



Verified Carbon Standard

GREEN GOLD LORETO 1

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Established in 2008, GREEN GOLD FORESTRY PERU SA, ('GGF') is a vertically integrated sustainable hardwood company owning modern sawmilling facilities at Iquitos in Loreto, Peru. GGF is Peru's largest forestry concession holder, with 254,000 ha under management. With the Green Gold Loreto 1 project, Green Gold Forestry will take 183,445 ha of its production forest concession area out of the planned logging cycle and into management for ecosystem services. Within the project boundary, baseline logging will cease, together with the establishment and maintenance of logging roads, skidding trails and other infrastructure. Thereby, emissions will be eliminated from the extraction and processing of logs, from collateral mortality of felling operations, and from roads, skidding trails and other infrastructure. The forest will be protected from disturbance, reducing emissions from logging operations and allowing carbon content to accumulate over time, taking advantage of the overall trend of carbon accumulation in Amazonian forests (Brienen et al, 2015). The project's overall climate benefit is estimated at about 9.74million tCO₂e over its first 20-year crediting period (averaging about 487,000 tCO₂e per year). Any negative effects that biodiversity may have experienced from logging operations will be allowed to recover.

The project will work with neighboring communities to establish an active conservation program for their benefit and for that of the climate and the forest's biodiversity and ecosystem health. At a minimum, the same number of personnel will be hired from the communities for the conservation project as are currently employed in the logging operation. Jobs will include forest rangers, eco-guides, research and monitoring assistants and other support staff. Forest rangers will regularly patrol the project area, particularly its fluvial access routes, to detect and deter illegal logging, hunting and encroachment. The project plans to develop the conservation area as a prime destination for ecotourism and scientific research, establishing a lodge and research station within the first five years. Furthermore, the project intends to establish and support sustainable non-timber forest products (NTFP) and fruit growing enterprises with the communities.

1.2 Sectoral Scope and Project Type

This is an AFOLU Improved Forest Management (IFM) Logged to Protected Forest (LtPF) project. It is not grouped.

1.3 Project Eligibility

- The project reduces emissions from forest degradation and removes emissions through forest growth, relative to the baseline scenario.
- The project complies with the applicability conditions of an approved VCS Methodology (VM0010).
- The project design and its implementation do not violate any Peruvian laws.

1.4 Project Design

The project consists of a single project activity instance.

Eligibility Criteria

N/A

1.5 Project Proponent

Organization name	Green Gold Forestry Peru SA
Contact person	Mr. Gareth Hughes
Title	General Manager
Address	Calle Moore 908-A, Iquitos, Iquitos, Loreto, Peru
Telephone	(51) 995194038
Email	gareth.hughes@ggfgroup.pe

1.6 Other Entities Involved in the Project

No other entities are involved in the project.

1.7 Ownership

The project is 100% owned by Green Gold Forestry Peru SA (GGF), which owns the forest concession licenses referred to herein. Through these concession licenses GGF has a contractual right in the land, vegetation and conservational or management process that generate GHG emission reductions or removals. These vest with the project proponent, as a result of the enforceable and irrevocable agreement with the Peruvian state (New Law of Forestry and Wildlife - N° 29763).

1.8 Project Start Date

The project start date is the 1st of August 2020. This is the date on which it is assumed that logging operations would have resumed in the project area in the baseline scenario, whereas the project activity of conservation is effectively being implemented. It marks the beginning of the dry season when logging operations are feasible again after the rainy season.

1.9 Project Crediting Period

The project crediting period is 20 years, commencing on the 1st of August 2020 and ending on the 31st of July 2040.

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale

Project	
Large project	X

Year	Estimated net GHG emission reductions or removals (tCO ₂ e)
1	359,131
2	372,584
3	386,036
4	399,489
5	412,942
6	426,394
7	439,847
8	453,300
9	466,752
10	480,205
11	493,657
12	507,110
13	520,563
14	534,015
15	547,468
16	560,921
17	574,373
18	587,826
19	601,279
20	614,731
Total estimated ERs	9,738,622
Number of crediting years	20
Average annual ERs	486,931

The primary project activity within the project boundary is conservation of the existing forest ecosystem, i.e., the avoidance of any logging, mining, hunting or unsustainable NTFP collection. Conservation of the forest will be ensured by:

1.11 Description of the Project Activity

1. Involving the neighbouring communities in the project, to ensure their participation in, and commitment to, forest conservation, by making them project stakeholders and beneficiaries. The project is partnering with two Peruvian NGOs (Derecho, Ambiente y Recursos Naturales (DAR) and Centro para el Desarrollo del Indígena Amazónico (CEDIA)) with experience in community outreach and monitoring. GGF also already has dedicated staff for community work as part of its Forest Stewardship Council (FSC) certification. Community benefits include:
 - a. job creation and professional training (as forest rangers, eco-guides, technical assistants in project monitoring and scientific research, other on-site support staff);
 - b. supply of provisions (food and other goods) to the project's staff;
 - c. local enterprise development and training e.g., fruit tree planting and NTFP collection; and
 - d. establishment of a community development fund that communities will be able to make applications to (e.g., for infrastructure or education needs).
2. Regularly patrolling the project area with teams of forest rangers, who will be hired from neighbouring communities and trained and equipped to adequately and safely deal with potential incursions;
3. Erecting signs along all fluvial access points and existing logging roads to inform and warn potential intruders of the conservation status of the project area;
4. Remote monitoring using drone and satellite surveys.

Effective avoidance of intrusions by outsiders is ensured through a visible and regular presence of project staff in the project area. This will be achieved through regular forest ranger patrols, and also ecotourism expeditions and scientific research expeditions. The project will collaborate with local and regional law enforcers to support forest rangers in cases of repeated and/or threatening incursions.

The project's vision is to develop the project area as a centre for ecotourism and scientific research. The area can be reached within half a day by boat from Iquitos, the capital of Loreto and already a hub for ecotourism. GGF already has many links with research institutions locally (including Universidad Nacional de la Amazonía Peruana (UNAP) and Instituto de Investigaciones de la Amazonía Peruana (IIAP) in Iquitos) and internationally. Within two years after the project start date, the intention is to develop an eco-lodge and adjacent research station that will provide employment to community members as guides, research assistants and other supporting staff.

Changing the management of the project's forest areas from logging to conservation will avoid carbon emissions and negative biodiversity impacts from forest degradation and disturbance. Furthermore, it will allow the unlogged forests to accumulate even more carbon, which is sequestration that would not be possible if subjected to logging. The long-term effects of

disturbance and degradation on 'intact forests' are significant and the project will avoid these effects and allow the natural ecosystem to thrive (Maxwell et al, 2019).

Peru has a national REDD+ policy that requires all projects to be part of a jurisdictional REDD+ program from 2021. However, development of national and jurisdictional reference levels has so far exclusively focused on deforestation and has not included emissions from planned forest management, nor is it foreseen that it will do so as this falls outside the baseline approach used to predict future deforestation (and in due course degradation) from historical data. This makes it impossible for the Green Gold Loreto 1 project to participate in a jurisdictional REDD+ program. It may be possible that the Ministry of Environment and Mining (MINAM) will in future develop a nesting policy for IFM projects, but no indication or guidance exists to this effect. The project has discussed its situation with MINAM, expressing its desire to operate independently until such time as nesting becomes appropriate. MINAM has shown in meetings to be fully supportive of the project.

1.12 Project Location

The project areas have been divided by GGF into three project regions, each comprising one or more discreet parcels of forest land. The three regions are:

1. Consolidado#1 – Total area 125,558 ha
2. Consolidado#2 – Total area 30,620 ha
3. San Regis – Total area 27,268 ha

The locations of the project areas are shown in Figure 1. Individual maps of the project regions, including geodetic coordinates, are presented in Section 3.3: Project Boundary.

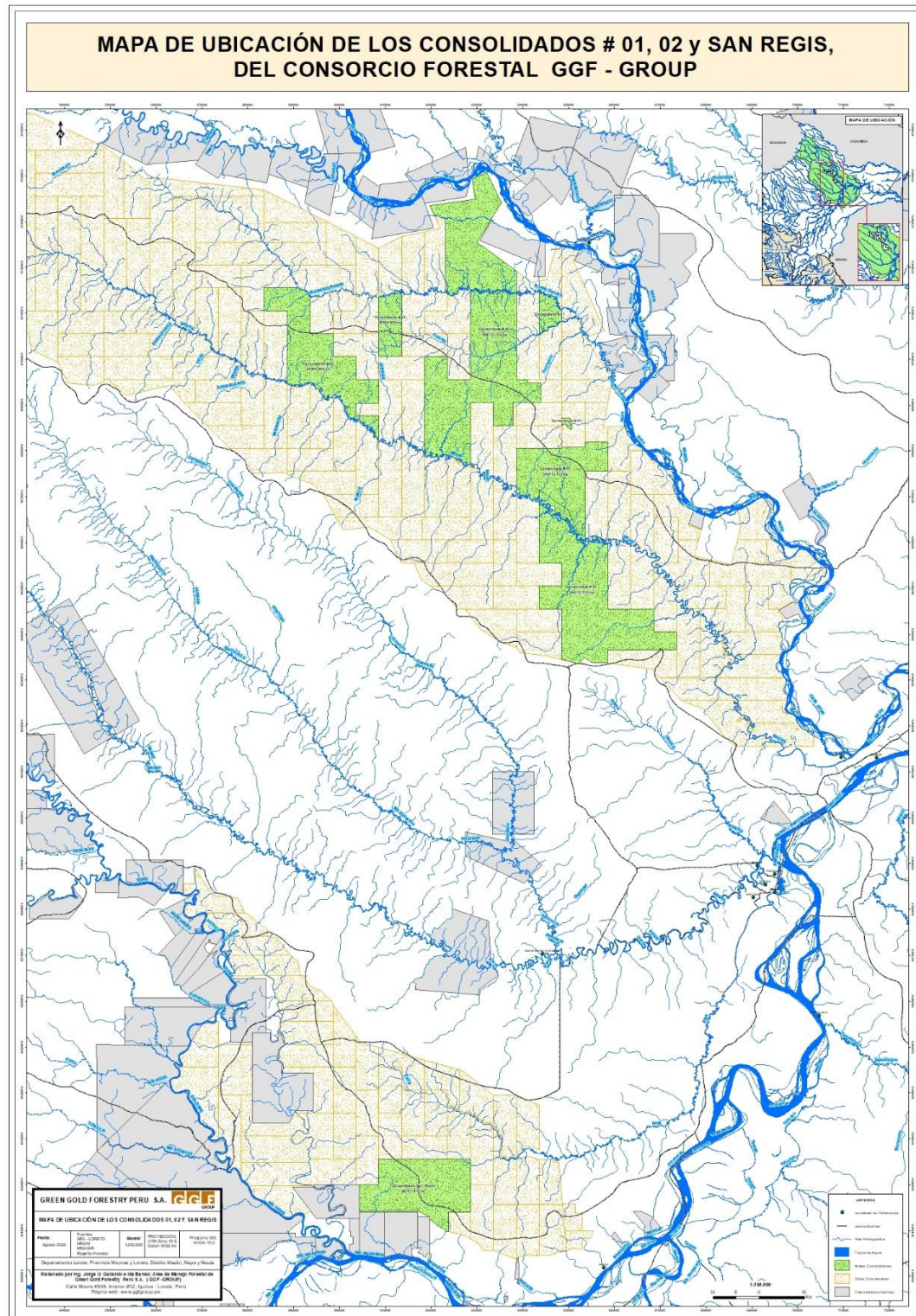


Fig. 1. Locations of the logging concessions in which the project areas are situated

1.13 Conditions Prior to Project Initiation

GGF started logging in the area in 2011, growing its portfolio of concession licences to about 170,000 ha by 2018. In 2018 GGF acquired rights to a further circa 80,000 ha with a view to expanding its logging operations after raising capital for increased and more streamlined operations. In accordance with the 20-year felling cycle about 30,000 ha has been selectively logged since 2011 (these areas are not part of the project area). The situation is therefore that the project area has not historically been logged by GGF, but that this would be the case in the baseline scenario as they currently form part of GGF's actively managed concessions. It is not clear whether the project area was logged in the past, but not likely after the 1980s. The Peruvian government sold logging licences in Loreto in its most recent round in 2003 with a subsequent round in 2018. There is now a new push to get the area logged. The Regional Government has announced a re-activation of the forest sector initiative which promotes intensive logging.

The project areas can be described as lowland humid tropical, with an altitudinal range between 10 and 80 meters above fluvial water levels. They are areas of ancient alluvial origin, lifted up slightly by the rise of the Andean mountain chain and partially eroded in the higher parts and filled with alluvial sediments in the lower parts (MINAM, 2015).

The project areas are covered 100% with forest vegetation of two vegetation types, which are classified as Bosque de Colina Baja (94.7% of the project area) and Bosque de Terraza Alta (4.7% of the project area). Bosque de Colina Baja covers most of the Amazonian part of Peru, extending to nearly 24million ha or 18.7% of the national territory (MINAM, 2015). It grows on the higher, partially eroded parts of the land. Bosque de Terraza Alta grows on the uplifted ancient river terraces (>10 m above fluvial water levels) that are partially dissected by pluvial erosion gullies (MINAM, 2015).

Importantly, the two forest types are indistinguishable ecologically and from a forest management perspective, as there is considerable overlap in tree species composition between them (MINAM, 2015) and there are no significant differences in number of trees, basal area, dominant tree height or volume (Arevalo Sandi, 2013). The main difference is geological, both growing on alluvial deposits, but with Bosque de Terraza Baja on the lower areas where the somewhat younger alluvial deposits are and Bosque de Colina Baja on the higher, somewhat older deposits. As stated, the altitudinal difference is no more than a few tens of meters. All areas are highly eroded. All GGF's logging operations have historically taken place in Bosque de Colina Baja and Bosque de Terraza Alta without distinction, and this would also be the case if logging were to continue and expand in the baseline. The two forest types can therefore be lumped into a single stratum.

Detailed maps of the three project regions' vegetation cover are presented in Figures 2, 3 and 4. The project areas border or are dissected by a number of black-water rivers, the Tacsha Curaray and the Mazán being the most prominent. These rivers provide access to the concession areas and are transportation routes for logs out of the forest to the sawmill in Iquitos.

The climate in the project regions is very humid, with heavy rains all year round. Nevertheless, there is a rainy season from about March-August and a 'dry' season from September to February, approximately. Forestry operations are not possible in the rainy season due to mud, but there are also many days in the 'dry' season when forestry work must be paused due to rains and mud.

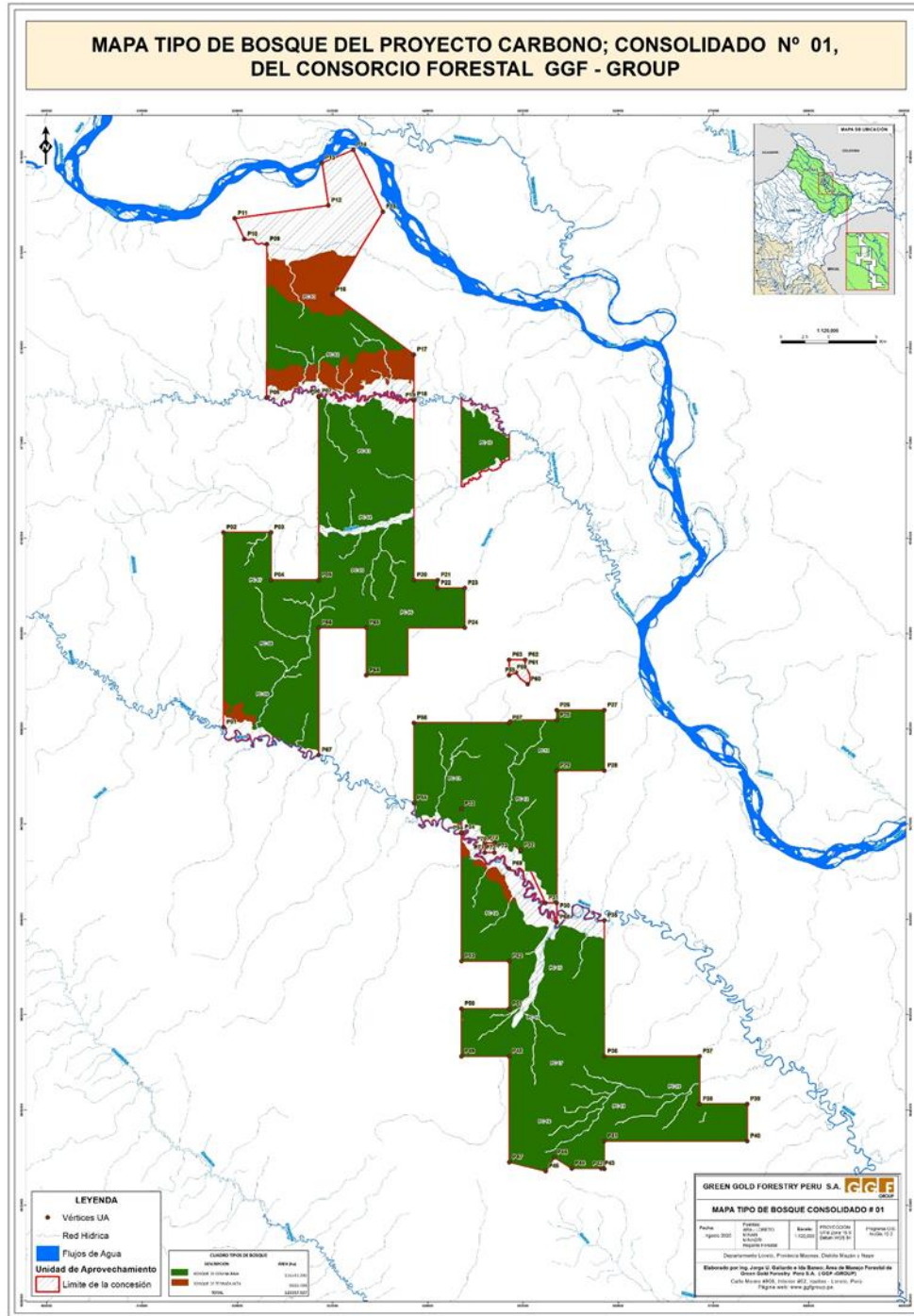


Fig. 2. Vegetation map of the Consolidado#1 project region

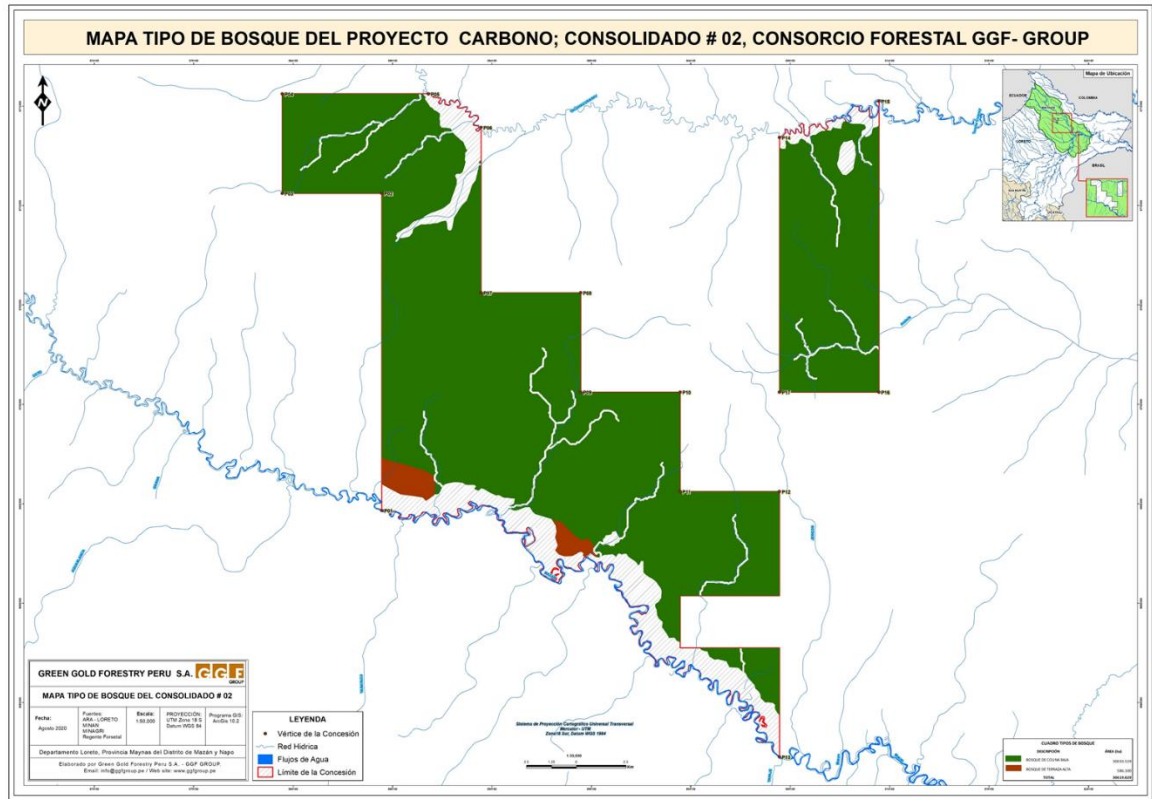


Fig. 3. Vegetation map of the Consolidado#2 project region

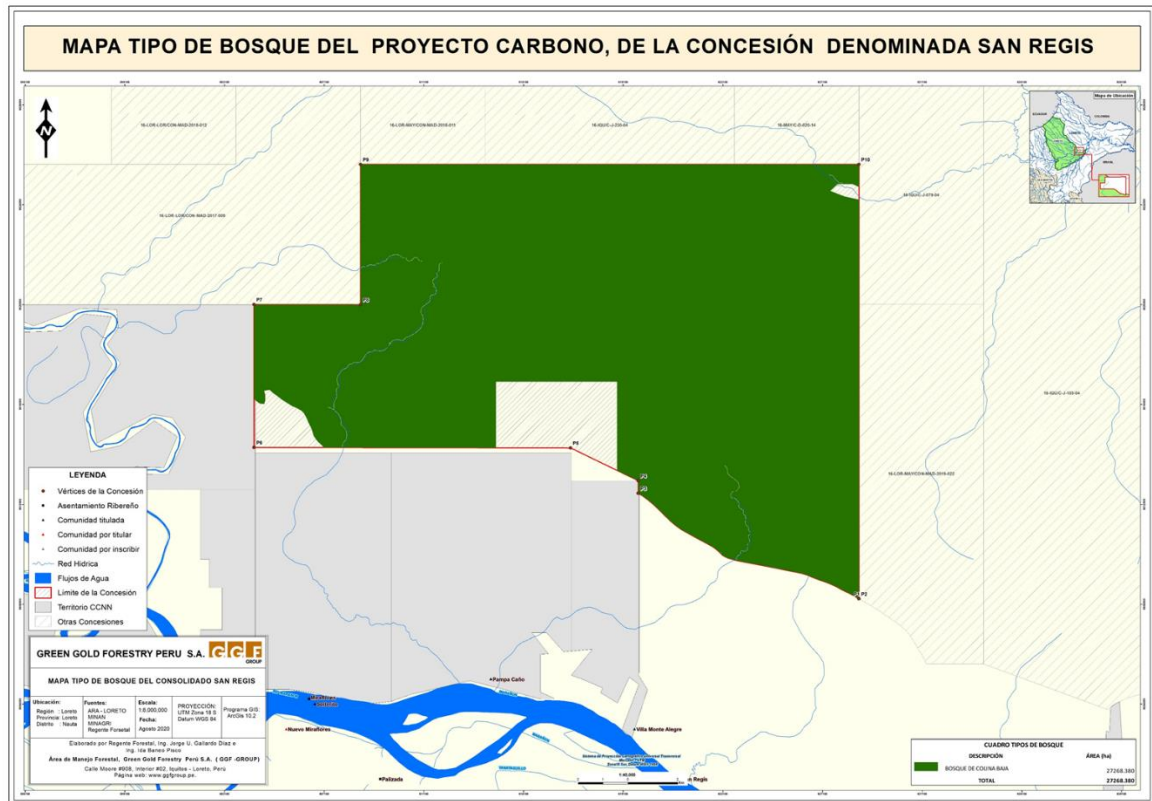


Fig. 4. Vegetation map of the San Regis project region

No people live within the GGF project area and there are no customary tenure or access rights held by local stakeholders.

