 2020, they are captured in the forest loss. We mitigated this problem by removing timber and fruit plantations from forest loss using vector datasets of plantations.

Another source of uncertainty is that some areas captured as non-forest in our current land use analysis may have been recently deforested and are not permanently converted. At the opposite, it is likely that grassland/shrublands have been classified as regenerating forest in our results. We found 3% of conversion to savanna, grassland, shrubland or cropland. Austin et al. (2017) did a similar assessment in Indonesia by conducting a visual interpretation of a sample of the area using high-definition images and found that 20% of the forest loss consisted of conversion to grassland/shrubland[77].

Data in the form of shapefiles from different sources was used and the data sources were incomplete. This source of uncertainty was mitigated by locating the best data sources and by comparing data from various sources and, where useful, by merging datasets to conduct the analysis.

One of the important datasets used was the Global Forest Watch Planted Forest[109] dataset. According to Global Forest Watch, this data is mostly from 2015 and covers approximately 80% of the world's plantations[110]. For Chile, this was the only dataset used to assess the presence of plantations. For Indonesia we completed the dataset with other local sources. Nonetheless, plantations may be underestimated in both countries. Also, in Indonesia some plantations are classified as fruit and timber plantations. Where fruits were present, we classified the plantation as an agriculture plantation.

Some shapefiles of the current range of species at risk (HCV 1) in Indonesia are recent. Therefore, the species habitat represented in our shapefiles had likely already changed due to habitat destruction caused by forest conversion. As a consequence, our analysis likely underestimates the presence of HCVs in forests before they were converted.

The qualitative section of this study was conducted solely based on a literature review, using information obtained locally or from international stakeholders. We did not conduct broad consultations and ground proofing. Therefore, our results and analysis are limited to the information that our team was able to collect. Because of the abundance of research by a myriad of scientists and institutions and on a multitude of subjects surrounding deforestation, plantations, legislation, indigenous lands, human rights, biodiversity etc. for Indonesia and Chile, there is a risk that credible scientific papers exist that would nuance or contradict our findings. To mitigate this, SmartCert did its best to sample a cross section of papers from universities, NGOs, governments, UN institutions and the private sector and used more than 100 publications for the qualitative section.

 Another uncertainty to keep in mind is that there may be a significant proportion of the post-1994 conversion that is exempted from the Conversion Policy because it does not apply to companies operating on lands converted by other entities. Small scale producers (less than 50 ha) may also be dispensed from the procedure.

Another factor that may influence the impact of the Conversion policy is that forest management units that have been partially converted after 1994 may be disqualified in their entirety from certification if the areas converted cannot be excised. In this scenario the policy may enable the certification of larger areas than what was converted after 1994.

Table 3 and Table 8 report the statistic for potential HCVs in the area converted between 1990-2019 because it was not possible to map conversion between 1994-2019. Consequently, the HCV statistics are slightly overestimated.

5.5.2 Theoretical model of wood volumes

Many assumptions were made throughout the wood volume modeling process, and the results are sensitive to these assumptions:

a. The accuracy of the planted area by species is correlated to the precision of the Global Forest Watch Planted Forest dataset. While for Chile official databases confirm planted species distribution obtained through GIS analysis, for Indonesia, less up-to-date and detailed data was available to confirm results.

b. Wood volume forecasts only considered the accumulated total converted area available for forest plantation in 2019. However, GIS and literature review confirmed that conversion happened continuously since 1994, which may suggest that if the same trend persists, available area could be higher by 2050 than the available area in 2019.

c. Highly intensive silvicultural practices are applied to forest plantations in both countries, using chemicals, genetic tree improvement, and large-scale mechanized harvesting. Those plantations are mainly managed as monoculture plantations, and management practices vary considerably according to factors such as final product, site, and land-ownership. Thus, volume growth rates may vary significantly. In Chile, official datasets were available through IN-FOR and CONAF for the nine growing zones in the country. But because the country has started a program of genetic improvement since the 70's, achieving important advances during this period, it is impossible to know the next achievements that could lead to higher volumes per hectare for the next 30 years. For Indonesia, there are a range of scientific articles describing growth rates for various species on the islands. However, there is no constancy on the analysis (growth indexes, silvicultural practices, tree age during assessments). Also, information is not centralized nor up to date. This makes it difficult to make consistent comparisons between growing rates in the country.

d. Changes in market demand could have significant impacts on silvicultural practices, including rotation period and species composition. Even though both countries have a wide portfolio of products for export, in terms of volume roughly half the trade is accounted for by the paper sector, and half by all other wood products combined. Indonesia has produced on average two times more roundwood than Chile since 2010. However, there is a decreasing trend for Indonesia's participation in the roundwood global market since 2013. On the other hand, Chile has increased its participation by 18% in that same period.

e. Since 2008, plantation development on private land in Chile where natural forest exists are regulated by the "Ley de Recuperación del Bosque Nativo y Fomento Forestal"[111]. It allows the conversion of a maximum of 25% of the forest areas with less than 45° slopes. This may significantly reduce the development of plantations or their size and consequently reduce plantation wood projections.

6. Conclusion

Our study demonstrates that permitting FSC certification on converted lands after 1994 while requiring forest restoration does present opportunities, but that in both countries the surface area available for restoration and/or plantation development is limited. If restoration is only allowed in areas that meet the FSC definition of "conversion", the policy will have a limited impact on fighting deforestation in these countries. This is because the FSC definition of "conversion" requires permanently converted lands. As shown by our study, the main driver for conversion is urbanization and infrastructure development. Consequently, the amount of converted lands available for restoration and plantation development determined on the basis of our criteria is relatively small. However, there is a much greater opportunity to restore degraded forests or other natural ecosystems such as mangroves or peatlands. These areas are not considered converted nor by FSC nor by our study. They are likely captured in the regenerating forest classes but remain significantly altered. We believe that the type of ecosystem that can be restored as part of the conversion policy is a critical consideration that will be decisive for the success of the policy.

Our analysis indicates that environmental and social HCVs were present in the converted areas. Some environmental HCV are likely to be restored through adequate habitat restoration. However, the restoration of social HCV remains intangible because restoration of social values has little precedent in both countries.

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