GGF has undertaken a survey of local stakeholders in the area of influence of the project and this was completed in June 2020. This includes socioeconomic, anthropological, demographic and territorial information within the surrounding area of the project.

The survey was completed with the support of institutions that operate within the Napo/Curaray area, including: Regional Environmental Authority (ARA), Common Good Institute (IBC), the Peruvian Amazon Research Institute (IIAP), Nature and Culture International (NCI), and the National Institute of Statistics and Informatics.

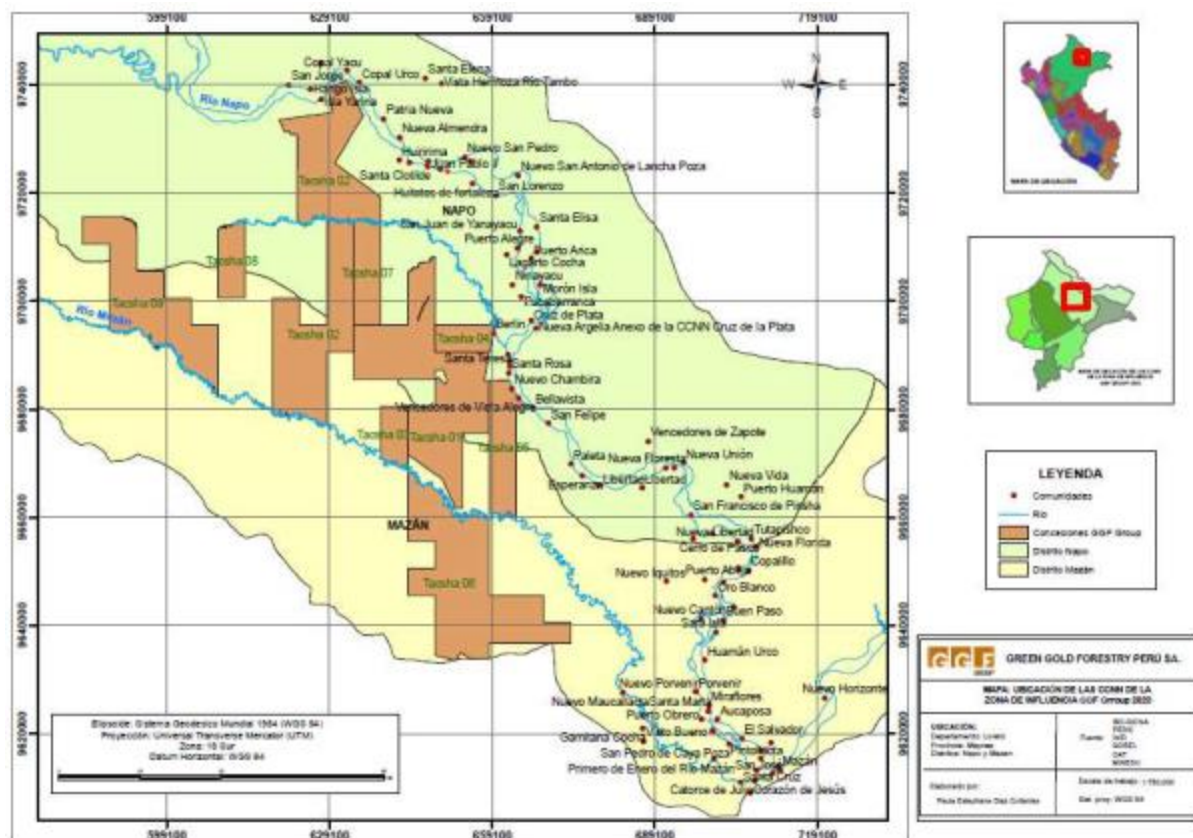


Fig. 5 Map of communities living along the Napo/Curaray river systems in the vicinity of the concession areas in which the project areas are located.

97 communities are located in the Napo/Curaray river systems (Fig. 5), and these are represented by four federations. Twelve communities are located in GGF's direct zone of influence (Table 1) and comprise a population of approximately 2,770 (Table 2). These are: Copal Yacu, Copal Urco, Bellavista, Vencedores de Vista Alegre, Nueva Chambira, Santa Teresa, Santa María de Loreto, Santa Rosa, Berlin, San Luis de Tacsha Curaray, Rango Isla and Fortaleza. These communities are stable and there is no current migration into the area.

Table 1. Communities within the project's direct zone of influence

N°	Comunidad	Zona	Sub Zona	Este	Norte	Referencia
1	Bellavista	Napo	Medio Napo	666571.0001	9680169	Margen derecha del río Napo
2	Berlin	Napo	Medio Napo	659284.0003	9694021	Margen derecha del río Tacshacuray
3	Copal Urco	Napo	Medio Napo	634556.0001	9740342	Margen izquierda del río Napo
4	Copal Yacu	Napo	Medio Napo	632357.0001	9742562	Margen izquierda del río Napo
5	Isla Yarina	Napo	Medio Napo	627519.5723	9737304.073	Margen derecha del río Napo
6	Nueva Chambira	Napo	Medio Napo	662703.0001	9683893	Margen derecha del río Napo
7	Rango Isla	Napo	Medio Napo	625631.0003	9739163	Margen izquierda del río Napo
8	San Luis de Tacsha Curaray	Napo	Medio Napo	661976.1547	9690024.003	Margen derecha del río Napo
9	Santa María de Loreto	Napo	Medio Napo	662237.0001	9688893	Margen derecha del río Napo
10	Santa Rosa	Napo	Medio Napo	662177.0003	9686698	Margen derecha del río Napo
11	Santa Teresa	Napo	Medio Napo	662314.0003	9687852	Margen derecha del río Napo
12	Vencedores de Vista Alegre	Napo	Medio Napo	663940.0001	9682004	Margen derecha del río Napo

Fuente: IBC-SICNA 2016

Most people in the Napo area belong to the Kichwa ethnic group and are descendants of the Quijos, a native people of Ecuador. Like many Amazonian indigenous peoples, the Quijos were forced to abandon their traditional territories by rubber barons in the late nineteenth century and were repatriated to the Napo basin. Most understand and speak the Spanish language alongside Kichwa.

Table 2. Number of members and households of communities within the project's direct zone of influence

N°	Comunidad	Habitantes	Viviendas	Familia	Hombres	Mujeres
1	Bellavista	241	40	46	110	131
2	Berlin	75	14	19	42	33
3	Copal Urco	404	89	89	190	214
4	Copal Yacu	113	23	23	65	58
5	Isla Yarina	60	15	13	20	40
6	Nueva Chambira	18	7	8	10	8
7	Rango Isla	133	26	27	63	70
8	San Luis de Tacsha Curaray	1109	146	150	673	436
9	Santa María de Loreto	276	29	31	92	93
10	Santa Rosa	30	6	6	20	10
11	Santa Teresa	238	36	41	109	96
12	Vencedores de Vista Alegre	80	12	15	27	38

Fuente: IBC-SICNA 2016 y GGF, 2018

The communities have few linkages to the formal market economy and mainly engage in subsistence activities (Table 3.), growing banana, cassava, chonta and maize, and practicing fishing, hunting and aguaje harvesting. Most have obtained land rights, which entitle them to grow crops and engage in hunting and fishing. In many instances, community land is partially deforested or degraded as a result of agriculture and logging.

Table 3. Productive activities in each of the 12 communities.

N°	Comunidad	Actividades Productivas	Productos
1	Bellavista	Agricultura, pesca y caza	Plátano, yuca, chonta, pesca
2	Berlin	Agricultura, pesca y caza	Plátano, yuca, maíz, chonta
3	Copal Urco	Agricultura, pesca y caza	Plátano, yuca, maíz, chonta
4	Copal Yacu	Agricultura, pesca y caza	Plátano, yuca, maíz, chonta
5	Isla Yarina	Agricultura, pesca y caza	Plátano, yuca, maíz, chonta
6	Nueva Chambira	Agricultura, pesca y caza	Plátano, yuca, maíz
7	Rango Isla	Agricultura, pesca y caza	Plátano, yuca, maíz
8	San Luis de Tacsha Curaray	Agricultura, pesca y caza	Plátano, yuca, maíz
9	Santa María de Loreto	Agricultura, pesca y caza	Plátano, yuca, maíz
10	Santa Rosa	Agricultura, pesca y caza	Plátano, yuca, maíz
11	Santa Teresa	Agricultura, pesca y caza	Plátano, yuca, maíz
12	Vencedores de Vista Alegre	Agricultura, pesca y caza	Aguaje, maíz, yuca, plátano

These communities are all members of FECONAMNCUA (Federación de Comunidades Nativas del Medio Napo, Curaray y Arabela), which supports the social, political and economic development of these communities. Other institutions active in the area include Regional Organization of the Indigenous Peoples of the East (ORPIO), Maijuna Kichwa Regional Conservation Area, National Program for the Conservation of Forests for the Mitigation of Climate Change (PNCB-MCC-MINAM), and Nature and Culture International.

Government programs (Table 4) provide basic services to communities and give extra support for vulnerable people. These include: Cuna mas (care for children under three years' old); Qali warma (nutritional program); Programa juntos (supporting the poorest households); Pension 65 (providing bimonthly support of S/.250 to the elderly). Basic education is provided, mainly to secondary level, although some communities receive only primary education. A scholarship program, Beca 18, supports exceptional students to access higher education. For reference, Peru's minimum wage is S/930/month plus benefits (pension, etc.)

Table 4. Governmental support programmes active in the 12 communities

N°	Comunidad	Qali warma	Beca 18	Pensión 65	Juntos	Cuna Más	Otras instituciones
1	Bellavista	SI	SI	SI	SI	SI	
2	Berlin	SI	SI	SI	SI	SI	GGF
3	Copal Urco	-	-	-	-	-	
4	Copal Yacu	-	-	-	-	-	
5	Isla Yarina	-	-	-	-	-	
6	Nueva Chambira	SI	SI	SI	SI	SI	
7	Rango Isla						
8	San Luis de Tacsha Curaray	SI	SI	SI	SI	SI	GGF
9	Santa María de Loreto	SI	SI	SI	SI	SI	GGF
10	Santa Rosa	SI	SI	SI	SI	SI	
11	Santa Teresa	SI	SI	SI	SI	SI	GGF
12	Vencedores de Vista Alegre	SI	SI	SI	SI	SI	

Table 5. Access to services and utilities in the 12 communities.

Comunidad	Educación	No. Educación Primaria	Salud	Luz	Agua Potable	Desagüe	Comunicación
Bellavista	Inicial, Primaria y Secundaria	60314	-	Si	No	No	SI
Berlin	Primaria	6010160	No	Panel Solar	No	No	No
Copal Urco	Primaria y Secundaria	60770	-	-	No	No	-
Copal Yacu	Primaria	601495	-	-	No	No	-
Isla Yarina	Primaria	601065	-	-	No	No	-
Nueva Chambira	Primaria	6010271	-	Generador	No	No	No
Rango Isla	Primaria y Secundaria	60973	-	-	No	No	-
San Luis de Tacsha Curaray	Inicial, Primaria y Secundaria	60310	Puesto de salud	Generador	No	No	Si
Santa María de Loreto	Inicial, Primaria	601401	Puesto de salud	Generador	No	No	Si
Santa Rosa	Primaria	601470	-		No	No	Si
Santa Teresa	Inicial, Primaria	60312	-	Generador	No	No	Si
Vencedores de Vista Alegre	Inicial, Primaria	601713	-	Generador	No	No	Si

About half of the communities have access to power and communications via generators and solar panels. None has access to fresh water or sanitary drainage (Table 5).

Under the baseline scenario there are not expected to be any changes in the ecosystem services that the local stakeholders rely upon.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

Green Gold Forestry is fully compliant with all relevant regulations. This is demonstrated by the fact that there are no outstanding issues with the government regulator (OSINFOR) and no outstanding or pending legal actions. The company's FSC certification is further evidence that it is fully compliant with all relevant laws, statutes and regulations.

GGF has a contractual right as owner of the forest concession licenses in the land, vegetation and conservational or management process that generate GHG emission reductions or removals. These vest with the project proponent, as a result of the enforceable and irrevocable agreement with the Peruvian state under the New Forestry and Wildlife Law N° 29763. The National Constitution of Peru provides that natural resources are patrimony of the nation, and determines mechanisms through which private owners can be granted with the rights of use of natural resources. The Institutional Law for the Sustainable Use of Resources Law N° 26821 states in Article 4 that 'fruits and products of natural resources... are owned by the holders of the right of use of such fruits and products.'

The following laws, statutes and regulatory frameworks apply:

Labour Regulations:

- Law N° 30792 Law of Fair Profits for Mothers, considers maternity leave as days worked for the calculation of profits
- Law N°. 30795 Law for the Prevention and Treatment of Alzheimer's Disease and Other Dementias (leave of no more than one paid day to care for the patient)
- Law N°. 30807, March 6, 2019. Modification of article 2 of Law 29409, Law that grants the right to paternity leave to workers in public and private activity
- Law 28553 General Law for the Protection of People with Diabetes
- Legislative Decree No. 1410, Legislative Decree that incorporates the crime of harassment, sexual harassment, sexual blackmail and dissemination of images

- DL N° 1405, Legislative Decree that establishes regulations for the enjoyment of paid vacation rest in the public and private sectors
- Legislative Decree No. 1417, September 13, 2018. Legislative Decree that promotes the inclusion of People with Disabilities

Regulations for the Constitution of Companies in Peru:

- D. Leg. N° 1332 Legislative Decree that facilitates the incorporation of companies through business development centers
- General Law of Companies Law N°. 26887
- Decree Law No. 21621, the Law that created Individual Limited Liability Company

Regulations covering Covid19:

- Supreme Decree that develops provisions for the Private Sector, on remote work provided for in Emergency Decree No. 026-2020, Emergency Decree that establishes exceptional and temporary measures to prevent the spread of COVID19 Supreme Decree N°. 010-2020 -TR
- R.M N° 135-2020-MINSA, which approves - Technical Specification for the textile manufacture of facial masks for community use
- R.M N° 055-2020-MINSA, which approves the Guide for the prevention of Covid 19 in the workplace
- Resolution of the Superintendency 121-2020-SUCAMEC, which extends the term of validity in qualifying titles SUCAMEC, in the matter of weapons, explosives, pyrotechnic products and private security services

Environmental laws and regulations:

- General Environmental Law No. 28611
- MINAM Citizen Participation Regulation - Supreme Decree No. 002-2009-MINAM
- Rules of participation citizen in monitoring actions environmental agency in charge of the Environmental Assessment and Enforcement - OEFA board of directors' resolution N° 032-2014-OEFA / CD
- Regulation of Citizen Participation for the performance of Hydrocarbon Activities SUPREME DECRET No. 002-2019-EM
- Law No. 27446, law of the National Environmental Impact Assessment System
- Law No. 29325 law of the national system of environmental assessment and control
- Law for the Creation of the Supervisory Body for Investment in Energy – OSINERG
- Supreme Decree that approves the Regulation of Inspection and Sanction of Fishing and Aquaculture Activities SUPREME DECRET No. 017-2017-PRODUCE
- Guidelines for recognition or Heritage Custodian accreditation Forestry and Wildlife of the Nation resolution of the executive directorate n° d000081-2020-minagri-serfor-de
- Guidelines for surveillance and control of natural protected areas, approved with RP n° 193-2019-sernanp
- Law N°. 30215, Remuneration Mechanisms Law for Ecosystem services SUPREME DECRET No. 009-2016-MINAM
- General customs law Legislative Decree No. 1053
- Law N°. 29763, DS N° 018-2015-MINAGRI, Approves the regulation for forest management
- Guidelines for recognition or Heritage Custodian accreditation Forestry and Wildlife of the Nation resolution of the executive directorate n° d000081-2020-minagri-serfor-de

1.15.1

1.15 Participation under Other GHG Programs

Projects Registered (or seeking registration) under Other GHG Program(s)

The project has not been registered, nor is it seeking registration under any other GHG programs.

Projects Rejected by Other GHG Programs

The project has not been rejected by any other GHG programs.

1.16 Other Forms of Credit

1.15.2 Emissions Trading Programs and Other Binding Limits

The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading.

1.16.1 Other Forms of Environmental Credit

The project has not sought or received another form of GHG-related environmental credit.

1.16.2 Additional Information Relevant to the Project

Leakage Management

Not applicable. As per the applied methodology the project may not result in the displacement of pre-project activities through activity-shifting leakage. The project cannot manage market leakage, which instead is accounted for.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the Project Description.

Sustainable Development

The project complies with all national sustainable development objectives. It has the support of the Environment Ministry, of SERFOR (the forestry authority) and the Regional Government.

Further Information

N/A

2 SAFEGUARDS

2.1.1

2.1 No Net Harm

No net negative environmental impacts

2.1.2

The GHG accounting methodology deals with climate mitigation impact. Thus, this section focuses on biodiversity and ecosystem services other than climate change mitigation.

The change in forest management from logging to conservation is not expected to result in any negative environmental impacts. On the contrary, the reduced anthropogenic disturbance under conservation management will ensure there is continued habitat for the currently present biodiversity and continued optimal provision of the ecosystem services the forests provide.

No net negative socio-economic impacts

The project is expected to generate positive socio-economic impacts for communities that neighbour the project. At a minimum, the same number of personnel will be hired from the communities for the conservation project as are currently employed in the logging operation. Jobs will include forest rangers, eco-guides, research and monitoring assistants and other support staff. Forest rangers will regularly patrol the project area, particularly its fluvial access routes, to detect and deter illegal logging, hunting and encroachment. The project plans to develop the conservation area as a prime destination for ecotourism and scientific research, establishing a lodge and research station within the first five years. Furthermore, the project intends to establish and support sustainable NTFP and fruit growing enterprises with the communities.

No significant other socio-economic impacts are expected, positive or negative.

2.2 Local Stakeholder Consultation

Measures dictated by the Government of Peru in response to the COVID 19 pandemic (DECREE OF URGENCY 035-2020) establish the mandatory isolation and social immobilization provided in the declaration of a national state of emergency. As at Q2 2021, stakeholder consultations continue to be affected by the pandemic and it is not possible to hold in-person meetings with communities (as communities do not have internet access it is not possible to meet remotely).

However, an initial meeting has been held in Iquitos in November 2020 with the president of the Federation of Native Communities of the Middle Napo Curaray and Arabela (FECONAMNCUA) and with the North Regional Director of the Center for Amazon Development (CEDIA), where the project was described in detail, including opportunities for the participation of communities in the sustainable development of economic activities through non-timber products. GGF has subsequently held virtual meetings with CEDIA and DAR to review the project, including plans for stakeholder consultations.

When quarantine measures are eased, we expect to hold formal meetings with the communities on a bimonthly basis in the field. We anticipate that in the initial stages of the project more frequent meetings may be required, as agreed with the community representatives. Meeting notes will be generated and assistance, decisions and agreements will be signed-off by all participants.

Formal meetings will be held every two weeks with CEDIA and DAR. Initially these will address planning and project design, and once we are able to go into the field, they will cover implementation, reporting and progress.

GGF will be represented by its Operations Manager and its Community Relations Officer CEDIA and DAR will each designate a point person responsible for the project who will be present at all meetings. FECONAMNCUA will designate their representatives at the first meeting and it is expected that they will name three persons. It is expected that the CEOs of GGF, CEDIA and DAR will attend meetings every 6 months, or when otherwise deemed necessary.

The project will be socialized through informational meetings and local consultations as established in GGF's Community Relations Plan. Feedback and other contributions will be integrated into the overall plan in order to safeguard against any potential negative impacts. This program of consultation will be ongoing through the life of the project under the leadership of GGF's Community Relations Manager.

The organisations involved in the project will each be represented by appointed persons. These will form a Community Relations Committee with responsibility for the day-to-day activities of the

project, reporting to the CEOs of their respective organisations. Measurable targets will be established and evaluated on a 6-monthly basis.

The procedures for local stakeholder consultation build upon GGF's existing community relations plan that was developed to meet the requirements for certification under the Forest Stewardship Council. These include identification of stakeholders (native communities, federations, state and private institutions, etc.), establishment of communication channels, statement of GGF's responsibilities, grievance procedures, etc. All meetings are formally documented, together with follow-up actions. The overall objective is to ensure that local stakeholders are fully informed and consulted on the project and that there are no negative impacts.

Such consultations have been carried out by GGF for many years and are well-documented.

Given current circumstances in regard of COVID, the project proponent requests to proceed to VCS registration without completing a full local stakeholder consultation, considering:

1. The long-standing relationship between GGF and the surrounding communities and other stakeholders
2. The meeting held in November 2020 with the president of FECONAMNCUA and with the North Regional Director of CEDIA at which the project was described in detail,
3. GGF's existing knowledge regarding the communities' interests and grievances from 10 years of previous consultations and meetings as part of GGF's FSC certification requirements
4. The benefits for the local communities that are embedded in the VCS project design, where they stand to gain more than in the current situation.

2.3 Environmental Impact

The project has not carried out any environmental impact assessments.

2.4 Public Comments

No public comments were received during the public comment period.

2.5 AFOLU-Specific Safeguards

As discussed in Section 2.1.2 the project is not expected to generate negative socio-economic impacts for local stakeholders.

The project will not impact local stakeholders' property rights or access rights to resources. The project areas and natural resources within them are physically and legally separate from any such local stakeholders' rights. There is also no known common practice of local stakeholders illegally accessing natural resources within the project area.

A stakeholder identification process is also required for FSC certification and GGF has therefore been doing this since 2011. This includes a diagnostic analysis of surrounding communities and their social, educational and economic circumstances. In accordance with FSC safeguarding procedures any grievances and conflicts have been successfully and peacefully resolved to the satisfaction of surrounding communities. The project will continue using the same approaches and protocols.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

The project applies methodology VM0010 - Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.3 (28 April 2016)

Also applied are the following tools:

- CDM Tool for testing significance of GHG emissions in A/R CDM project activities, v.1
- VCS tool VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, v3.0
- VCS AFOLU Non-Permanence Risk Tool v4.0

3.2 Applicability of Methodology

The project meets all the methodology's applicability conditions, as demonstrated below.

This is demonstrated in Section 3.4.1 below. GGF has been actively logging in the area since 2011. Management of the concession is governed by the concession licenses of the concessions that comprise the project area. The licenses can be renewed every 5 years for 5 additional years based on the successful delivery of the targets set out in the General Management Plan presented by the holder to the authorities for the previous 5 years. This General Management Plan includes the planned timber harvest within the concession area. The current General Management Plans for the period 2018-2023 were approved and GGF's concession licenses renewed in 2018.

Under the project scenario, forest use must be limited to activities that do not result in commercial timber harvest or forest degradation

The project is dedicated to conservation of the forests within the project area. No commercial timber harvest will take place within the project area by the project proponent and the project is designed to exclude as much as possible any illegal timber harvest. No activities will be allowed within the project area that will lead to forest clearance or degradation. Planned timber harvest must be estimated using forest inventory methods that determine allowable off take as volume of timber ($m^3 ha^{-1}$)

Forest inventory and planned timber harvest as described in GGF's timber concession forest management plans are both expressed in $m^3 ha^{-1}$.

The boundaries of the forest land must be clearly defined and documented

The boundaries of GGF's timber concession areas are clearly defined and documented in the forest management plans. The project area comprises 10 concessions. All land within the project area is forest land.

The baseline scenario cannot include conversion to managed plantations

The baseline scenario does not include conversion to managed plantations.

The baseline scenario, project scenario and project case cannot include wetland or peatland

All wetland areas within GGF's logging concessions have been excluded from the project area. There is no indication that any areas with peat soils are present in the project area.

All applicability conditions of VCS and CDM tools used in conjunction with this methodology must be met.

All are met. See further below in this section for a discussion of how VCS and CDM tools' applicability conditions are met.

The project is **eligible** to apply the methodology as demonstrated by the following:

Legal Right to Harvest

GGF has been issued legal harvesting rights in the form of ten production concession licences that cover 100% of the project area. These licences have been issued since 2008, and last renewed in 2018, by the Forest Department of Loreto on the basis of its approval of GGF's 5-yearly plans for forest management that includes a definition of the spatial extent of each concession, the volume of the timber resource to be extracted and a description of harvesting practices.

Intent to Harvest

As mentioned above, GGF has in place ten valid and verifiable government-approved timber management plans for harvesting the project area. GGF has carried out logging operations in concession areas adjacent to the project area since 2011.

Applicability conditions of the tools used in this PD

Tool for the demonstration and assessment of additionality in VCS agriculture, forestry and other land use (AFOLU) project activities (VT0001), v.3

Condition a) AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced;

The project or any activities similar to it are entirely compliant with national laws, as demonstrated in Section 1.14.

Condition b) The use of this tool to determine additionality requires the baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.

Methodology VM0010 does not provide for a stepwise approach justifying the determination of the most plausible baseline scenario. It simply instructs users to apply the VCS additionality tool, as this provides a stepwise approach for determining the most plausible baseline scenario. The application of the Tool and its stepwise approach is presented in Section 3.4.1.

3.3 Project Boundary

CDM Tool for testing significance of GHG emissions in A/R CDM project activities (Version 1)

This tool has no relevant applicability conditions.

GHG Sources

Methodology VM0010 prescribes in Section 5.3, Table 1 which carbon pools to include and exclude (this table is reproduced here as Table 6).

Table 6. Carbon pools

Carbon pools	Included?	Justification / Explanation of choice
Aboveground trees	Included	The stock change in the above ground tree biomass must be estimated
Above ground non-tree	Excluded	Exclusion is always conservative when forest remains as forest
Belowground	Excluded	Unlikely to change significantly in forests remaining as forests and is difficult to measure – omission is conservative
Deadwood (logging slash)	Included in the baseline	The dead wood (logging slash) carbon pool is expected to be larger in the baseline than in the project scenario, and therefore this pool must be included
Dead wood (naturally accumulated)	Excluded	Following IPCC guidelines ¹ , it is assumed that carbon stocks in the naturally occurring dead wood pool (both standing and lying) are equivalent in both the project and baseline scenario, and therefore this pool is conservatively excluded. It is not conservative to account for this pool in the baseline scenario only.
Harvested wood products	Included	Will be greater in baseline than project scenario and significant
Litter	Excluded	Insignificant and exclusion is conservative
Soil organic carbon	Excluded	Exclusion is always conservative when forest remains as forest

Methodology VM0010 prescribes in Section 5.4 which emissions sources to include and exclude. The only choice to the project developer is that of inclusion or exclusion of CO₂, CH₄ and NO₂ emissions from combustion of fossil fuels (in vehicles, machinery, and equipment), which depends on the significance of the emissions source.

The significance of the baseline emissions from combustion of fossil fuels (in vehicles, machinery and equipment) varies over the duration of the project. In year 1 it is 8.5% of overall baseline emissions, then it decreases until it dips below 5% in year 3. This is for emissions reductions of CO₂; emissions reductions from CH₄ and NO₂ are considered negligible. Based on this, CO₂

emission reductions from combustion of fossil fuels are conservatively considered to be insignificant and will be excluded in the monitoring and calculations.

Table 7 summarises the inclusion or exclusion of emissions sources and gases within the project boundary, as per Table 2 of VM0010 and the above discussion on the significance of emissions from combustion of fossil fuels:

Table 7. Emissions sources and gases within and without the project boundary

Table 1: Emissions sources and gases within and without the project boundary				
Source		Gas	Included?	Justification/Explanation
Baseline	Combustion of fossil fuels (in vehicles, machinery and equipment)	CO ₂	Excluded	Considered insignificant
		CH ₄	Excluded	Considered insignificant
		N ₂ O	Excluded	Considered insignificant
		Other	N/A	
	Removal of herbaceous vegetation	CO ₂	Excluded	Based on CDM EB decision reflected in paragraph11 of the report of the 23 rd session of the board: cdm.unfccc.int/Panels/ar/023/ar_023_rep.pdf
		CH ₄	N/A	
		N ₂ O	N/A	
		Other	N/A	
	Burning of biomass	CO ₂	Excluded	Burning of biomass, if any, would be caused by natural fires, not by baseline forest management
		CH ₄	Excluded	Burning of biomass, if any, would be caused by natural fires, not by baseline forest management
		N ₂ O	Excluded	Burning of biomass, if any, would be caused by natural fires, not by baseline forest management
		Other	N/A	
Project	Combustion of fossil fuels (in vehicles, machinery and equipment)	CO ₂	Included	Conservative, though not likely to be significant
		CH ₄	Excluded	Considered insignificant
		N ₂ O	Excluded	Considered insignificant
		Other	N/A	
	Removal of herbaceous vegetation	CO ₂	Excluded	Based on CDM EB decision reflected in paragraph 11ofthe report of the 23 rd session of the board: cdm.unfccc.int/Panels/ar/023/ar_023_rep.pdf
		CH ₄	N/A	
		N ₂ O	N/A	
		Other	N/A	
	Burning of biomass	CO ₂	Excluded	Monitored as stock changes in aboveground biomass
		CH ₄	Included	May be significant emission source in theory, though fire risk is negligible in the project region
		N ₂ O	Excluded	

		Other	N/A	
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The project area consists of all areas classified as ‘Bosque de Colina Baja’ and ‘Bosque de Terraza Alta’ on the vegetation maps (the green and dark orange areas on the map), with a total area of 183,445 hectares (Table 8).

Geographical boundaries

Table 8. Break-down of the project area into the two harvestable forest classes.

<i>Forest class</i>	<i>Consolidado #1</i>	<i>Consolidado #2</i>	<i>San Regis</i>	<i>Total</i>
Bosque de Colina Baja	116,531	30,034	27,268	173,833
Bosque de Terraza Alta	9,026	586	0	9,612
Total	125,557	30,620	27,268	183,445

The geographical boundaries, vegetation cover and baseline forestry management of the three project regions (Consolidado#1, Consolidado#2 and San Regis) are presented in Figures 6, 7 and 8.

Each project region would be logged on a 20-year rotation and has been divided into 20 land parcels of similar size. These are numbered PC1, PC2, etc. The geographic coordinates of the polygon vertices of each land parcel, as well as its size in hectares, are presented in the maps.

Overlaid is the planned forestry infrastructure for baseline forest management: primary roads (yellow), secondary roads (red), log landings or decks (black dots), camps (crossed pink dots) and river ports (green-blue dots with a small black dot).

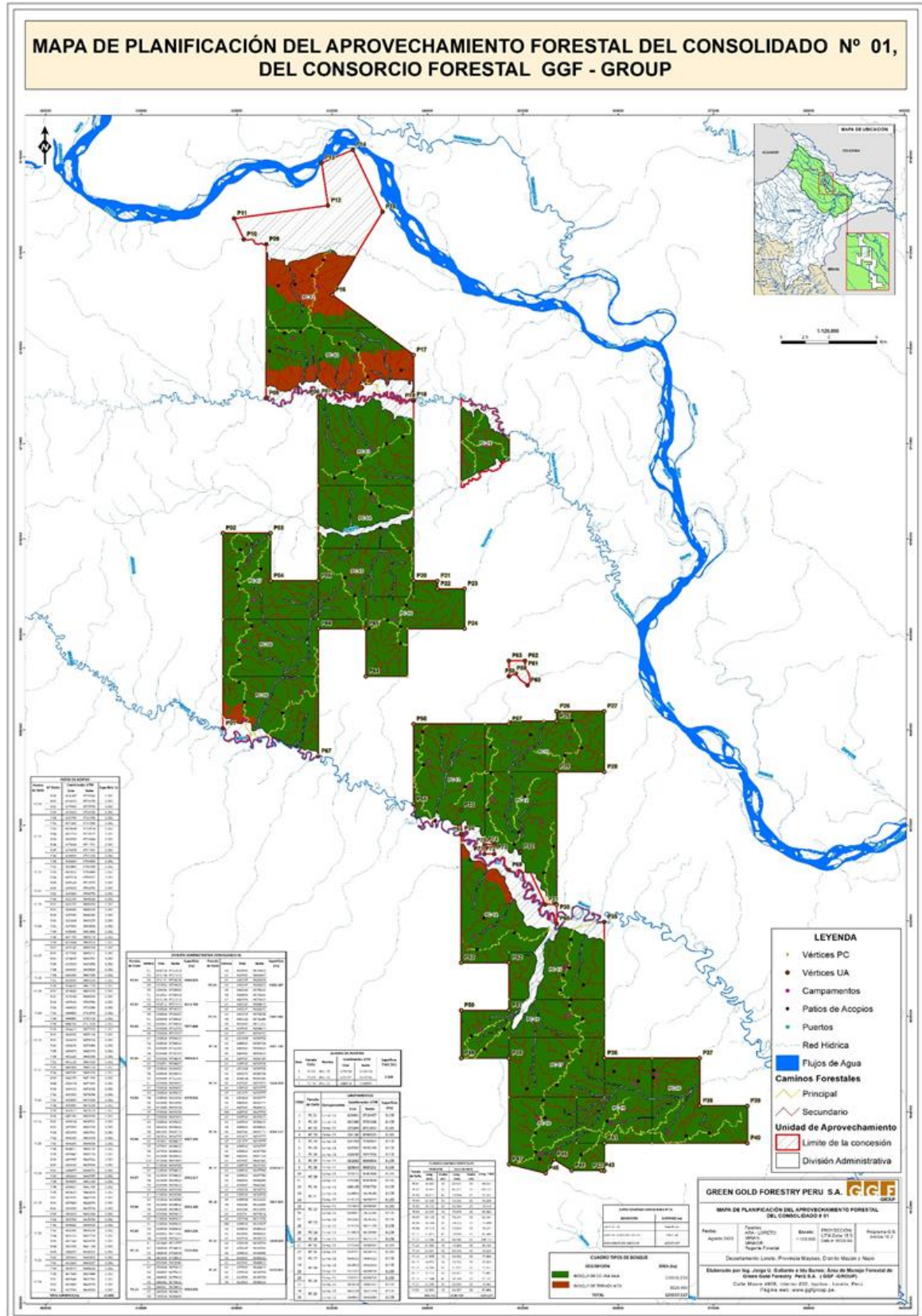


Fig. 7. Boundaries of concession areas, boundaries of land parcels, location of roads, log landings, camps and ports in the Consolidado#2 project region



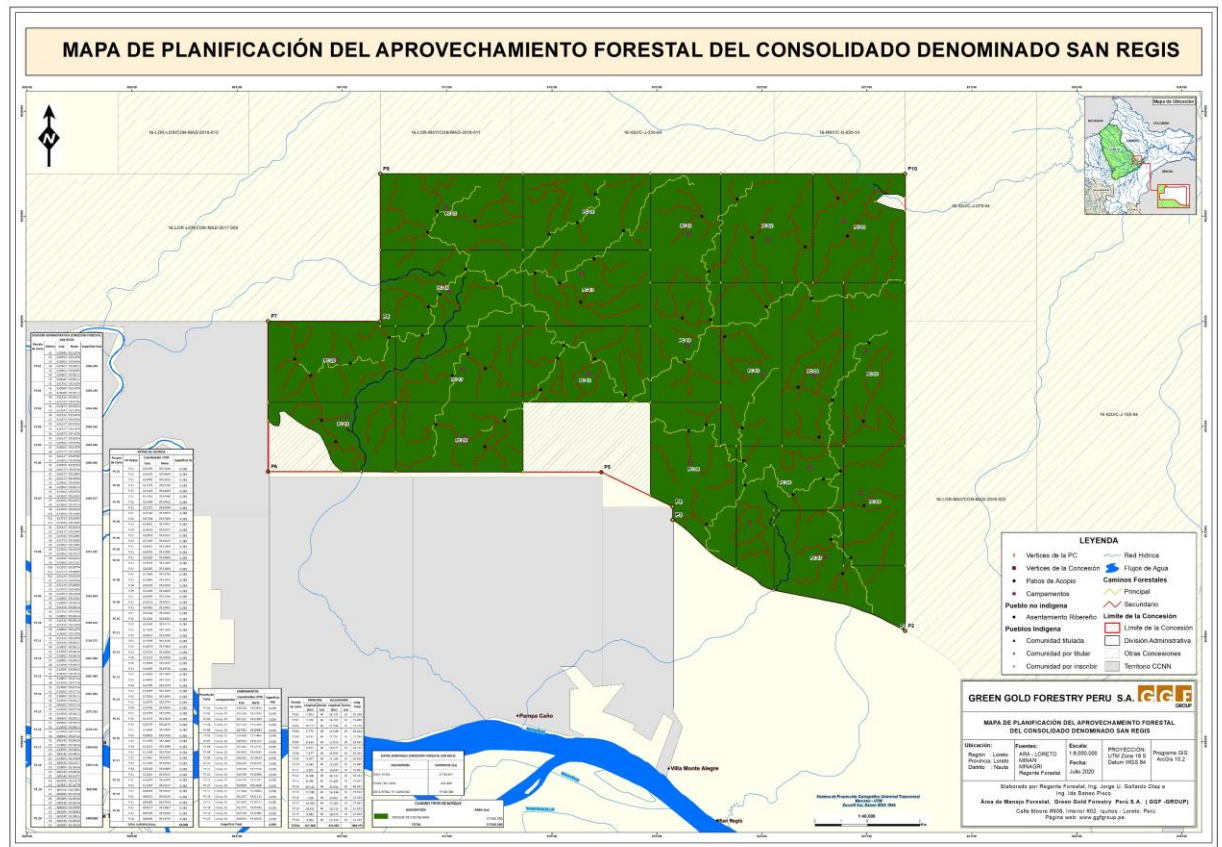


Fig. 8. Boundaries of concession areas, boundaries of land parcels, location of roads, log landings, camps and ports in the San Regis project region

As per the methodology the geographical boundary for leakage from market effects is the national boundary of Peru.

3.4.1 Baseline Scenario

For the selection of the baseline scenario, the methodology requires the VCS tool, VT0001 Tool for the Demonstration and Assessment of Additionality in AFOLU Project Activities, v3.0 (2012) to be used in the demonstration of this tool. This tool prescribes a step-wise approach to be followed:

Step 1. Identification of alternative land use scenarios to the AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS project activity

The following credible alternative land use scenarios are identified:

1, **Continuation of the pre-project land use: planned timber harvest.** GGF has been logging in concession areas adjacent to the project area since 2011. It has gradually grown its operations from a loss-making start-up to broadly operationally break-even. It has invested in its own sawmill and in the expansion of its concession areas. It has demonstrated that it has the experience and

the capacity to significantly ramp-up forest operations, timber processing and make sales to export markets, thereby becoming the profitable business that its investors have always wanted. The planned timber harvest is a highly plausible land use scenario.

2. Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project. This scenario assumes that GGF would cease logging activities within the project area, while maintaining logging activities outside of the project area so as to comply with its legal obligations as a production forest concession holder. Within the project area, GGF would sustainably harvest indigenous fruits (a non-timber forest product) and promote eco-science tourism (hosting students, scientific researchers, film makers, etc.).

No other land uses exist within the project boundary, or have existed within the project boundary at any point in the last ten years, or exist in similar forestry concessions in the vicinity of the project areas. Any agricultural land uses are strictly confined to demarcated community areas. Illegal conversion of forestry concession land for agriculture is rare and has not occurred on the project areas. Illegal logging is not considered a land use: it may affect the forest in both of the above credible alternative land use scenarios.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

Sub-step 1b a) Land use scenarios 1 is fully compliant with applicable laws and regulations. The project area forms a part of GGF's government-leased logging concessions and a planned timber harvest must be carried on some of the area.

Land use scenario 2 is also fully compliant with applicable laws and regulations, because GGF is maintaining a logging operation on part of its concession areas (outside the project boundary), alongside fruit harvesting within the project area. This serves the purpose of legal compliance with the concession contracts.

Sub-step 1b b) The list of plausible land use scenarios thus consists of two options: 1) Planned timber harvest, and 2) the project activity without being registered as a VCS AFOLU project.

Sub-step 1c. The selection and determination of the most plausible baseline scenario will be done in Step 2 below by elimination of the project activity without being registered as a VCS project as a plausible land use alternative through an investment analysis.

Step 2 of the Tool is an investment analysis

Sub-step 2a. Determine appropriate analysis method

An investment comparison analysis (Option II) is applied,

Sub-step 2b. – Option II: apply investment comparison analysis

A comparison of Net Present Value (NPV) is applied

Sub-step 2c. Calculation and comparison of financial indicators

Land use scenario 1 – Continuation of the pre-project land use: planned timber harvest: NPV of \$10.476million

Land use scenario 2 – Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project: Negative NPV.

The critical assumptions and data inputs into the project's financial model are as follows:

For land-use scenario 1:

- Project time horizon – 20 years
- Discount rate – 10%
- Operating costs – forest concession fees, timber felling, extraction, log transport, sawing and processing – \$11,038,000 annually
- Finished products transport and export – \$2,257,000 annually
- Overheads – certification, survey, accounting, audit, legal, insurance, communications, travel, consumables and project staff – \$1,372,000 annually
- Timber forest product sales – \$17,177,000 annually

For land-use scenario 2:

- Project time horizon – 20 years
- Discount rate – 10%
- Operating costs – forest rangers, consumables, forest concession fees, forest surveys, etc. – \$730,000 annually
- Overheads – accounting, audit, legal, insurance, communications, travel, consumables and project staff – \$956,000 annually
- Non-timber forest product sales – \$200,000 annually
- Infrastructure and machinery cost – \$60,000 (2021)
- Local employment – \$278,000 annually
- Development fund – \$100,000 annually

Without revenues from sales of VCUs the proposed VCS AFOLU project returns a negative IRR and a negative NPV and cannot therefore be considered financially attractive.

One-off set-up costs – \$130,000 in 2021

3.4.2

Section 6.2 of the Methodology – Modelling the baseline scenario – requires the project proponent to use the Common Practice Baseline Scenario if the required information for the Historical Baseline Scenario cannot be provided.

Common Practice data pathway

In order to apply the Historical Baseline Scenario, the following documents must exist for the project proponent:

1. Historical records of forest management exist for a minimum of 5 or more years preceding the project start date. -> These exist

2. Historical records that indicate that the management practices have surpassed the legal requirements (provided by conforming to all local and regional forest legislation). -> These exist

3. Historical records that indicate that the historical management surpasses financial barriers by providing above average financial returns. -> These do not exist, as GGF has not yet achieved overall profitability. For GGF the alternative to conservation through VCU sales is to raise working capital to invest in: operational improvements and value-added processing, improving economies of scale by expanding its concession areas, optimising extracted volumes, and reach profitability in that manner. As a last resort, if investment proves difficult to raise, GGF could consider saving costs by dropping its FSC certification and its Reduced Impact Logging (RIL) forest management practices. Because point 3 of the above cannot be satisfied the Common Practice data pathway must be applied. See Section 4.1 for parameters used in the common practice data pathway.

Common practice is defined as timber harvest under the legal requirements for forest management and will be determined from a timber harvest plan developed from:

- 1) The project area through scenario modelling as though the legal requirements were implemented in the project area; and
- 2) A reference area (or multiple reference areas) already under timber harvest management that complies with legal requirements for forest management and selected to be representative of local common practice for timber harvest.

Representative reference for common practice

The discussion below is based on Methodology Deviation #7 (see Section 3.6), which determines that reference companies with a similar business model are a more accurate reference than a reference area as prescribed by VM0010. Deviation #7 should be read before the discussion below of reference companies for the common practice extraction rate.

GGF's planned timber extraction rate of 15m³/ha is commercially viable (i.e., this volume of timber is available, marketable and profitable) and is consistent with the forest management of other companies in the region that follow best practice guidelines in harvesting and processing lesser-known species alongside better-known woods. These companies are able to utilise lesser-known species and run a business model that is profitable, sustainable (or as sustainable as is possible) and legal, through having invested in and developed sustainability certification, processing capacity, and international markets for products that cater for less species-specific products (e.g., composite wood products). As a result of the wider range of targeted species, their extraction volumes are higher than if only the well-known species were extracted. It is this business model that GGF has been striving to work towards, culminating in its 2018 business plan and investment memorandum. This model is different from most other logging operators in the Amazon region, who focus exclusively on the well-known species and consequently operate with a lower extraction rate. They have not invested in processing capacity and market access and therefore, more often than not, engage with illegality to maintain profitability (this has certainly been the case in Peru – EIA, 2012).

Importantly, the production of composite wood products is not species-specific: any species with the right physical properties can be used. This greatly widens the range of commercially viable species locally, but it also means that the business model is transferable to similar forests but with a somewhat different species composition, as long as there is sufficient volume of species with the right physical properties. Our reference companies demonstrate that this is the case in various locations in the Amazon basin.

GGF's business model is aligned with the common practice of other leading FSC-certified companies in the Amazon region. The recommended best practice is to maximise yields by extracting lesser-known species alongside better-known woods and, by doing so, reduce over-exploitation of selected species thereby preserving the natural balance of diversity of the forest as well as improving business economics. (for example, see: About LKTS (lesserknowntimberspecies.com), Tropical Timber - STTC (europeansttc.com), and Guide to Lesser Known Tropical Timber Species | WWF (panda.org))

FSC-certified reference companies in the region that operate similar business models to GGF and in similar forest types include:

Agrocortex is in Acre, Brazil, which borders Loreto. According to its website, Agrocortex Madeiras do Acre (AMA) extracts 150,000m³ logs annually from 5,860ha plots (25.6m³/ha) <http://www.agrocortex.com/>

Consorcio Forestal Amazonico, based in Ucayali, operated 160,650ha production concessions. These concessions are lowland and dissected by rivers (like GGF's). A 30-year harvest cycle is used, indicating 5,355ha each year. http://fsc.org.pe/blog/wp-content/uploads/2011/11/RESUMEN_DE_PLAN_DE_MANEJO_CFA.pdf . We have managed to find published data on harvest volumes in 2006, that indicate total commercial volumes of 78,165m³ on a 4,100ha plot (19m³/ha) <https://es.slideshare.net/BioModus/plan-operativo-anual-2004-consorcio-forestal-amazonico>

Precious Woods, located near Manaus, harvests a maximum of 15-20m³/ha (Precious Woods > biodiversity-forest-management). Like GGF, Precious Woods harvests both well-known and lesser-known species as a sustainability strategy and there is considerable overlap of harvested woods with GGF A181179_01_PHW_Datenblaetter_EN_Cs6.indd (preciouswoods.com). According to its most recent annual report (see p.20 Annual Report_PdfWeb EN_2019.pdf (preciouswoods.com)) Precious Woods Brazil harvested 156,100m³ in 2019 from its 370,000ha (out of total holdings of 472,576ha), which is harvested on a 35-year cycle (14.7m³/ha).

GGF is unique in Loreto for its FSC certification and is alone in its approach to utilising lesser-known tree species. There is considerable evidence of illegal logging practices in the vast majority of other forest concessions in Loreto (for example, see <https://www.nature.com/articles/srep04719>), and most focus on a limited number of high-value (and often CITES-listed) species. Indeed, this is the business model, legal or not, of most other concessionaires in Peru.

3.4.3 The management practices of leading FSC-certified companies in the region, like those referenced above, are representative of the model of forest management in GGF's business plan, and these provide the common practice for GGF to be compared with.

Stratification

3.4.4 The project areas consist of a single relevant stratum for emission reduction calculations, consisting of the forest classes 'Bosque de Colina Baja' and 'Bosque de Terraza Alta', according to the Peruvian National Vegetation Map by the Ministry of the Environment (MINAM, 2015). These two forest classes can be considered a relatively homogenous forest type in the project region, since changes in soil types, topography and climate are minimal. For soils, see the National Map of Soils of Peru by MINAGRI, which shows that the project area consists overwhelmingly of a single soil type (ACh-ALh-LXh). The altitudinal range within the project area is less than 80m (see project maps).

Timber Harvest Plan

GGF has prepared a timber harvest plan for the project area, based on its existing forest inventories, its target extraction volume and its FSC-guided forest management practices. In accordance with VM0010, the Timber Harvest Plan establishes:

- 1) The forest inventory data: number of trees and harvestable volume per species
- 2) Demarcation of all non-harvest areas within the forest based on legally required exclusions for environmental features such as slope, swamp areas or conservation buffers
- 3) Division of the harvestable forest into annual operating areas (referred to also as land parcels) using common practice
- 4) Design and presentation of the forestry infrastructure to harvest, skid/haul, store and move harvested timber products from the land parcels to downstream processing or market entry points. This includes all forest roads, primary skid trails and log landings/decks that would be established under the baseline scenario as a georeferenced layer (shapefile or equivalent), and lists necessary harvest and transport machinery.
- 5) The timber harvest plan follows best practice for timber harvest practices according to FSC guidelines, including planning of roads, skid trails and log landings.

1. Forest inventories

GGF has carried out detailed inventories of areas it has logged in the last 12 years. These are provided in the form of a 'Plan Operacional Annual' (POA - Annual Operating Plan in English) to the Department of Forestry for approval. The POAs are not based on sample plots, as VM0010 requires, but on the full area to be logged at the time. They therefore give a more accurate inventory than sample plots. Inventories were carried out according to standard and mandatory forestry methods, using the Smalian equation to calculate merchantable volume from Diameter at Breast Height (DBH) and Commercial stem Height (HC), including applying a Form Factor of 0.65 to reduce the bole's top diameter and thus introduce a measure of conicity (See Section 3.6 Deviation #1).

GGF has always practiced selective logging and its POAs have therefore only focused on its commercial target species. Before 2018 the list of target species was more limited, but with a view on its 2018 business plan (see Section 4.1.1), which signals a shift towards less species-specific products, the latest POA (number 10) has inventoried all trees above the internally applied minimum DBH (on average 18% above the mandated minimum) for each commercial species on an area of 3,000ha. This POA10 will therefore be used as the forest inventory for the entire project area, meaning that it will be assumed that the same species mix occurs everywhere and that the merchantable volume for each species in each annual operating area can be derived by dividing the inventoried volume in POA10 by 3,000 and multiplying by the area of the annual operating area.

2. Demarcation of all non-harvest areas

The maps (see Section 3.3) show all areas under GGF's management that will not be harvested, including conservation areas and areas that seasonally inundate and are not suitable for logging. Note that these areas are outside the VCS project boundary. However, they are part of GGF's conservation management, which includes the project areas.

3. Division of the harvestable forest into annual operating areas

The maps (see Section 3.3) show the project areas divided into 20 annual operating areas, or land parcels. These have been numbered PC1-20 in each of the three areas and these numbers are used throughout the calculation worksheets. Land parcels in the Consolidado#1 are marked as C1PC1-20. Land parcels in the Consolidado#2 are marked as C2PC1-20. Land parcels in San Regis are marked as SRPC1-20.

4. Design and presentation of the forestry infrastructure to harvest, skid/haul, store and move harvested timber products

The maps (see Section 3.3) show the forestry infrastructure in each area and each annual operating area. They have been prepared following common practice: primary roads are planned to follow the 'ridges' between rivers and avoiding river crossings as much as possible. As this is the infrastructure with the highest cost the establishment of roads is minimised as much as possible. Secondary roads (tracks) are planned according to the same principles but with the aim

of accessing all forest areas. From there skid trails (not shown on the map) will branch out into the forest to reach individual trees.

Timber Harvesting Schedule

For the purpose of estimating the net annual changes in carbon stocks resulting from planned timber harvest in the baseline scenario, a detailed planned timber harvesting schedule is developed from the timber harvest plan, setting out details of harvest and forestry infrastructure establishment for each land parcel in the project area in terms of the following:

1. The species to be harvested

Species to be harvested, including their inventoried commercial volume in POA10 (3,000ha) and their wood density, are presented in Table 9.

Table 9. Species to be harvested, their inventoried commercial volume and their wood density. Species have been classed into high and low wood density classes. Source: Global Wood Density Database (<https://scholar.google.es/citations?user=H2fDZJOAAAAJ&hl=es&oi=sra>), www.peruforestal.org and <http://madexo.pe/madera-cachimbo/> for *Allantoma decandra*. Green cells indicate species for which no specific wood density was available and for which a wood density was chosen based on other species within the genus.

Nº	Wood density class (for wood product class allocation)	Species	Scientific name	Vol m³ in POA10	Wood density
1	High Density Species	Tahuari	<i>Tabebuia incana</i>	41.6	0.94
2		Azucarillo	<i>Dialium guianense</i>	102.4	0.89
3		Shihuahuaco	<i>Dipteryx micrantha</i>	1070.5	0.87
4		Quinilla	<i>Manilkara bidentata</i>	338.7	0.87
5		Machimango	<i>Eschweilera coriacea</i>	3599.5	0.85
6		Palisangre	<i>Brosimun rubescens</i>	1880.2	0.83
7		Parinari	<i>Licania micrantha</i>	567.1	0.84
8		Cepanchina	<i>Sloanea floribunda</i>	1.0	0.81
9		Ana Caspi	<i>Apuleia leiocarpa</i>	622.3	0.7
10		Caimitillo	<i>Pouteria caimito</i>	3366.9	0.8
11		Guacamayo Caspi	<i>Simira rubescens</i>	23.5	0.8
12		Remo Caspi	<i>Aspidosperma excelsum</i>	389.3	0.79
13		Estoraque	<i>Myroxylon balsamum</i>	8.7	0.78
14		Quillobara	<i>Caraipa grandifolia</i>	2.0	0.78
15		Quillobara	<i>Caraipa grandifolia</i>	606.4	0.78
16		Quillobordon	<i>Aspidosperma parvifolium</i>	44.9	0.78
17		Lucuma	<i>Pouteria lucuma</i>	1.6	0.77
18		Cashillo	<i>Aptandra tubicina</i>	25.0	0.77
19		Yacushapana	<i>Buchenavia grandis</i>	721.3	0.76
20		Azucar huayo	<i>Hymenaea oblongifolia</i>	663.5	0.74
21		Itauba	<i>Mezilaurus itauba</i>	1.5	0.74
22		Lacre	<i>Tetragastris panamensis</i>	1.4	0.73
23		Brea Caspi	<i>Tetragastris panamensis</i>	4.4	0.73
24		Capirona	<i>Calycophyllum spruceanum</i>	37.9	0.72
25		Apacharana	<i>Licaria elata</i>	2.6	0.7
26		Porotillo	<i>Swartzia auriculata</i>	123.1	0.7
27		Huangana Caspi	<i>Senefeldera inclinata</i>	24.7	0.7
28		Almendro	<i>Caryocar glabrum</i>	531.9	0.68

29		Mari mari	<i>Vatairea guianensis</i>	1612.6	0.67
30		Metohuayo	<i>Caryodendrom orinocense</i>	8.0	0.65
31		Metohuayo	<i>Caryodendrom orinocense</i>	52.7	0.65
32		Chontaquiro	<i>Hymenolobium pulcherrimum</i>	448.9	0.64
33		Tamamuri	<i>Brosimum acutifolium</i>	71.1	0.64
34		Huayruro	<i>Ormosia amazonica</i>	1298.4	0.62
35		Charichuelo	<i>Garciniama crophylla</i>	27.4	0.77
36		Lagarto Caspi	<i>Calophyllum brasiliense</i>	25.7	0.60
37		Copaiba	<i>Copaifera paupera</i>	3.4	0.61
38		Panguana	<i>Brosimum parinarioides</i>	425.9	0.63
39		Requia	<i>Guarea kunthiana</i>	110.8	0.62
40		Mata Mata Huayo	<i>Trichilia pleeana</i>	64.0	0.62
41		Sacha Mango	<i>Grias peruviana</i>	51.1	0.62
42		Palometa caspi	<i>Neea floribunda</i>	40.1	0.62
43		Añuje Rumo	<i>Anaueria brasiliensis</i>	2792.8	0.61
44		Moena	<i>Aniba panurensis</i>	924.2	0.61
45		Shimbillo	<i>Inga pezizifera</i>	94.2	0.61
		TOTAL VOL M3		22855.0	
46	Low Density Species	Bara caspi	<i>Guatteria inundata</i>	47.2	0.54
47		Palorosa	<i>Tipuana tipu</i>	2.7	0.59
48		Cachimbo	<i>Allantoma decandra</i>	1579.7	0.59
49		Tortuga Caspi	<i>Duguetia spixiana</i>	1.2	0.58
50		Shiringa	<i>Hevea guianensis</i>	338.3	0.57
51		Huimba	<i>Ceiba samauma</i>	175.4	0.57
52		Caucho	<i>Hevea guianensis</i>	8.8	0.57
53		Andiroba	<i>Carapa guíanensis</i>	3.1	0.57
54		Guariuba	<i>Clarisia racemosa</i>	407.7	0.56
55		Mauba	<i>Vochysia venulosa</i>	3.4	0.48
56		Azufre Moena	<i>Guatteria sp.</i>	3.6	0.54
57		Espintana	<i>Guatteria modesta</i>	2.1	0.54
58		Naranja podrido	<i>Parahancornia peruviana</i>	29.0	0.52
59		Chingonga	<i>Brosimun utile</i>	225.1	0.51
60		Tornillo	<i>Cedrelinga catenaeformis</i>	2617.2	0.45
61		Copal	<i>Protium aracouchini</i>	605.3	0.49
62		Tangarana	<i>Triplaris Americana</i>	1497.0	0.49
63		Canela Moena	<i>Licaria triandra</i>	203.1	0.47
64		Capirnuri	<i>Clarisia biflora</i>	153.9	0.47
65		Cumala	<i>Virola calophylla</i>	6819.5	0.47
66		Cedro	<i>Cedrela odorata</i>	170.296	0.46
67		Pashaco	<i>Parkia nitida</i>	4382.0	0.38
68		Quillosisa/Cedrillo	<i>Vochysia vismiifolia</i>	2590.2	0.59
69		Marupa	<i>Simarouba amara</i>	283.72	0.38
			TOTAL VOL M³		22149.6
			Total volume 3000ha (m³)	45004.6	
			Average volume per hectare	15.00	
			Weighted average wood density (t/m³)		0.614

2. The year in which timber harvest and/or forest infrastructure establishment in each land parcel is scheduled to occur

The 20 land parcels in each project area are scheduled to be harvested according to their number, that is: the three land parcels numbered PC01 on the maps are scheduled to be harvested in Year 1; the three land parcels numbered PC02 on the maps are scheduled to be harvested in Year 2; etc.

Infrastructure establishment in each land parcel is assumed to take place the same year as harvesting.

3. The number of years each land parcel is in a post-harvest and/or post forestry infrastructure establishment state during the project crediting period

Logged land parcels will be in a post-harvest and post-forestry infrastructure establishment state for 20 years.

4. The maximum and minimum diameters at breast height (DBH), at stump and at top for tree harvesting

Peruvian forestry regulations do not prescribe a maximum cutting diameter at breast height or a minimum or maximum diameter at stump or tree top. However, there is a legal minimum harvesting DBH for the common commercial tree species. GGF applies an internal minimum harvesting DBH that for each of these species that is on average 18% higher than the legal minimum DBH (Table 10).

Table 10. Legal and applied internal minimum harvesting DBH for the common commercial tree species.

Nombre Científico	Familia	Referencia	Línea de Producción	DMC Normado	DMC Ejecutable	Diferencia DMC Ejecutable/Normado
<i>Otoba parvifolia</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Caryocar glabrum</i>	Caryocaraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	60	46%
<i>Apuleia leicarpa</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	60	46%
<i>Carapa guianensis</i>	Meliaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	50	22%
<i>Anaueria brasiliensis</i>	Lauraceae	Fichas OSINFOR	Aserrio	41	55	34%
<i>Hymenaea oblongifolia</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	50	51	2%
<i>Allantoma decandra</i>	Lecythidaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	60	46%
<i>Licaria triandra</i>	Lauraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Hymenolobium pulcherrimum</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	50	22%
<i>Virola calophylla</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Virola mollisima</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Virola albidiflora</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Virola pavanis</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Osteophloeum platyspermum</i>	Myristicaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Ormosia amazonica</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	60	30%
<i>Brosimum utile</i>	Moraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Eschweilera coriacea</i>	Lecythidaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	50	22%
<i>Caryodendron orinocense</i>	Euphorbiaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	50	22%
<i>Vatairea guianensis</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	55	34%
<i>Simarouba amara</i>	Simaroubaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Aniba panurensis</i>	Lauraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Aniba guianensis</i>	Lauraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Nectandra reticulata</i>	Lauraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Brosimum rubescens</i>	Moraceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	60	46%
<i>Parkia nitida</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	50	51	2%
<i>Macarobium acaciifolium</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	50	51	2%
<i>Manilkara bidentata</i>	Sapotaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	50	22%
<i>Guarea kunthiana</i>	Meliaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	46	50	9%
<i>Dipteryx micrantha</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	51	60	18%
<i>Cedrelina cateniformis</i>	Fabaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	61	65	7%
<i>Buchenavia grandis</i>	Combretaceae	R.D.E.Nº118-2019-MINAGRI-SERFOR-DE	Aserrio	41	55	34%
				Promedio:		18%

5. The planned harvesting regime (clear felling, specie/stratum-selective logging, area-selective logging)

The planned harvesting regime is area-selective logging.

6. The fraction of merchantable timber volume from clearing of forest roads, skid trails and log landings that is to be processed into wood products

All infrastructure areas are initially part of the area from which timber is extracted. This means that the commercial volume of 15m³ will be extracted from all areas that will subsequently be converted into roads, skid trails, log landings and port areas (the fraction is therefore 1, or 100%). After commercial harvest, all remaining biomass will be converted into dead wood for infrastructure establishment. However, this addition to the dead wood pool in the forest is calculated as a Logging Impact Factor per cubic meter of timber extracted.

7. The technical specifications for the categories of wood products to be harvested

Wood products to be produced from harvested timber are:

Table 11. Product types, recovery rates and product longevity categories for different types of harvested species.

		% OF LOG RECOVERED	Product longevity (y)
High density high value species	DECKING	23%	3-100
	S4S	15%	3-100
	DECK TILE	5%	3-100
	OTHER	2%	3-100
	Total	45%	
High density low value species	SLEEPERS	35.00%	3-100
	KILN STICKS	28.00%	3-100
	OTHERS	3.00%	3-100
	Total	66%	
Low density high value species	RSKD	50.00%	3-100
	RSKD SHORT	10.00%	0
	OTHER	5.00%	0
	Total	65%	
Low density low value species	RSAD	65.00%	3-100
	RSAD SHORT	13.00%	0
	OTHER	5.00%	0
	Total	83%	

8. The total volumes or fractions to be harvested, broken down by categories of wood products defined as sawn wood, wood-based panels, other industrial roundwood, paper and paper board, and other

Long-lived (3-100yr) products: $OF \times 0.86 = 45.9\%$ of extracted log carbon stocks.

Short-lived products and waste (0yr): 46.7% of extracted log carbon stocks.

Reference is made to the latest version of the Green Gold Loreto 1 ER Calculation Spreadsheet, Inputs Baseline tab, Cells B46 and B47, and to the data tables in Section 5.1.

3.5 Additionality

For the demonstration of additionality, the methodology requires the VCS tool, VT0001 Tool for the Demonstration and Assessment of Additionality in AFOLU Project Activities, v3.0 (2012) to be used, i.e., the latest version of this Tool. This tool prescribes a step-wise approach to be followed to demonstrate additionality:

Step 1. Identification of alternative land use scenarios to the AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS project activity

The following credible alternative land use scenarios are identified:

1, Continuation of the pre-project land use: planned timber harvest. GGF has been logging in parts of the project area since 2011. It has gradually grown its operations from a loss-making start-up to broadly operationally break-even. It has invested in its own sawmill and in the expansion of its concession areas. It has demonstrated that it has the experience and the capacity to significantly ramp-up forest operations, timber processing and make sales to export markets, thereby becoming the profitable business that its investors have always wanted. The planned timber harvest is a highly plausible land use scenario.

2. Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project. This scenario assumes that GGF would cease logging activities within the project area, while maintaining logging activities outside of the project area so as to comply with its legal obligations as a production forest concession holder. Within the project area, GGF would sustainably harvest indigenous fruits (a non-timber forest product) and promote eco-science tourism (hosting students, scientific researchers, film makers, etc.).

No other land uses exist within the project boundary, or have existed within the project boundary at any point in the last ten years, or exist in similar forestry concessions in the vicinity of the project areas. Any agricultural land uses are strictly confined to demarcated community areas. Illegal conversion of forestry concession land for agriculture is rare and has not occurred on the project areas. Illegal logging is not considered a land use: it may affect the forest in both of the above credible alternative land use scenarios.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

Sub-step 1b a) Land use scenarios 1 is fully compliant with applicable laws and regulations. The project area forms part of GGF's government-leased logging concessions and a planned timber harvest must be carried on some of the area.

Land use scenario 2 is also fully compliant with applicable laws and regulations, because GGF is maintaining a logging operation on part of its concession areas, alongside fruit harvesting within the project area. This serves the purpose of legal compliance with the concession contracts.

Sub-step 1b b) The list of plausible land use scenarios thus consists of two options: 1) Planned timber harvest, and 2) the project activity without being registered as a VCS AFOLU project.

Sub-step 1c. The selection and determination of the most plausible baseline scenario will be done in Step 2 below by elimination of the project activity without being registered as a VCS project as a plausible land use alternative through an investment analysis.

An investment comparison analysis (Option II) is applied.

Sub-step 2b. – Option II: apply investment comparison analysis

Step 2 of the Tool is an investment analysis

A comparison of Net Present Value (NPV) is applied

Sub-step 2a. Determine appropriate analysis method

Sub-step 2c. Calculation and comparison of financial indicators

Land use scenario 1 – Continuation of the pre-project land use: planned timber harvest: NPV of \$10.476million

Land use scenario 2 – Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project: Negative NPV.

The critical assumptions and data inputs into the project's financial model are as follows:

For land-use scenario 1:

- Project time horizon – 20 years
- Discount rate – 10%
- Operating costs – forest concession fees, timber felling, extraction, log transport, sawing and processing – \$11,038,000 annually
- Finished products transport and export – \$2,257,000 annually
- Overheads – certification, survey, accounting, audit, legal, insurance, communications, travel, consumables and project staff – \$1,372,000 annually
- Timber forest product sales – \$17,177,000 annually

For land-use scenario 2:

- Project time horizon – 20 years
- Discount rate – 10%
- Operating costs – forest rangers, consumables, forest concession fees, forest surveys, etc. – \$730,000 annually
- Overheads – accounting, audit, legal, insurance, communications, travel, consumables and project staff – \$956,000 annually
- Non-timber forest product sales – \$200,000 annually
- Infrastructure and machinery cost – \$60,000 (2021)
- Local employment – \$278,000 annually
- Development fund – \$100,000 annually
- One-off set-up costs – \$130,000 in 2021

Without revenues from sales of VCUs the proposed VCS AFOLU project returns a negative IRR and a negative NPV and cannot therefore be considered financially attractive.

Sub-step 2d. Sensitivity analysis

We have flexed the business model of the proposed VCS AFOLU project by doubling revenues from fruit sales and assumed net annual profits of \$100,000 from eco-science tourism. These scenarios generate negative IRRs and therefore support the case that VCU revenues are necessary to make the project financially attractive and support the case for additionality.

Step 4. Common practice analysis

To our knowledge there is no documented evidence that other logging concession holders in Peru have converted (any part of) their logging operations into active forest conservation projects or are in the process of doing so. Mrs. Hilda Maria Morales Peña of GERFOR confirmed by email on 31st March 2021 that no information about any projects implementing conservation, tree plantings and/or community development in logging concessions was found on GERFOR's information platforms.

3.6 Methodology Deviations

The project proponent proposes the following methodology deviations:

1.

The project proponent must deviate from VM0010 in Section 8.1.1 'Calculation of [baseline] carbon stocks in commercial timber volumes', which states that "Yield tables or allometric equations must be used to convert field measurements of diameter (DBH, at typically 1.3m [4.3 ft] above ground level or above buttress where they exist), and total height H of each tree in the sample plots to merchantable volume, $V_{l,j,i,sp.}$." Instead, in its forest inventory the project proponent has calculated merchantable volume from DBH and commercial height by applying Smalian's formula (utilizing a Form Factor of 0.65), which is mandatory forestry practice in Peru (Directiva 046-2016 of SERFOR, 2016). Smalian's formula calculates the volume of a tree from its Diameter at Breast Height (DBH) and bole height as if it were a cylinder, then applying a Form Factor to simulate the conicity of the bole (in effect reducing the bole's top diameter).

The project proponent must demonstrate that this deviation results in a more conservative or more accurate estimate of baseline emissions. In order to compare the deviated method with an allometric equation we are unfortunately restricted to calculating with commercial height, not total height, as this is what has been estimated in POA10. Benitez Romero et al (2020) found six allometric equation to calculate volume from diameter and commercial height (the fact that these were all from the 1930s to 1960s demonstrates how difficult it is to find such equations in the modern literature) and tested them to harvested trees from the Brazilian Acre State, south-western Amazonia (to the south-east of Loreto). Applying Benitez Romero's best fit equation (Model MV2) to calculate the commercial volume of each tree in POA10 results in a consistently higher volume (59,085m³ in 3,000ha) than estimated using the proposed deviation (47,606m³).

In principle, GGF had decided in its business plan to extract no more than 15m³/ha. In terms of the baseline emissions being claimed by the project there is not much difference between a more or less conservative volume estimation method, since either way the emissions related to 15m³/ha extracted would be claimed. However, this decision was based on a lower inventoried volume, and had Model MV2 been used for the inventory (resulting in nearly 20m³/ha standing

extractable volume) GGF would likely have decided to take out more volume. After all, GGF's business is based on selling real products, not estimated volumes. Less trees means less income. While GGF's corporate ethos is highly geared towards sustainability it must balance this with profitability. The proposed method is therefore conservative (as well as mandatory forestry practice in Peru).

If GGF had still decided to limit its extraction to 15m³/ha this would have resulted in less inventoried trees being harvested. Since GGF would have prioritized the denser species (which are generally more valuable) the weighted average wood density of harvested trees would have been higher and thus claimed baseline emissions would have been higher. This is another reason the proposed method is conservative.

2.

The project proponent wishes to deviate from the exact way VM0010 calculates baseline carbon stock changes in the logging slash, residual stand damage and damage from infrastructure establishment fractions of the dead wood pool and proposes an alternative that is very similar but more direct and more accurate because it can use results from peer reviewed scientific publications that are applicable to the project region and to logging operations generally. Specifically:

VM0010's Section 8.1.1 *Calculation of [baseline] carbon stocks in commercial timber volumes* contains the following text: "Once the timber harvest plan is complete and VEX_{j,i}|BSL as well as (VEX,INF_{j,i}|BSL) is calculated, the **Biomass Conversion and Expansion Factors (BCEF) method** must be used to determine the carbon stock in harvested biomass. This method is appropriate as forest inventory data and allowable harvest must be based on volume estimates to which expansion factors can be readily applied." (p.20).

The method outlined in VM0010 uses the BCEF to calculate dead wood from logging slash in Section 8.1.2. To this is added the dead wood resulting from residual stand damage and from infrastructure establishment (the fraction that is not extracted). Residual stand damage is calculated as the extracted carbon stock multiplied by a Residual Stand Damage Factor (F_{RSD/BSL}).

The proposed deviation consists of applying a Logging Damage Factor (LDF in tC/m³) (Pearson et al, 2014) which combines logging slash and residual stand damage into a single factor that is applied to extracted volume to calculate carbon content in these two dead wood fractions. Dead Wood remaining in the forest from infrastructure establishment will be calculated separately applying a Logging Infrastructure Factor (LIF, in tC/m³) (Pearson et al, 2014), which combines biomass mortality from road construction, skid trails and log decks, camps and ports. LDF and LIF were derived from 6 studies that quantified logging impacts. While the Pearson et al (2014) paper reviews studies from the tropics of all three continents the results are consistent across sites and are of high statistical significance. Half of the sites are in the Amazon or Guiana Shield regions. Their results can therefore be considered applicable to the project area. In contrast, no species-specific BCEFs exist for the Peruvian Amazon and there are no data available for an applicable Residual Stand Damage Factor (F_{RSD/BSL}), which makes the method as prescribed by VM0010 less accurate than the proposed deviation.

This deviation is consistent with VM0010's requirement that "forest inventory data and allowable harvest must be based on volume estimates to which expansion factors can be readily applied."

The deviation renders Equations 3, 6 and 7 of VM0010 obsolete and replaces Equation (5) with the following equation:

$$\Delta C_{DWSLASH,i,p} |BSL = \sum_{j=1}^j (V_{EX,j,i}|BSL * LDF) + (V_{EX,j,i}|BSL * LIF) \quad (5)$$

Where:

$\Delta C_{DWSLASH,i,p} |BSL$ = Change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum i in land parcel p, in tC ha⁻¹;

$V_{EX,j,i BSL}$ $m^3 \cdot ha^{-1}$;	=	Mean volume of extracted timber per unit area for species j in stratum i ; in
LDF	=	Logging Damage Factor, in tC/m^3
LIF	=	Logging Infrastructure Factor, in tC/m^3

3.

The project proponent proposes to deviate from VM0010 on the monitoring of annual carbon stock changes in the project scenario. The proposed new approach will result in higher monitoring accuracy, as it will be less dependent on extrapolation of field plot data to the larger project area and will instead use a much larger set of actual data from the entire area (for further justification, see Appendix 2). This monitoring approach deviates from Section 8.2: *Project emissions* in the way net project emissions are then calculated.

The project proponent proposes to perform the monitoring of annual carbon stock changes in above ground biomass of trees in the project scenario through bi-annual carbon stock mapping and analysis of carbon stock changes through comparing maps from different years. Carbon stock maps are produced through a combination of samples from LiDAR satellite sensors, such as NASA's GEDI and/or ICESAT-2, which will give thousands of estimates of aboveground biomass per year in ~25m diameter plots, and operational continuous cover satellites such as Sentinel-1/2 and/or Landsat 8/9. The spaceborne LiDAR data is a measure of forest height and volume, and it must be calibrated using field data to convert to biomass, so existing field plots from the project area (to be established when allowed by COVID-19) and from the nearby region will be used for this purpose. Machine learning approaches are then used to find the best-fit model of a combination of the remote sensing datasets with calibrated LiDAR biomass measurements. This will allow for extrapolation of measured forest properties across the landscape at a 30m spatial resolution, deriving a per-pixel biomass estimation. These maps are then compared to the field plots (which are not directly used for model extrapolation, just for forest property assessment) to provide a quantified error and bias for the maps. Once calibrated, this model is expected to produce accurate (at the 95% confidence interval per pixel) biomass maps for a period of 5-10 years, when applied to new remote sensing datasets. However, the model may be re-trained every 4 years when additional plot measurements become available if the map shows too high an error with the new measurements.

Ground plot measurements will follow the Rainfor/ForestPlots.net methodology. Approx. 30 plots will be established by the project proponent within the project area and remeasured every 4 years. In addition, already established permanent sample plots in the same forest type and in the vicinity of the project area (i.e., covered by the satellite images) will also be used. The data for these are available on the Rainfor/ForestPlots.net databases.

Biomass maps are thus created for each bi-annual monitoring event (and for the project start date) and then compared. This creates a ΔC map where for each pixel the changes in biomass are presented. This ΔC map is the equivalent of the determination of $\Delta C_{AB,t|PRJ}$, applying Equation 32 of VM0010. However, Equation 32 needs to be modified as the calculation of ΔC is not done by stratum anymore, but by pixel. Also, methodology deviation #5 (see below) requires a further modification to the way project emissions from carbon stock changes are calculated. Hence, Equation 32 is modified to:

$$\Delta C_{AB,t|PRJ} = \sum_{basepix=1}^M (C_{AB,basepix,t2|PROJ} - C_{AB,basepix,t1|PROJ})/T * 44/12 \quad (32)$$

Where:

$\Delta C_{AB,t|PRJ}$ = Annual carbon stock change in aboveground biomass of trees in year t , tCO_2e/yr ;

$t1$ = year 1 of the project activity;

$C_{AB,pix,t|PROJ}$ = Mean aboveground biomass carbon stock of trees in pixel pix at time t , tC/ha ;

T = Number of years between monitoring time t_1 and t_2 ($T = t_2 - t_1$); years;

basepix = 1, 2, 3 ... M pixels within the area of any land parcel harvested in the baseline scenario since the start of the project activity ; and

44/12 = Ratio of molecular weights of carbon dioxide and carbon, $tCO_2e \ tC^{-1}$.

This determination of the gross annual carbon stock change in aboveground biomass of trees accountable in year t using biomass maps (see Section 5.3.7) forms the basis for further calculations to derive net project emissions $\Delta C_{NET,t|PRJ}$, as outlined below.

First, to detect any areas of disturbance, i.e. significant reduction in carbon stocks ($>10tC/ha$), a grid of 3×3 pixels (less than one ha - pixel size is $30 \times 30m$, so the grid covers $8100 \ m^2$) will be moved over the biomass map in a Geographic Information System and any grid with a cumulative ΔC exceeding $10tC$ may be an indication of natural or anthropogenic disturbances (see Section 5.3.7).

Equation (38) in Section 8.2.3 is replaced by Equation (M1):

$$\Delta C_{NET,t|PRJ} = \Delta C_{AB,t|PRJ} - \Delta C_{burn,i,t} + \Delta C_{DIST-FR,t|PRJ} - \Delta C_{dist,i,t} + \Delta C_{DIST,t|PRJ} \quad (M1)$$

Where:

$\Delta C_{NET,t|PRJ}$ = Net project emissions and removals since the previous monitoring event (tCO_2e/yr)

$\Delta C_{AB,t|PRJ}$ = Gross project emissions and removals since the previous monitoring event within the areas that would have been harvested in the baseline scenario up until the monitoring date t , before accounting for emissions from fire and non-fire disturbances that would also have occurred in the baseline scenario (tCO_2e/yr)

$\Delta C_{burn,i,t}$ = All emissions from fire disturbances within the areas that would have been harvested in the baseline scenario up until the monitoring date t , since the previous monitoring event (tCO_2e/yr)

$\Delta C_{DIST-FR,t|PRJ}$ = Emissions from fire disturbances since the previous monitoring event that would not have occurred in the baseline scenario, and thus attributable to the project (tCO_2e/yr)

$\Delta C_{dist,i,t}$ = All emissions from non-fire disturbances within the areas that would have been harvested in the baseline scenario up until the monitoring date t , since the previous monitoring event (tCO_2e/yr)

$\Delta C_{DIST,t|PRJ}$ = Emissions from non-fire disturbances since the previous monitoring event that would not have occurred in the baseline scenario, and thus attributable to the project (tCO_2e/yr)

Since the ΔC map observes all changes in biomass, including those from natural disturbances (and illegal logging, see Deviation #4 below), and since for natural disturbances only the emission from biomass that would not have been there in the baseline scenario (i.e., extracted volume) should be counted, the biomass losses from natural disturbances are re-added to the monitored biomass changes. Then, the area of observed natural disturbances is used to calculate project emissions from biomass that would not have been there in the baseline scenario, for fire and non-fire disturbances respectively (Equations 33, 34 and 35). These emissions are then subtracted to derive $\Delta C_{NET,t|PRJ}$.

Please note that Section 8.2.2.1 Option B: Natural Disturbance – Non-Fire states that “For non-fire natural disturbance, it is assumed that a disturbance event in the project scenario would also have occurred in the baseline scenario. Project emissions are therefore equal to the non-fire natural disturbance to biomass absent in the baseline scenario (harvested and removed) but present in the project scenario.” This is the same for Option A: Natural Disturbance – Fire. However, whilst this principle is upheld in Equations 33 and 34 for fire disturbance, Equation 35 does not apply it. Instead, Equation 35 calculates project emissions from non-fire disturbance as

the area affected multiplied by the total carbon stock in aboveground biomass. This is contrary to the stated principle.

The project proponent therefore proposes to modify Equation 35 to:

$$\Delta C_{DIST,t|PRJ} = \sum_{j=1}^j (A_{dist,i,t} * B_{i,t|PROJ}) * CF_j * 44/12 \quad (35)$$

Where:

$\Delta C_{DIST,t|PRJ}$ = Net greenhouse gas emissions resulting from non-fire disturbance in year t, tCO₂e

$A_{dist,i,t}$ = Area affected by non-fire disturbance for stratum i at time t, ha

$B_{i,t|PROJ}$ = Average aboveground biomass stock present in the project scenario but absent in the baseline scenario before disturbing stratum i, time t; t d. m. ha⁻¹; Calculated applying Equation 34.

CF_j = Carbon fraction for biomass of species j; tC t.d.m⁻¹

In Section 8.2.1: *Ongoing forest growth in the project scenario*, which calculates $\Delta C_{AB,t|PRJ}$ annual aboveground carbon stock change in trees in the project scenario, Sections 8.2.1.1-8.2.1.3 will still be followed to provide estimates of aboveground tree carbon stock in sample plots based on field measurements (however, see Deviation #1 above). Sections 8.2.1.4 – 8.2.1.5 are now obsolete, as there is only a single project stratum and the measured aboveground tree carbon stock in sample plots is directly used as an input into the model that produces the above-mentioned carbon stock maps. The calculation of $\Delta C_{AB,t|PRJ}$ in the modified Equation (32) of Section 8.2.1.6 is now done directly through the comparison of the biomass maps from two monitoring events.

4.

The project proponent wishes to deviate from VM0010 in the monitoring of illegal logging impact. The proposed deviation uses the quantification of carbon stock changes as proposed in Deviation #3, which significantly increases accuracy (for justification, see Appendix 2).

As the above-mentioned ΔC derived from carbon stock maps comparison will quantify any impact of illegal logging on carbon stocks the methodological emphasis shifts to correctly identifying an observed ΔC as resulting from illegal logging for the purpose of applying Equation 37 to calculate related fossil fuel emissions and to take action to prevent future illegal logging.

To detect illegal selective logging an analytical function will be programmed in a Geographic Information System in the following proposed manner: a square grid of 16x16 pixels will be moved over the biomass map. Any square of 256 30x30 m pixels covers approximately 23ha. If within any grid more than 6 pixels show a ΔC above 5 tC (equivalent to the aboveground biomass of a large tree plus collateral damage), and it is within striking distance of an access point ($D_{DIST_IL,i}$) this may be an indication of tree mortality that exceeds the natural level, i.e. it may be an observation of illegal logging¹ (see Section 5.3.7). Ground surveys will then confirm which of the pixels with flagged mortality events resulted from illegal logging.

This approach no longer requires the limited field sampling when the PRA indicates there is a potential for illegal logging activities.

To calculate fossil fuel emissions resulting from illegal logging, $C_{FUEL,IL}$, Equation 37 is modified to:

¹ The number of pixels to be detected within the grid and the detection threshold value were discussed with Prof. Ed Mitchard of the University of Edinburgh and Space Intelligence Ltd. who indicated these are realistic.

$$C_{FUEL,IL,t} = C_{FUEL} / C_{EX,i|BSL} \times 44/12 \times \sum_{pix}^M (\Delta C_{IL,pix,t}) \quad (37)$$

Where:

$C_{FUEL,IL,t}$ = Fossil fuel emissions resulting from illegal logging at time t, tCO₂e

C_{FUEL} = Total carbon emissions associated with the combustion of fossil fuel in forestry and wood processing machinery, in tC;

$C_{EX,i|BSL}$ = Change in carbon stock of extracted wood products resulting from timber harvest in the baseline, in tC ha⁻¹;

$\Delta C_{IL,pix,t}$ = Change in carbon stock resulting from illegal logging in pixel *pix* at time t, tC

pix = number of pixels 1,2,3,... M

Thus, the carbon stock change caused by illegal logging is obtained by addition of the observed ΔC of all pixels identified as illegal logging pixels from the 16x16 pixel grid analysis described above and in Section 5.3.7 and that have been confirmed by field visits.

5.

The project proponent proposes to amend Section 8.2.1.2: *Measurements* by replacing the text

“Only the individual trees, species and strata which were to be harvested in the baseline scenario are to be measured. The tree dimensions and minimum diameter at breast height (DBH) specified by the selected allometric equation in Section 8.2.1.1 must apply to these trees. Any minimum values employed in inventories are held constant for the duration of the project.”

with:

“Only trees that fall within the tree dimensions and the minimum diameter at breast height (DBH) specified by the allometric equation in Section 8.2.1.1 are to be measured. Any minimum values employed in inventories are held constant for the duration of the project.”

Using the biomass mapping as proposed in Deviation #3 (and as detailed in Appendix 1) is more accurate than extrapolation from field sample plots (as justified in Appendix 2). However, the remote-sensing imagery detects all trees in the forest, not only those trees that would have been harvested in the baseline. Therefore, the model that creates the resulting maps of total above-ground biomass needs to be trained by field plot data that measure all trees above minimum diameter.

The consequence of the above approach is that a change also needs to be made in the temporal calculation of project emissions. Rather than measuring the ΔC in only those trees that would have been harvested in the baseline scenario in the field plots and then assuming that this ΔC applies to all project areas, harvested or not (as VM0010 does), the amended approach compares the carbon stock changes and fire-related emissions of the full aboveground biomass, i.e., of all trees above minimum diameter in the forest **from the moment that baseline logging would have taken place on a parcel**. Before that moment, the forest behaves identical in both scenarios (except for illegal logging in the project scenario).

The modified Equation 32 (see also methodology deviation #3 above) expresses this change:

$$\Delta C_{AB,t|PRJ} = \sum_{basepix=1}^M (C_{AB,basepix,t2|PROJ} - C_{AB,basepix,t1|PROJ})/T * 44/12 \quad (32)$$

Where:

$\Delta C_{AB,t|PRJ}$ = Annual carbon stock change in aboveground biomass of trees in year t, tCO₂e/yr;

t1 = year 1 of the project activity;

$C_{AB,pix,t|PROJ}$ = Mean aboveground biomass carbon stock of trees in pixel *pix* at time t, tC/ha;

T = Number of years between monitoring time *t1* and *t2* (*T* = *t2* – *t1*); years;

basepix = 1, 2, 3 ... M pixels within the area of any land parcel harvested in the baseline scenario since the start of the project activity ; and

44/12 = Ratio of molecular weights of carbon dioxide and carbon, tCO_{2e} tC⁻¹.

The proposed deviation does not only result in the direct comparison of the same parameter (ΔC in all trees) in the two scenarios from the time that they diverge, which is a more logical and more correct comparison than VM0010's, but it also supports Deviation #3, which results in significantly increased monitoring accuracy (see Appendix 2).

6.

In Section 8.1.3, VM0010 lumps the carbon stocks of extracted timber of all species together (Equation 8), then asks to portion this into wood product classes k . Then it apportions default percentages of the WW, SLF and OF fractions to each wood product class k . This approach is useful when the project proponent does not have any specific data on wood products per species and on recovery rates in the sawmill, but due to applying global default data it is not accurate. GGF does have the mentioned specific data, thus applying them is more accurate than using the defaults. And since GGF is the baseline agent it is appropriate to use these specific data. GGF has invested in modern sawmill equipment, so its recovery rates will be higher than that achieved by the global defaults reported in Winjum (1998), resulting in a more conservative estimate of baseline emissions. However, log recovery rates are highly product specific, with the more processed, higher-value products having lower recovery rates (more processing means more sawing, thus more waste).

The project proponent can assign one of four wood product classes to each species in its Timber Harvest Plan, based on its wood density and value. These wood product classes are: High Density – High Value, High Density – Low Value, Low Density – High Value, and Low Density – Low Value). For each of the products k in these four classes GGF has recorded and verifiable log recovery rates from its sawmill operations (see Table 11, Section 3.4.4). Each product has been assigned to the longevity 0 years (WW and SLF) and longevity 3-100 years (OF) fractions (Table 11).

Therefore, for each species the extracted carbon in logs can be divided into the fraction that is immediately emitted (longevity 0 years), the fraction that is emitted between years 1 and 20 (86% of the products with longevity 3-100 years – see data table p.69 of VM0010), and the fraction that remains in wood products forever (14% of the products with longevity 3-100 years).

This renders Equation 8 obsolete. The project proponent proposes to replace it with:

$$OF_j = 1 - (WW_j + SLF_j) \quad (8)$$

Where:

OF_j = Fraction of biomass carbon from the 'oxidised fraction' that is assumed to be emitted to the atmosphere from wood products between years 3-100 after harvest for species j , dimensionless;

WW_j = Fraction of biomass carbon from wood waste that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless;

SLF_j = Fraction of biomass carbon from the short-lived wood product pool that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless

Equation 9 is modified to:

$$C_{WPO,i,t;BSL} = \sum_{j=1}^j C_{EX,i,j,t;BSL} * (WW_i + SLF_i) \quad (9)$$

Where:

$C_{WPO,i,t;BSL}$ = Carbon stock of extracted timber from stratum i that is assumed to be emitted immediately at the time of harvest t , in tC $\cdot$ ha⁻¹;

$C_{EX,i,j,t;BSL}$ = Carbon stock of extracted timber from species j in stratum i at time t , in tC $\cdot$ ha⁻¹;

WW_j = Fraction of biomass carbon from wood waste that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless;

SLF_j = Fraction of biomass carbon from the short-lived wood product pool that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless

And Equation 10 is modified to:

$$CWP_{20,i,t|BSL} = \sum_k^j C_{EX,i,j,t|BSL} * OF_j * 0.86 \quad (10)$$

Where:

$CWP_{20,i,t|BSL}$ = Carbon stock of extracted timber from stratum i at time t that is assumed to be emitted between years 1 and 20, in tCh^{-1} ;

$C_{EX,i,j,t|BSL}$ = Carbon stock of extracted timber from species j in stratum i at time t , in tCh^{-1} ;

OF_j = Fraction of biomass carbon from the 'oxidised fraction' that is assumed to be emitted to the atmosphere from wood products between years 3-100 after harvest for species j , dimensionless;

7.

The project proponent proposes to deviate from VM0010 on the criteria for the selection of a reference area for the development of the common practice baseline scenario. VM0010 states in Section 6.2.2 that this reference area "must be in the same region as the project area and must match the project area in terms of forest types, climate and elevation (identical mix of forest types $\pm 20\%$; identical annual precipitation $\pm 20\%$; elevation classes (500 m classes) in the reference region shall be in the same proportion as in the project area ($\pm 20\%$))"

VM0010 then also states that "Where there is limited capacity to generate the baseline scenario using a reference site in the region of the project area, multiple reference areas may be selected to cover a country so long as the reference area criteria regarding forest types, climate and elevation are met."

The VCS approach of a baseline reference area is that it is representative for what would occur within the project area in the baseline scenario. There must therefore be criteria for 'representativeness'. The wording in VM0010 on the reference area provides these criteria in terms of forest types, climate and elevation. It allows the project proponent to find a reference area outside the project region so long as these geographical criteria are met. However, the wording in VM0010 does not include any other criteria. It does not consider business model as a criterion, perhaps because VM0010 was developed with a specific project in mind, the April Salumei project in Papua New Guinea (the only validated VCS project so far to have applied VM0010), which does not identify a specific baseline logging agent but a hypothetical one in an area that was sanctioned for logging by the government but where there was no logging history. The methodology developers apparently did not foresee a situation where an already operational logging company would need to use a baseline reference area.

For GGF, business model is an essential criterion because its business model is not at all represented within the common practice of logging in Loreto or even in Peru. GGF's business model is that of an FSC-certified, vertically integrated, capital-intensive company that is able to process a wide range of tree species. These include many lesser-known species for which no market demand exists, which can be commercialised because they can be processed into non-species-specific composite products and/or kiln sticks. Due to its FSC certification, its processing capacity and its production volume GGF can target international markets effectively, making a return on its capital investment.

In contrast, the majority of logging companies in Peru operate on the extraction and commercialisation of a much narrower selection of higher-value species. This means the volume

they extract is generally much lower (see for example Goodman et al, 2019). Furthermore, there are few FSC-certified logging companies in Peru and none in Loreto. Finally, most companies in Peru, or even in the Amazon, have not invested in processing capacity and international market access, and therefore often engage with illegality to maintain profitability (EIA, 2012). We therefore argue that a reference area limited by regional or national boundaries will not provide baseline representativeness for this project. It would be more accurate to find reference companies that apply a similar business model to GGF's and to look at their extraction practices, as extracted volume per ha is the only parameter that is used for the common practice baseline in GGF's case. The use of reference companies would be allowable so long as the criteria regarding forest types, climate and elevation are met.

GGF has identified three companies that operate with a similar business model to its own within the Amazon basin (two in Brazil, one in Peru), within a similar forest type, climate and elevation (see Section 3.4.2). GGF proposes to deviate from VM0010 by using these companies as the reference for its common practice baseline scenario of extracted timber volume per hectare.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

The baseline emissions calculated in this PD include:

1. Emissions from wood product conversion
2. Decomposition of deadwood from harvested trees
3. Emissions from wood product retirement
4. Stock change due to regrowth following timber harvest
5. Decomposition of trees incidentally killed during tree felling
6. Decomposition of trees killed through skid trail creation
7. Decomposition of trees killed through road construction

As per VM0010, the following baseline emissions have been conservatively excluded from calculations:

4.1.1 1. Emissions through subsequent forest re-entry

The project is following the common practice data pathway, as concluded in Section 3.4.

Calculation of carbon stocks in commercial timber volumes

For the calculation of carbon stock in commercial timber volumes GGF has established a Timber Harvesting Schedule as per VM0010 and based on its own logging practices (see Section 3.4.4). The Timber Harvesting Schedule allows for the calculation of:

- 1) The mean extracted volume of extracted merchantable timber per unit area by species in each stratum in each year ($V_{EX,j,i|BSL}$ – Equation 4 of VM0010).

There is no legal maximum extraction rate in Peru, but there is a legal minimum DBH established for the main commercial tree species. However, GGF has internally mandated its own minimum DBH for these species, which is on average 18% higher than the legal minimum (see Table 10,

Section 3.4.4). Based on POA10, its most complete forest inventory in terms of species included², which applies its internal minimum DBH list, GGF could take out a volume of 16.3m³/ha³. In its business plan and investment memorandum (both will be available at validation) for the expansion and optimisation of its logging business in its ambition to make it profitable while maintaining sustainability the company aimed for an average extraction rate of 15m³/ha, which is what will be used for baseline modelling. Note this is a conservative extraction rate relative to the legally allowed extraction volume. This extraction rate is in line with the common practise for logging companies with a similar business model in the Amazon basin.

2) All infrastructure areas are initially part of the area from which timber is extracted. This means that the commercial volume of 15m³/ha will be extracted from all areas that will subsequently be converted into roads, skid trails, log landings (decks) and port areas. In Equation 4, $V_{EX,j,i|BSL}$ thus includes $V_{EX,INF,j,i|BSL}$.

After commercial harvest, all remaining above ground biomass on areas of infrastructure establishment will be converted into dead wood. However, this addition to the dead wood pool in the forest is calculated as a Logging Impact Factor per cubic meter of timber extracted (see Section 3.6: deviation #2).

Calculation of the carbon stock of timber harvested

Calculation of the carbon stock of timber harvested is done in the GGF Loreto 1 baseline emissions calculation spreadsheet, applying Equation 4 of VM0010.

$$C_{EX,j,i|BSL} = (V_{EX,j,i|BSL} + V_{EX,INF,j,i|BSL}) * D_j * CF_j \quad (4)$$

Where:

$C_{EX,j,i BSL}$	Mean carbon stock of extracted timber per unit area for species j in stratum i ; tC·ha ⁻¹ ;
$V_{EX,j,i BSL}$	Mean volume of extracted timber per unit area for species j in stratum i ; in m ³ ·ha ⁻¹ ;
$V_{EX,INF,j,i BSL}$	Mean volume of extracted timber for forestry infrastructure per unit area for species j in stratum i ; m ³ ·ha ⁻¹ ;
D_j	Basic wood density of species j ; t d.m. m ⁻³ ; ¹²
CF_j	Carbon fraction of biomass for species j ; tC t d.m. ⁻¹ ;
i	1,2,3 ... M strata; and
j	1,2,3 ... J tree species.

The parameters used in this equation are:

Mean volume of extracted timber per unit area for species j in stratum i , m³·ha⁻¹ ($V_{EX,j,i|BSL}$) – Value applied: 15 m³·ha⁻¹ (independent of species)

² POA10 was conducted in 2017 and does therefore not require a field validation, as it is less than 10 years old (VM0010, p18). Note also that there are many more species included in POA10 than in previous POAs, as a result of GGF's intended change of business model to produce and export non-species-specific products (composite wood products, kiln sticks, etc).

³ Note that this volume was calculated from measured DBH and commercial height, using Smalian's formula and a form factor, as described in Methodology Deviation #1.

Wood Density (D_j , biomass per m^3) – 0.614 t/m^3 (volume weighted average of harvested species, see Table 9)

Carbon Fraction (CF) – 0.5 (IPCC default)

The values applied are discussed in the data tables in Section 5.1.

Calculation of dead wood (logging slash) generated in the process of timber harvest

Calculation of the carbon stock changes in the forest dead wood pool is done in the GGF Loreto 1 baseline and project emissions calculation spreadsheet, applying Equation 5 as proposed in Methodology Deviation #2, described Section 3.6.

$$4.1.2 \quad \Delta C_{DWSLASH,i,p} \text{ BSL} = \sum_{j=1}^j (V_{EX,j,i} \text{ BSL} * LDF) + (V_{EX,j,i} \text{ BSL} * LIF) \quad (5)$$

Where:

$\Delta C_{DWSLASH,i,p} \text{ BSL}$ = Change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum i in land parcel p , in $tC \text{ ha}^{-1}$;

$V_{EX,j,i} \text{ BSL}$ = Mean volume of extracted timber per unit area for species j in stratum i ; in $m^3 \text{ ha}^{-1}$;

LDF = Logging Damage Factor, in tC/m^3

LIF = Logging Infrastructure Factor, in tC/m^3

The parameters used are:

Mean volume of extracted timber per unit area for species j in stratum i , $m^3 \text{ ha}^{-1}$ ($V_{EX,j,i} \text{ BSL}$) – Value applied: 15 $m^3 \text{ ha}^{-1}$ (independent of species)

Logging Damage Factor (tC/m^3 extracted) - Value applied: 1.134

Logging Infrastructure Factor (tC/m^3 extracted) - Value applied: 0.458

4.1.3 The values applied are discussed in the data tables in Section 5.1.

Calculation of baseline carbon sequestered in wood products

Calculation of the carbon stock changes in the Wood Products pool is done in the GGF Loreto 1 baseline and project emissions calculation spreadsheet, applying Equations 8, 9, 10 (as modified in Section 3.6 Deviation #6) and Equation 11 of VM0010.

$$OF_j = 1 - (WW_j + SLF_j) \quad (8)$$

Where:

OF_j = Fraction of biomass carbon from the 'oxidised fraction' that is assumed to be emitted to the atmosphere from wood products between years 3-100 after harvest for species j , dimensionless;

WW_j = Fraction of biomass carbon from wood waste that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless;

SLF_j = Fraction of biomass carbon from the short-lived wood product pool that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless

$$C_{WP0,i,t} \text{ BSL} = \sum_{j=1}^j C_{EX,i,j,t} \text{ BSL} * (WW_i + SLF_i) \quad (9)$$

Where:

$C_{WP0,i,t|BSL}$ = Carbon stock of extracted timber from stratum i that is assumed to be emitted immediately at the time of harvest t , in tCh^{-1} ;

$C_{EX,i,j,t|BSL}$ = Carbon stock of extracted timber from species j in stratum i at time t , in tCh^{-1} ;

WW_j = Fraction of biomass carbon from wood waste that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless;

SLF_j = Fraction of biomass carbon from the short-lived wood product pool that is assumed to be emitted to the atmosphere immediately at the time of harvest for species j , dimensionless

$$C_{WP20,i,t|BSL} = \sum_k^j C_{EX,i,j,t|BSL} * OF_j * 0.86 \quad (10)$$

Where:

$C_{WP20,i,t|BSL}$ = Carbon stock of extracted timber from stratum i at time t that is assumed to be emitted between years 1 and 20, in tCh^{-1} ;

$C_{EX,i,j,k|BSL}$ = Carbon stock of extracted timber from species j in stratum i at time t , in tCh^{-1} ;

OF_j = Fraction of biomass carbon from the 'oxidised fraction' that is assumed to be emitted to the atmosphere from wood products between years 3-100 after harvest for species j , dimensionless;

The parameters used in these equations are:

Wood Waste and Short-Lived Wood Products, that are assumed to be emitted immediately into the atmosphere: 46.7%

Long-lived Wood Products, that are assumed to be emitted over a 20-year linear decay function: 45.9%

Wood Products that are assumed to permanently store carbon: 7.5% (14% of the Long-lived Wood Products (as per Winjum et al, 1998)).

The values applied are discussed in the data tables in Section 5.1.

$$C_{WP100,i|BSL} = C_{WP,i|BSL} * OF_k \quad (11)$$

Where:

$C_{WP100,i,p|BSL}$ Cabron stored in wood products that are assumed to be retired between 3 - 100 years after harvest from stratum i in land parcel p , $tC\ ha^{-1}$;

$C_{WP,i|BSL}$ Carbon stock of extracted timber from stratum i that is assumed to enter the wood products pool that is not immediately emitted at the time of harvest, in $tC\ ha^{-1}$;

OF_k Fraction of biomass carbon for wood product type k that is assumed to be emitted to the atmosphere between 3 and 100 years of timber harvest, dimensionless;¹⁴ and

i 1,2,3 ... M strata.

Change in carbon stocks due to forest regrowth after harvest

Calculation of the carbon stock changes in the Wood Products pool is done in the GGF Loreto 1 baseline and project emissions calculation spreadsheet, applying Equation 12 of VM0010.

$$C_{RG,i,p|BSL} = \sum_i RGR_i \quad (12)$$

Where:

$C_{RG,i,p BSL}$	Carbon sequestration resulting from forest regrowth after timber harvest and establishment of forestry infrastructure in stratum i in land parcel p , $tC\ ha^{-1}yr^{-1}$;
RGR_i	Regrowth rate of forest post timber harvest post forestry infrastructure establishment for stratum i , $tC\ ha^{-1}yr^{-1}$; ¹⁵
i	1,2,3 ... M strata

The parameters used in this equation are:

RGR_i , Regrowth rate of forest post timber harvest post forestry infrastructure establishment for stratum i , $tC\ ha^{-1}yr^{-1}$ – Value applied: $1.02\ tC\ ha^{-1}yr^{-1}$

The values applied are discussed in the data tables in Section 5.1.

4.1.5 Calculation of baseline emissions from the combustion of fossil fuels in forestry and wood processing machinery

Baseline emissions from fuel combustion are considered insignificant as per application of the CDM Tool for testing significance of GHG emissions in A/R CDM project activities, version 1.

4.1.6 Calculation of baseline scenario of greenhouse gas emissions from change in carbon stocks

In this section Equations 23-28 of VM0010 are applied to calculate $GHG_{NET|BSL}$, the net greenhouse gas emissions in the baseline scenario, in tCO_2e . Except for the area A logged each year (1/20th of the project area), all parameters are calculated. The calculations are performed in the GGF Loreto 1 baseline and project emissions calculation spreadsheet. Results are presented in Table 12, Section 4.4.

4.2 Project Emissions

Project emissions include the change in carbon stocks of ongoing forest growth, forest disturbances, and illegal logging. Calculation of project emissions is done in the GGF Loreto 1 baseline and project emissions calculation spreadsheet, applying Equation M1 (which replaces Equation 38 of VM0010, see Methodology Deviation #3, Section 3.6). Results are presented in Table 12, Section 4.4.

$$\Delta C_{NET,t|PRJ} = \Delta C_{AB,t|PRJ} - \Delta C_{burn,i,t} + \Delta C_{DIST-FR,t|PRJ} - \Delta C_{dist,i,t} + \Delta C_{DIST,t|PRJ} \quad (M1)$$

Where:

$\Delta C_{NET,t|PRJ}$ = Net project emissions and removals since the previous monitoring event (tCO_2e/yr)

$\Delta C_{AB,t|PRJ}$ = Gross project emissions and removals since the previous monitoring event within the areas that would have been harvested in the baseline scenario up until the monitoring date t , before accounting for emissions from fire and non-fire disturbances that would also have occurred in the baseline scenario (tCO_2e/yr)

$\Delta C_{burn,i,t}$ = All emissions from fire disturbances within the areas that would have been harvested in the baseline scenario up until the monitoring date t , since the previous monitoring event (tCO_2e/yr)

$\Delta C_{DIST-FR,t \text{ IPRJ}}$ = Emissions from fire disturbances since the previous monitoring event that would not have occurred in the baseline scenario, and thus attributable to the project (tCO₂e/yr)

$\Delta C_{dist,i,t}$ = All emissions from non-fire disturbances within the areas that would have been harvested in the baseline scenario up until the monitoring date t, since the previous monitoring event (tCO₂e/yr)

$\Delta C_{DIST,t \text{ IPRJ}}$ = Emissions from non-fire disturbances since the previous monitoring event that would not have occurred in the baseline scenario, and thus attributable to the project (tCO₂e/yr)

Project sequestration in ongoing forest growth

There is a growing body of literature confirming net carbon sequestration in undisturbed Amazonian forests, probably caused by a CO₂ fertilization effect. Brien et al (2015) found a net biomass accumulation of around 1 t/ha/yr (0.5 tC/ha/yr) between 2000 and 2010 in a study of 321 plots across the Amazon region (Fig. 9, graph a, the red full line indicates net biomass change starting at just above 1 t/ha/yr in 2000 and dipping just below 1 t/ha/yr in 2010).

4.2.1

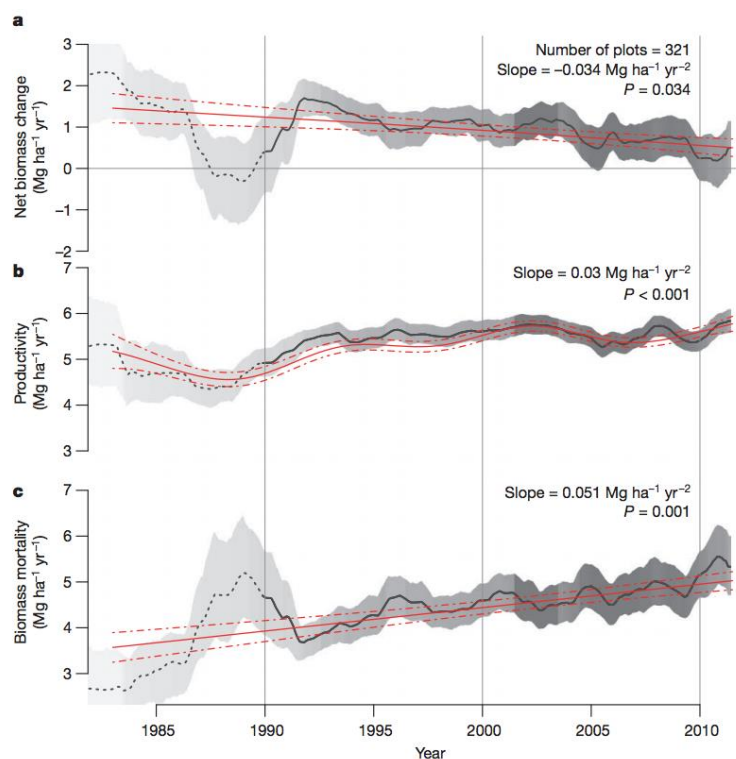


Fig. 9. Net biomass change, productivity and mortality in Amazonian forests. Source: Brien et al (2015)

However, they also observed that this effect is increasingly being reduced by tree mortality (Fig. 9). Increased mortality may be a result of more frequent climatic extremes, such as drought and storms. This trend might result in net carbon accumulation going down to zero, or even below, in the future. It is likely, however, that tree mortality due to drought is lower in Loreto than in areas in the Amazon with more rainfall seasonality, and that we may assume carbon being captured by the project's protected forests during the entire crediting period.

In a similar study of a Peruvian subset of plots, Vicuña Miñano et al (2018) concluded an average yearly carbon accumulation of 0.52 tC/ha/yr between 1997 and 2017 for undisturbed forests in Peruvian Amazonian national parks.

Carbon accumulation in the project area will be monitored using carbon stock maps derived from remote sensing data and ground plots (see Section 3.6 Deviation#3 and Section 5.3.7). However, for the purpose of the *ex-ante* estimation of project emissions/sequestration we assume an annual accumulation of 0.4 tC/ha/yr over the project crediting period, which is lower than the 0.52 tC/ha/yr found by Vicuña Miñano et al (2018).

VM0010's Equation 32 and guidance in Section 8.2.1.6 directs projects to estimate project sequestration in ongoing forest growth **each year in all strata over the entire project area**, but to do this only for the trees that would have been logged. However, this project argues for a different approach in Section 3.6, Deviation #5 (including a modification of Equation 32). For each unlogged parcel, any sequestration would also have occurred in the baseline scenario **until that land parcel would have been logged**. At that point the land parcel in question cannot continue the same sequestration rate as in the project scenario. This means that in Year 1 only the sequestration in the parcels PC1 should be accounted for; in Year 2 the sequestration in the parcels PC1 and PC2; etc. As per Section 3.6, Deviation #5, this is how project sequestration will be accounted for in this project, applying the modified Equation 32:

$$\Delta C_{AB,t \mid PRJ} = \sum_{basepix=1}^M (C_{AB,basepix,t2 \mid PROJ} - C_{AB,basepix,t1 \mid PROJ})/T * 44/12 \quad (32)$$

Where:

$\Delta C_{AB,t \mid PRJ}$ = Annual carbon stock change in aboveground biomass of trees in year t, tCO_{2e}/yr;

t1 = year 1 of the project activity;

$C_{AB,pix,t \mid PROJ}$ = Mean aboveground biomass carbon stock of trees in pixel *pix* at time t, tC/ha;

T = Number of years between monitoring time t1 and t2 (T = t2 - t1); years;

basepix = 1, 2, 3 ... M pixels within the area of any land parcel harvested in the baseline scenario since the start of the project activity ; and

44/12 = Ratio of molecular weights of carbon dioxide and carbon, tCO_{2e} tC⁻¹.

4.2.2

Project emissions from natural forest disturbances

Project emissions from natural forest disturbances will be monitored (see Section 5: Monitoring, and Methodology Deviation #3, Section 3.6).

For the purpose of an *ex-ante* estimation of project emissions/sequestration we assume that no such disturbances will take place. This is consistent with the discussion that natural disturbance risks are negligible in the project area, as presented in the VCS Non-Permanence Report.

4.2.3

Therefore, $A_{burn,i,t}$ and $A_{dist,i,t}$ in Equations 33 and 35 of VM0010 are zero and the outcomes of these equations is zero.

Project emissions from illegal logging

Project emissions from illegal logging will be monitored (see Section 5: Monitoring, and Methodology Deviation #4, Section 3.6).

Currently, the risk and incidence of anthropogenic disturbances is low due to the continued presence of GGF near key access point, the good relationship with nearby communities and the lack of population centers upstream on the Tacsha Curaray and Mazán rivers. It is the expectation and objective of the project to continue this discouragement of anthropogenic disturbances in the VCS project. Therefore, the *ex-ante* estimation of project emissions from illegal logging is zero. $A_{DIST-IL,j}$ in Equation 37 of VM0010 is zero and the outcome of this equation is zero. No Participatory Rural Appraisal (PRA) has been carried out for this *ex-ante* estimation. This will be done as part of project monitoring, as described in Section 5.

4.3 Leakage

Activity shifting leakage

No logging activities will be shifted from the project areas to other concession areas owned by GGF.

4.3.1

This will be demonstrated by comparing forest management plans prepared more than 24 months before the project start date with the log volumes from areas outside of the project area that will be harvested by GGF during the project time period. The reference harvest volumes are shown on POA10 (see table 9), which was completed in July 2017 and was used to prepare GGF's 2018 business plan.

It should be noted that to comply with the contractual obligations that GGF has towards the Peruvian State, the company will continue logging on a 20-year rotation in a small portion of its concession holdings outside of the project area (totalling c.30,000ha). This will be of reduced intensity compared with pre-project management, at approx. 3m³/ha on average, compared with 15m³/ha in POA10. Any negative environmental impacts associated with forestry infrastructure will be minimal as logging areas are near rivers and will not require the construction of roads.

Market leakage

4.3.2

GGF's products have historically been sold into both the international market and the domestic market.

GGF was founded to be a timber exporting company. However, while growing the business the company could not capitalize fully on the added value from the export market due to start-up logistical problems (often related to not achieving the bulk required for transportation to the exterior) and capital constraints. With its 2018 expansion business plan and investment memorandum GGF aimed to raise the operational capital and size that would allow it to primarily focus on exporting wood products. The main market for this expansion is the US. All products made from high-value species are for export (see Table 11 in Section 3.4.4). The combined volume of high-value species in POA10 is 60.3% of the total volume.

International timber markets may to a certain extent be interested in specific species but they are not geographically specific and they are highly flexible in demand, meaning that if Species A were not to be supplied anymore by GGF in Loreto, Peru, a US buyer would not insist that a replacement batch of Species A must be sourced from Loreto, Peru. Instead, a buyer will look at how much of which species is on offer and buy it if the price is right and they can on-sell it themselves. There may be small regional preferences with regard to the coloring of a specific species, but this may affect price or preference, not demand. Generally speaking, the international market for FSC-certified tropical hardwoods will absorb what is supplied to it, as long as it concerns species where there is some experience with their wood properties and processing. All high-value species to be harvested by GGF can also be sourced from Brazil and Ecuador, most also from Colombia, and some from Bolivia.

The estimated annual value of Peru's tropical timber industry is relatively small compared with its neighbours Brazil (3% of the value), Ecuador (30%) and Colombia (55%) (data from FAO State of the World's Forests, 2014). Also, displacement of production would be to other FSC-certified forest management operations in the American tropics, of which there are only 10 in Peru and only one (GGF) in Loreto (<https://pe.fsc.org/es-pe/nuestro-impacto/datos-y-cifras>). Together, they cover 1million ha of managed forests, out of a total managed forest estate of 6.3million ha. In other words, the likelihood that GGF's production would be displaced to other areas within Peru is very small.

In addition, an estimated 50% of the low-value species volume, i.e., 20% of the overall volume, would be exported in the form of products that are not species-specific, such as kiln sticks and finger-jointed products, both with a high demand in the US market. Since they are not species-specific, kiln sticks and finger-jointed products can be sourced from anywhere in the world. For

the US market the most likely source will be Central and South America, however. Market leakage from products GGF would have sold into the international market is therefore highly likely to occur outside of Peru.

Summarizing, market leakage from products (made out of 80% of harvested volume) GGF would have sold into the international market is therefore highly likely to occur outside of Peru.

Methodology VM0010 gives the boundary for the calculation of market leakage as the national boundary of Peru. Furthermore, VCS Standard 4.0 states in Section 3.14.10 that leakage occurring outside the host country does not need to be quantified. The calculation of market leakage therefore only applies to the portion of GGF's production that would have been sold into the national market (20%).

Domestic sales are local (Iquitos) and are principally off-cuts that are sold as fuel wood. It is irrelevant to buyers that the wood originates from FSC-certified operations. Any market leakage to replace baseline sales would therefore be taking place within the department of Loreto to production in forestry concessions or from illegal logging relatively near Iquitos.

The vegetation map of Peru (MINAM, 2015; Fig. 10 shows Loreto in detail) shows that forests around Iquitos are overwhelmingly of the same forest type (light green, which is Bosque de Colina Baja, see Section 1.12). Also, comparison with Fig. 1 (Section 1.12) shows that logging concessions around Iquitos are situated in this forest type.

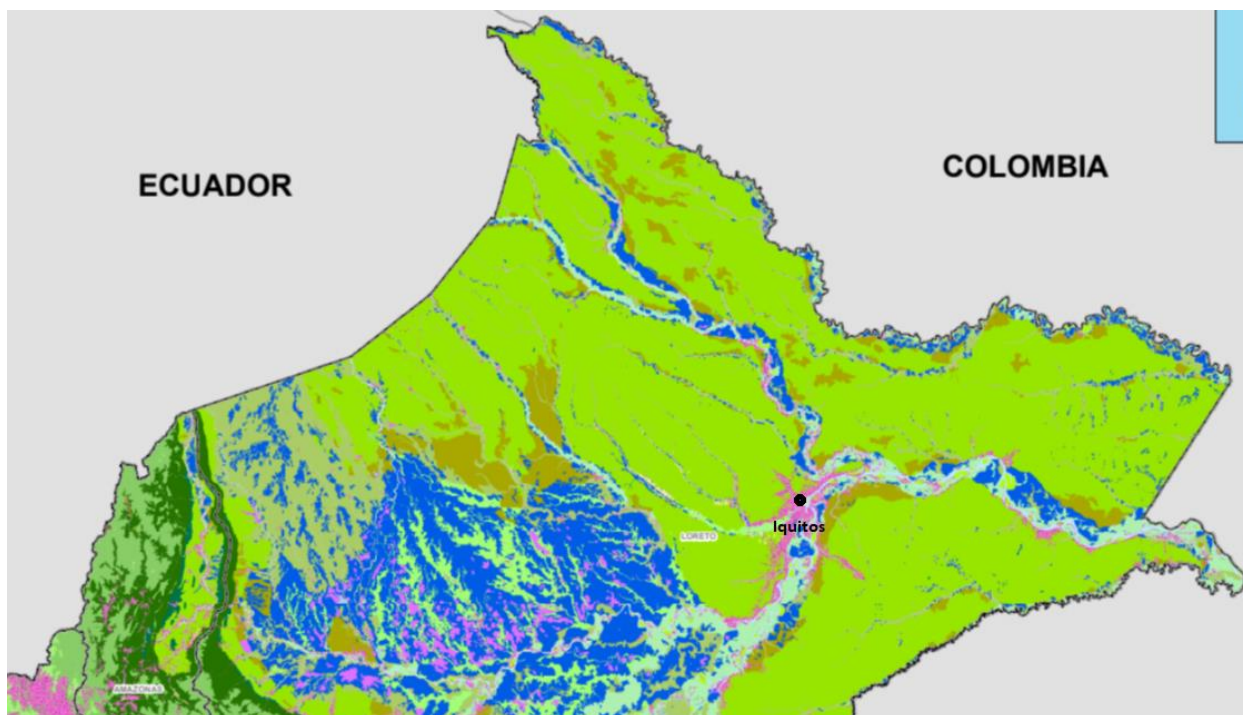


Fig. 10. Detail of the national vegetation map of Peru (MINAM, 2015), showing the vegetation in the Department of Loreto. Iquitos is indicated with a black dot

VM0010 (Box 2) requires that the ratio of merchantable biomass to total biomass is compared between the project forest (consisting of a single stratum) and the displacement forest. Both forests are Bosque de Colina Baja in Loreto, near Iquitos. For each of them the ratio is calculated as merchantable biomass (9.2 t/ha) over total biomass (280 t/ha):

$PMP_i = PML_{FT} = 9.2/280 = 0.033$ for the project forest, and
 $PMP_i = PML_{FT} = 9.2/280 = 0.033$ for the displacement forest.

Where:

PMP_i = merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries, %; and

PML_{FT} = mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type, %.

The value applied for merchantable biomass is the timber extraction volume (15 m³) multiplied by weighted average wood density (WD: 0.614 t/m³). The value applied for total aboveground tree biomass is based on Asner et al (2014). Both are discussed in the data tables in Section 5.1.

These two ratios are equal (+15%), pointing to a deduction factor of 0.4 (VM0010, Box 2). The Leakage Factor LF_{ME} to be applied to the portion of GGF's production that would have been sold into the national market (20%) is thus $0.2 * 0.4 = 0.08$.

This LF_{ME} is applied in Equation 40 of VM0010. Emissions from market leakage are calculated in the Green Gold Loreto 1 Emission Reduction and Removal Calculation Spreadsheet.

$$GHG_{LK|LTPF,t^*} = LF_{ME} * GHG_{NET|BSL,t^*} \quad (40)$$

Where:

$GHG_{LK LTPF,t^*}$	Total market leakage as a result of IFM LTPF activities, in the year t^* since the start of the project activity, tCO ₂ e;
LF_{ME}	Leakage factor for market-effects calculations, dimensionless;
$GHG_{NET BSL,t^*}$	Net greenhouse gas emissions in the baseline scenario in the year t^* since the start of the project activity, tCO ₂ e.

4.4 Net GHG Emission Reductions and Removals

The estimated net GHG emission reductions and removals in each year of the project crediting period are given in Table 12. They are the results from the Green Gold Loreto 1 Emission Reduction and Removal Calculation Spreadsheet, in which Equation 41 of VM0010 is applied.

$$GHG_{CREDITS|LIPF,t*} = GHG_{NET|BSL,t*} - GHG_{NET|PRJ,t*} - GHG_{LK|LIPF,t*} \quad (41)$$

Where:

- $GHG_{CREDITS|LIPF,t*}$ project greenhouse gas credits associated with the implementation of improved forest management (IFM) activities in the year t^* since the start of the project activity, in the project scenario, tCO₂e;
- $GHG_{NET|BSL,t*}$ net greenhouse gas emissions in the baseline scenario in the year t^* since the start of the project activity, tCO₂e;
- $GHG_{NET|PRJ,t*}$ net greenhouse gas emissions in the project scenario in the year t^* since the start of the project activity, tCO₂e; and
- $GHG_{LK|LIPF,t*}$ total greenhouse gas emissions due to leakage arising outside the project boundary as a result of the implementation of improved forest management (IFM) activities in the year t^* since the start of the project activity, in the project scenario, tCO₂e.

VM0010 states that estimated baseline emissions are averaged over the project crediting period and that each year the annual average emissions are applied.

To calculate the estimated net GHG emission reductions and removals in each year of the project crediting period Equation 41 of VM0010 is applied. Note that these values may be discounted by uncertainty and buffer discounts to derive at the number of verified carbon units (Section 8.4.1 of VM0010). These discounts will be calculated at Project Validation and Verifications. See Section 4.5 below regarding uncertainty propagation in baseline and project.

Table 12. Estimation of net GHG emission reductions and removals in each year of the project crediting period (see note underneath the table)

Year	Estimated baseline emissions or removals (tCO ₂ e)	Estimated project emissions or removals (tCO ₂ e)	Estimated leakage emissions (tCO ₂ e)	Estimated net GHG emission reductions or removals (tCO ₂ e)
1	122,282	13,453	30,059	359,131
2	172,316	26,905	30,059	372,584
3	222,350	40,358	30,059	386,036
4	272,384	53,811	30,059	399,489
5	322,418	67,263	30,059	412,942
6	372,452	80,716	30,059	426,394
7	422,486	94,168	30,059	439,847

8	472,520	107,621	30,059	453,300
9	522,554	121,074	30,059	466,752
10	572,588	134,526	30,059	480,205
11	541,943	147,979	30,059	493,657
12	511,298	161,432	30,059	507,110
13	480,653	174,884	30,059	520,563
14	450,007	188,337	30,059	534,015
15	419,362	201,790	30,059	547,468
16	388,717	215,242	30,059	560,921
17	358,072	228,695	30,059	574,373
18	327,427	242,147	30,059	587,826
19	296,782	255,600	30,059	601,279
20	266,137	269,053	30,059	614,731
Total	7,514,749	2,825,053	601,180	9,738,622
Average	375,737			

Note that VM0010 states in Section 8.1: Baseline Emissions on page 17: “Total [baseline] emissions are averaged across the project crediting period to give annual emissions and are multiplied by t^* , time elapsed since the start of project activity.” This is very clear guidance, however it is not reflected in Equation (41). To calculate the estimated net GHG emission reductions or removals in Table 12, the average baseline emissions across the project crediting period were used, as instructed by the methodology.

Uncertainty

As per the methodology, uncertainty is expressed as a variance greater than $\pm 15\%$ of the mean at the 95% confidence interval.

For the baseline scenario, variance of the following relevant input parameters was checked:

- **Project area:** no variance
- **Harvestable volume inventory data:** no variance. All trees were inventoried on 3,000ha, in effect a single data point. Measurement errors were not quantified. Diameter measurements generally have uncertainties of no more than a few percent, which will be normally distributed and cancel each other out in such a large dataset. Tree height estimates tend to have higher uncertainty attached to them; however, no quantitative data exist for this within GGF and any bias would be strongly person-dependent so that in a large inventory team the errors would probably cancel each other out. The method to calculate volume from DBH and commercial height (Smalian’s equation, see Methodology Deviation #1) has uncertainty attached to it. However, as has been

demonstrated in a comparison with an allometric equation method, this method results in an under-estimation of volume (this method to estimate commercial standing volume was designed to deliver an *at least* estimate, so that foresters can build a low-risk business case on it). In addition, the baseline extraction rate is 5.5% lower than the inventoried average volume per ha, which likely cancels out a significant part of the uncertainty due to measuring and estimation error. In view of the above, no uncertainty will be propagated for extracted volume.

- **Above ground C content:** This is an estimated average without variance. However, the Asner et al (2014) map of above ground carbon density for Peru shows a relatively homogenous carbon density for the project areas. In the paper's supplementary information, a map of estimated relative uncertainty (as a % of the mean C density) is published (Fig 9), showing the uncertainty for the project areas to be <5%.
- **Forest regrowth:** the regression equation that calculates recovery time from % loss of aboveground carbon content from logging presented by Rutishauser et al (2015) gives a standard error of 0.022 on the value of 1.106 for the variable θ , which equals an uncertainty of 1.99%.
- **Wood densities:** no variance data available. However, with the use of species-specific wood densities and with a low number of species without known wood density the assumption is that of low uncertainty for this input parameter.
- **Logging Damage Factor (LDF):** this is based on the average value of two linear regression equations in Pearson et al (2014), one relating LDF (tC/m³ extracted) with the standing biomass carbon stock, the other with log length. The first equation has a coefficient of determination R^2 of 0.98, meaning that 98% of the variance of the dependent variable (LDF) has been accounted for by the regression equation, i.e., 2% uncertainty. The second equation has an R^2 of 0.86, i.e., 14% uncertainty. The average uncertainty is thus 8%.
- **Skidding Factor (SF):** no variance data available (Pearson et al, 2014).
- **Wood product class percentages:** full set of GGF historical data, not based on sampling so no variance.

Thus, the uncertainty propagation in the baseline will be done using the uncertainties of forest regrowth and LDF. This is calculated as the square root of the sum of the squares of the two parameters (see Equation 42 below, applied *mutatis mutandis*). Baseline uncertainty is therefore: $U_{BSL} = \text{SQRT}(0.0199^2 + 0.08^2) = 0.0824$ (8.24%). If a 5% uncertainty were to be added for the aboveground C content estimate (this would not be quite correct because this is the uncertainty in the map, not around the estimate), this would result in a baseline uncertainty of 9.64%.

Project uncertainty will be calculated on the basis of monitoring results (see Section 5, Methodology Deviation #3, Appendix 1 and Appendix 2). As discussed in Appendix 2, uncertainty in the biomass maps is expected to be around 5%.

The total uncertainty is calculated as the square root of the sum of the squares of the baseline and project uncertainty, through propagating the error in the baseline stocks and the error in the project stocks by applying Equation 42 of VM0010. This will be done at verification, using the monitoring results to calculate project uncertainty. However, with the above assumption for project uncertainty, the forecasted total uncertainty would be 9.8%. This would fall within the 15% threshold, meaning that no uncertainty discount would be applied to the calculation of VCU.

$$U_{TOTAL|LtPF} = \sqrt{U^2_{PRJ} + U^2_{BSL}} \quad (42)$$

Where:

$U_{total LtPF}$	Total uncertainty for LtPF Project, dimensionless;
U_{PRJ}	Total uncertainty for the improved forest management activities in the project scenario, dimensionless; and
U_{BSL}	Total uncertainty for the baseline scenario, dimensionless.

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	$V_{EX,j,i BSL}$
Data unit	m ³ ha ⁻¹
Description	Mean volume of timber extracted for wood processing per unit area for species j in stratum i
Source of data	Forest inventory records of the project proponent
Value applied	15 m ³ /ha
Justification of choice of data or description of measurement methods and procedures applied	All infrastructure areas are initially part of the area from which timber is extracted. This means that the commercial volume of 15 m³/ha will be extracted from all areas that will subsequently be converted into roads, skid trails, log landings (decks) and port areas. Log volumes have been calculated for each harvestable tree on an area of 3000ha, using DBH and commercial stem height and applying Smalian's formula with a Form Factor of 0.65 (see Section 3.5: <i>Methodology deviation #1</i>)
Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks in harvested timber.
Comments	

Data / Parameter	D _j
Data unit	t. dm. m ⁻³
Description	Basic wood density of species <i>j</i>
Source of data	Species specific wood densities from Peruvian data tables and literature (see Table 9)
Value applied	0.614 (volume-weighted average for all species inventoried in POA10)
Justification of choice of data or description of measurement methods and procedures applied	This is the most accurate and realistic approach to establishing the wood density of extracted timber Species-specific wood densities are presented in Table 9, Section 3.4.4.
Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks in harvested timber.
Comments	

Data / Parameter	CF _j
Data unit	tCtd.m. ⁻¹
Description	Carbon fraction of dry matter for species <i>j</i>
Source of data	IPCC default
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	No species-specific values could be found in literature. The large variety of species to be harvested in the baseline justify the use of a default value.
Purpose of Data	• Calculation of baseline emissions • Calculation of project emissions
Comments	<i>Provide any additional comments</i>

Data / Parameter	Logging Damage Factor (LDF)
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Data unit	tC/m ³ extracted timber
Description	This factor determines the addition to the Dead Wood pool in the forest in tC for each m ³ of timber extracted, caused by harvesting. It combines dead wood from logging slash (stumps and crowns of harvested trees) and residual stand damage (biomass not in harvested trees killed by tree felling).
Source of data	Pearson et al (2014)
Value applied	1.134 tC/m ³
Justification of choice of data or description of measurement methods and procedures applied	Pearson et al (2014) introduce a complete accounting method for estimating emission factors from selective timber harvesting, which accounts separately for emissions from the extracted log, from incidental damage to the surrounding forest, and from logging infrastructure. Emissions are expressed as units of carbon per cubic meter of timber extracted to allow for simple application to timber harvesting statistics. They applied the method in six tropical countries (Belize, Bolivia, Brazil, Guyana, Indonesia, and Republic of Congo). Their results include statistically significant relationships between LDF and total aboveground biomass carbon stock (regression equation $y = -0.0039x + 1.7817$, $R^2 = 0.86$), and between LDF and extracted log length (regression equation $y = -0.0569x + 1.8388$, $R^2 = 0.98$). <i>LDF and total aboveground biomass carbon stock</i> Application of aboveground biomass carbon stock in Bosque de Colina Baja ACS_{0,i} (140tC/ha – see the data table below) to the regression equation results in an LDF of 1.236 <i>LDF and extracted log length</i> POA10 estimated the commercial height of over 15,000 standing trees to be harvested (i.e., excluding seed trees), which is the closest we can get to log length. The average commercial height was 14.17m. Application of this figure to the regression equation results in an LDF of 1.033 We have calculated the LDF to be applied in this project as the average of the two regression equation results, resulting in an LDF of 1.134

Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks in the dead wood pool.
Comments	

Data / Parameter	Logging Infrastructure Factor (LIF)
Data unit	tC/m ³ extracted timber
Description	This factor determines the addition to the Dead Wood pool in the forest in tC for each m ³ of timber extracted, caused by infrastructure establishment. It combines dead wood from road construction, skid trails, logging decks and ports. As all these areas will first have their commercial harvest extracted the LIF applies to the remaining biomass after logging.
Source of data	Pearson et al (2014)
Value applied	Calculated
Justification of choice of data or description of measurement methods and procedures applied	Pearson et al (2014) – see discussion above for LDF – also calculated LIFs for three sites, of which the site in Guyana is the most comparable with the project in terms of extracted timber volume (13m³/ha in Guyana compared to 15m³/ha in the Green Gold Loreto 1 Project) and mean log length (16m in Guyana compared to 14.2m in this project). However, the Guyana site had a total aboveground forest carbon stock of 244tC/ha, compared with 140tC/ha for the project site (see above in LDF discussion). The LIF is composed of a factor for skidding damage (SF), a factor for road construction damage (RF) and a damage factor for log deck areas (DF – this also includes camps and port areas). RF and DF quantify a complete removal of biomass, whereas SF quantifies damage from skid trails, which are often less destructive because they try to go around obstructing trees where possible. For SF the damage level is likely to be more determined by extraction rate and size of the extracted logs than by forest carbon stocks. Since the former two factors are similar in the Guyana site we consider it justified to apply the SF of 0.17tC/m³ from Guyana to the project. For the quantification of RF and DF we do not consider it justified to use the Guyana factor due to the difference in forest carbon stocks. So, we will add up all areas of road construction, log landings (decks), permanent camps and ports in the project area (A_{RF+DF}). We will then calculate the remaining forest carbon stock after extraction as follows:

$$C_{\text{non-HARV},i} = ACS_{0,i} - C_{\text{HARV},i|BSL} \quad (\text{BL1})$$

Where:

$C_{\text{non-HARV},i}$ = forest carbon stock not killed by harvesting in stratum i, in tC/ha

$ACS_{0,i}$ = forest carbon stock of unlogged forest in stratum i, in tC/ha

$C_{\text{HARV},i|BSL}$ = carbon stock in biomass killed by harvesting in stratum i, in tC/ha

$C_{\text{HARV},i|BSL}$ is calculated as follows:

$$C_{\text{HARV},i|BSL} = V_{\text{EX},i|BSL} * (\text{LDF} + \text{SF}) \quad (\text{BL2})$$

Where:

$C_{\text{HARV},i|BSL}$ = carbon stock in biomass killed by harvesting in stratum i, in tC/ha

$V_{\text{EX},i|BSL}$ = Volume of extracted timber in stratum i, in m³/ha

LDF = Logging Damage Factor, in tC/m³ extracted

SF = Skidding Factor, in tC/m³ extracted

$C_{\text{non-HARV},i}$ is assumed to be completely killed. We then calculate a combined (RF+DF) as follows:

$$(\text{RF}+\text{DF}) = (\text{ARF}+\text{DF} * C_{\text{non-EX},i}) / (\text{A}_{\text{EXpr}} * V_{\text{EX},i|BSL}) \quad (\text{BL3})$$

Where:

$(\text{RF}+\text{DF})_i$ = Combined Road Factor and Deck Factor in stratum i, in tC/m³ extracted timber

$\text{ARF}+\text{DF},i$ = Sum of areas of road construction, log landings (decks), permanent camps and ports in the project area, in stratum i, in ha.

$C_{\text{non-HARV},i}$ = forest carbon stock not harvested in stratum i, in tC/ha

A_{EXpr} = Area of all land within the project area where timber extraction will take place, in ha

$V_{\text{EX},i|BSL}$ = Volume of extracted timber in stratum i, in m³/ha

The Logging Impact Factor is then calculated as:

$$\text{LIF} = \text{SF} + (\text{RF}+\text{DF})_i \quad (\text{BL4})$$

	Where: LIF = Logging Impact Factor, in tC/m³ extracted SF = Skidding Factor, in tC/m³ extracted (RF+DF)_i = Combined Road Factor and Deck Factor in stratum i, in tC/m³ extracted timber The LIF is applied in Equation 5 (see Section 3.6: <i>Methodology deviations</i>)
Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks in the dead wood pool.
Comments	

Data / Parameter	ACS _{0,i}
Data unit	tC/ha
Description	Aboveground carbon stock in undisturbed forest in stratum i
Source of data	Literature
Value applied	140tC/ha for Bosque de Colina Baja/Bosque de Terraza Alta
Justification of choice of data or description of measurement methods and procedures applied	del Aguila-Pasquel et al (2013) measured 147tC/ha AGB (all sizes trees) in a 1-ha plot in the vicinity of the project area and on the same soil type. Asner et al (2014)'s Carbon density map for Peru indicates values between 120-150tC/ha for the project region. Here we will use 140tC/ha as a reasonable average (and conservative for the purpose of determining the LDF).
Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks in the dead wood pool.
Comments	

Data / Parameter	OF, PF, SLF, WW
Data unit	Kg kg ⁻¹
Description	OF = Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years after production; PF = Fraction of wood products that will store carbon permanently SLF = Fraction of wood products that would decay within 3 years of production, but that will be assumed to be emitted to the atmosphere immediately upon production; and

	WW = Fraction of extracted biomass effectively emitted to the atmosphere during production
Source of data	OF, SLF and WW: Project proponent's historical wood processing data <i>PF: Winjum et al ((1998))</i>
Value applied	OF*0.86 = 45.86% (86% of OF – <i>Winjum et al (1998)</i>) PF * 0.14 = 7.47% (14% of OF – <i>Winjum et al (1998)</i>) SLF: 0% WW: 46.67%
Justification of choice of data or description of measurement methods and procedures applied	These fractions apply the historical waste and recovery rates of the project proponent's wood processing practices.
Purpose of Data	Calculation of baseline emissions: calculation of carbon stocks sequestered in the wood products pool.
Comments	

Data / Parameter	RGR_i
Data unit	tC.ha ⁻¹ .yr ⁻¹
Description	Forest regrowth rate post timber harvest for stratum <i>i</i>
Source of data	Rutishauser et al (2015)
Value applied	1.02
Justification of choice of data or description of measurement methods and procedures applied	Rutishauser et al (2015) give the best (and only, to our knowledge) data on post-harvest tree carbon stock recovery for managed Amazonian forests. Comparing sites from the southwestern central and eastern Amazon they concluded that % loss of pre-harvest carbon stocks was a much better predictor of post-harvest recovery rate than geographic, climatic or edaphic variables, presenting the regression equation $t_{REC} = (100 * ACS_{loss} / ACS_0)^{1.106}$ ($R^2=0.994$) Where: t_{REC} = post-harvest recovery time of above-ground carbon stocks (trees with DBH>20 cm) ACS_{loss} = above-ground carbon stock lost through harvesting ACS_0 = pre-harvest above-ground carbon stock

	which we used to calculate a t_{REC} of 27.9 years from 28.4tC/ha ACS_{LOS} and ACS_0 of 140tC/ha. This results in a RGR_i of $28.4/27.9=1.02tC/ha/yr$ Note that this conservatively assumes that areas of infrastructure (roads, log decks, etc) will regrow at the same rate as logged forest. This is not realistic, as these areas will have been completely cleared and their soils denuded, scraped and compacted. A significant portion of the infrastructure area will also be in use for a longer period than their year of establishment, e.g., primary roads and ports.
Purpose of Data	Calculation of baseline emissions: Change in carbon stocks due to forest regrowth after harvest
Comments	<i>Provide any additional comments</i>

Data / Parameter	Ggi
Data unit	g kg ⁻¹ dry matter burnt
Description	Emission factor for stratum i for gas g
Source of data	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5
Value applied	Default values
Justification of choice of data or description of measurement methods and procedures applied	Default values
Purpose of Data	Calculation of project emissions
Comments	<i>Default values shall be updated whenever new guidelines are produced by the IPCC</i> <i>Fire disturbance has been unknown in this part of the Peruvian Amazon, due to the long rainy season and high annual precipitation. Even in a changing global climate this is not expected to change within the foreseeable future. Should any fire disturbance be monitored the project proponent can look up the most updated default value for this parameter.</i>

Data / Parameter	COMF _i
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Data unit	dimensionless
Description	Combustion factor for stratum <i>i</i>
Source of data	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5
Value applied	Default values
Justification of choice of data or description of measurement methods and procedures applied	Default values
Purpose of Data	Calculation of project emissions
Comments	Default values shall be updated whenever new guidelines are produced by the IPCC Fire disturbance has been unknown in this part of the Peruvian Amazon, due to the long rainy season and high annual precipitation. Even in a changing global climate this is not expected to change within the foreseeable future. Should any fire disturbance be monitored the project proponent can look up the most updated default value for this parameter.

Data / Parameter	$BCEF_R$
Data unit	t.dm.m ⁻³ (tonnes of dry matter per cubic meter)
Description	Biomass conversion and expansion factor applicable to volume of wood removals in the project area
Source of data	N/A
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	$BCEF_R$ is used for the purpose of calculating project emissions resulting from fire disturbance in Equation 34. VM0010 states that fire emissions attributable to the project are limited to the burning of the biomass portion that would have been removed in the baseline scenario, i.e., only the logs. It logically follows that $BCEF_R$ is used to calculate extracted log biomass from its volume. Thus, $BCEF_R$ is equivalent to wood density <i>D</i>.
Purpose of Data	Calculation of project emissions
Comments	<i>Provide any additional comments</i>

Data / Parameter	BCEF
Data unit	tC/m ³ (tonnes of dry matter per cubic meter)
Description	Biomass carbon conversion and expansion factor applicable to volume of all trees >10 cm DBH in carbon stock permanent sampling plots
Source of data	Goodman et al (2019)
Value applied	0.986
Justification of choice of data or description of measurement methods and procedures applied	BCEF is used for the purpose of calculating sample plot tree carbon stocks in Equation 29, together with the calculation of tree stem volume using Smalian's formula and a Form Factor of 0.65 (SERFOR, 2016). This replaces the allometric equation $f_j(X,Y,...)$. The result of this calculation will be used to recalibrate the model used to produce the carbon stock maps from remotely-sensed data if the map shows too high an error with the new plot measurements. Goodman et al (2019) report as one of their results that the relative portions of crop tree residuals and log carbon stocks are 65:40. This ratio can be used to calculate the carbon stock of crop tree residuals from the per-hectare carbon stock in extracted logs. When this is divided by the extracted volume per ha this gives the crop tree residual carbon stocks per m³ harvested. The total crop tree (or measured tree in sample plots) carbon stock per m³, i.e., the BCEF, can then be calculated by adding the wood density. While the above calculation method is specific to larger crop trees, and not to all trees to be measured, we consider it to be conservative, because larger trees will have a lower BCEF than smaller trees. It will therefore result in an underestimation of biomass carbon accumulation in the project scenario.
Purpose of Data	Calculation of project emissions
Comments	<i>Provide any additional comments</i>

Data / Parameter	PML _{FT}
Data unit	%
Description	mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type

Source of data	Merchantable biomass: 9.2 t/ha; source: 15 m3 extraction rate multiplied by the weighted average wood density (see also data table for WD). Total aboveground tree biomass: 280 t/ha; source: assumption based on Peruvian carbon map (Asner et al, 2014) – see also data table for ACS_{0,i}
Value applied	0.033
Justification of choice of data or description of measurement methods and procedures applied	The project has a single stratum, consisting of Bosque de Colina Baja/Bosque de Terraza Alta (these two forest types are indistinguishable in terms of tree species composition and biomass and are lumped together in the GGF forest inventory).
Purpose of Data	Calculation of project emissions
Comments	<i>Provide any additional comments</i>

5.2 Data and Parameters Monitored

Data / Parameter	$\Delta C_{AB,t PRJ-Gross}$
Data unit	tCO ₂ e/yr
Description	Sum of carbon stock changes observed by comparing the carbon stock values of all pixels within the project boundary on the carbon stock map from one monitoring campaign with their equivalent pixels on the carbon stock map from the previous monitoring campaign.
Source of data	carbon stock maps from remote sensing data.
Description of measurement methods and procedures to be applied	See Appendix 1
Frequency of monitoring/recording	Every 2 years after the project start date
Monitoring equipment	Satellite imagery, GIS
QA/QC procedures to be applied	Quality control / quality assurance (QA/QC) procedures for image processing and data handling will be applied in SOPs.

Purpose of data	Calculation of project emissions
Calculation method	$\Delta C_{AB,t PRJ-Gross} = \Sigma(\Delta C_{AB,pixel1} + \Delta C_{AB,pixel2} + \Delta C_{AB,pixel3} + \dots)$
Comments	<i>Provide any additional comments</i>

Data / Parameter	Illegal Logging PRA Results
Data unit	Dimensionless
Description	Assessment whether illegal logging is a risk within the project boundary and whether an on-the-ground survey must be triggered
Source of data	PRA
Description of measurement methods and procedures to be applied	The PRA must evaluate whether timber harvest may be occurring in the project area (and where) and must consist of semi-structured interviews / questionnaires. An additional output of the PRA must be a depth of penetration of illegal logging pressure ($D_{DIST_IL,i}$ see below). A maximum distance must be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting timber. Interviewees will be asked to indicate where they believe such access points are used by illegal loggers (e.g., which stretch of river). Interviewees will also be asked which species they believe are the most commonly harvested species.
Frequency of monitoring/recording	Every two years
Value applied	It is anticipated that less than 10% of interviewees believe that significant illegal logging occurs within the project boundary and the ex-ante assumption is that project emissions from illegal logging are zero.
Monitoring equipment	Community surveys in the communities
QA/QC procedures to be applied	PRA results will be kept in paper (if relevant) and digital format in the project office for the duration of the project and will be available at verification events.
Purpose of data	Calculation of project emissions

Calculation method	N/A
Comments	The PRA is not relevant anymore for the calculation of project emissions, as these are directly observed in the ΔC from comparing carbon stock maps. However, it is important for the project proponent to know whether the communities consider there to be a risk of illegal logging, in order to formulate appropriate response strategies. Also, the PRA is used to estimate $D_{DIST_IL,i}$. Ex ante estimation must be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging.
Data / Parameter	$D_{DIST_IL,i}$
Data unit	m
Description	Distance from access points that anthropogenic disturbances of forest carbon stocks can be assumed to take place within.
Source of data	PRA
Description of measurement methods and procedures to be applied	Interviews during PRA.
Frequency of monitoring/recording	Every two years
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	PRA results will be kept in paper (if relevant) and digital format in the project office for the duration of the project and will be available at verification events.
Purpose of data	Calculation of project emissions
Calculation method	At least 30 answers are required from each PRA. From the answers the median value will be taken and 100 m will be added to it.
Comments	
Data / Parameter	$A_{burn,i,t}$

Data unit	Hectare
Description	Area burnt in stratum i at time t
Source of data	GPS coordinates and Remote Sensing data
Description of measurement methods and procedures to be applied	Disturbance will be observed by comparing biomass maps between monitoring events and delineating areas of at minimum one hectare where a biomass reduction above 10tC is observed since the last monitoring event. Sites of disturbance observed on satellite imagery or during field patrols will be visited, the nature of the disturbance will be determined and the boundaries of the burnt area will be verified by GPS. See Section 3.5: <i>Methodology deviations</i> and Section 5.3: <i>Monitoring Plan</i> for more detail.
Frequency of monitoring/recording	Areas disturbed will be monitored in accordance with the monitoring and reporting schedule.
Value applied	Value applied at project validation is zero.
Monitoring equipment	Satellite imagery and GPS
QA/QC procedures to be applied	Quality control / quality assurance (QA/QC) procedures for image processing and data handling, as well as for field verification visits will be set out in SOPs.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	
Data / Parameter	Adist,i,t
Data unit	Hectare
Description	Area disturbed (non-fire) in stratum i at time t
Source of data	GPS coordinates and/or Remote Sensing data
Description of measurement methods and procedures to be applied	Disturbance will be observed by comparing biomass maps between monitoring events and delineating areas of at minimum one hectare where a biomass reduction above 10tC is observed since the last monitoring event. Sites of disturbance observed on satellite imagery or during field patrols will be visited, the nature of the disturbance will be determined, and the boundaries of the area will be verified by GPS.

Frequency of monitoring/recording	Areas disturbed will be monitored in accordance with the monitoring and reporting schedule.
Value applied	Value applied at project validation is zero.
Monitoring equipment	Satellite imagery and GPS
QA/QC procedures to be applied	Quality control / quality assurance (QA/QC) procedures for image processing and data handling, as well as for field verification visits will be set out in SOPs.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	

Data / Parameter	$A_{DIST_IL,i}$
Data unit	Hectare
Description	Area potentially impacted by illegal logging in stratum i
Source of data	GPS coordinates and/or Remote Sensing data
Description of measurement methods and procedures to be applied	Disturbance will be observed by comparing carbon stock maps between monitoring events. To detect illegal selective logging a square grid of 16x16 pixels will be moved over the Δcarbon stock map. Any square of 256 30x30 m pixels covers approximately 23ha. If within any grid more than 6 pixels show a ΔC above 5tC (equivalent to the aboveground biomass of a large tree), and it is within striking distance of an access point ($D_{DIST_IL,i}$) this may be an indication of tree mortality that exceeds the natural level, i.e. illegal logging. Sites of disturbance observed on satellite imagery or during field patrols will be visited, the nature of the disturbance will be determined, and its exact location will be verified by GPS.
Frequency of monitoring/recording	Areas disturbed will be monitored in accordance with the monitoring and reporting schedule.
Value applied	Value applied at project validation is zero.
Monitoring equipment	Satellite imagery and GPS
QA/QC procedures to be applied	Quality control / quality assurance (QA/QC) procedures for image processing and data handling, as well as for field verification visits will be set out in SOPs.
Purpose of data	This parameter is not used for the calculation of project emissions, as these are directly observed in the ΔC from comparing carbon stock maps. However, it is important for the

	project proponent to know the location and size of areas affected in order to formulate appropriate response strategies.
Calculation method	N/A
Comments	
Data / Parameter	A_{Plot}
Data unit	Hectare
Description	Total area of carbon stock sample plots
Source of data	Ground measurement
Description of measurement methods and procedures to be applied	Around 30 one-hectare permanent sample plots will be established at project start and remeasured in Year 2 after project start, according to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018). The number of 30 plots is recommended by Space Intelligence Ltd. as being sufficient to calibrate their model to produce carbon stock maps (see Section 5.3.7), considering the homogenous vegetation type covering the project area. They will be randomly spaced throughout the project area, but within 1 km of a road or navigable river for accessibility.
Frequency of monitoring/recording	Plots will be established at project start and remeasured in Year 2. After that the measuring frequency will be every 4 years.
Value applied	N/A
Monitoring equipment	Field measurement equipment (e.g., measuring tapes) to be specified in field measurement SOP.
QA/QC procedures to be applied	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the IPCC GPG LULUCF 2003, is recommended.
Purpose of data	Calculation of project emissions
Calculation method	According to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018).
Comments	
Data / Parameter	DBH
Data unit	cm
Description	Diameter at Breast Height

Source of data	Field measurement in sample plots
Description of measurement methods and procedures to be applied	According to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018). DBH is used for the purpose of calculating sample plot tree carbon stocks in Equation 29. It serves to calculate tree stem biomass using Smalian's formula and a Form Factor of 0.65 (SERFOR, 2016) and then aboveground tree biomass by multiplying with the BCEF. This replaces the allometric equation $fj(X,Y,...)$. The result of this calculation will be used to recalibrate the model used to produce the carbon stock maps from remotely sensed data if the map shows too high an error with the new plot measurements.
Frequency of monitoring/recording	Plots will be established at project start and remeasured in Year 2. After that the measuring frequency will be every 4 years.
Value applied	N/A
Monitoring equipment	Field measurement equipment (e.g., measuring tapes) to be specified in field measurement SOP.
QA/QC procedures to be applied	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the IPCC GPG LULUCF 2003, is recommended.
Purpose of data	Calculation of project emissions
Calculation method	According to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018).
Comments	
Data / Parameter	H_{Stem}
Data unit	m
Description	Stem Height of tree stems >10cm DBH in carbon stock permanent sample plots
Source of data	Ground measurement/estimation
Description of measurement methods and procedures to be applied	According to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018). DBH is used for the purpose of calculating sample plot tree carbon stocks in Equation 29. It serves to calculate tree stem biomass using Smalian's formula and a Form Factor of 0.65 (SERFOR, 2016) and then aboveground tree biomass by multiplying with the BCEF. This replaces the allometric equation

	$f_j(X, Y, \dots)$. The result of this calculation will be used to recalibrate the model used to produce the carbon stock maps from remotely sensed data if the map shows too high an error with the new plot measurements.
Frequency of monitoring/recording	Plots will be established at project start and remeasured in Year 2. After that the measuring frequency will be every 4 years.
Value applied	N/A
Monitoring equipment	Field measurement equipment (e.g., measuring tapes) to be specified in field measurement SOP.
QA/QC procedures to be applied	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or from the IPCC GPG LULUCF 2003, is recommended.
Purpose of data	Calculation of project emissions
Calculation method	According to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018).
Comments	

Data / Parameter	PMPi
Data unit	%
Description	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data	Merchantable biomass: 9.2 t/ha; source: 15 m ³ extraction rate multiplied by the weighted average wood density (see also data table for WD). Total aboveground tree biomass: 280 t/ha; source: assumption based on Peruvian carbon map (Asner et al, 2014) – see also data table for ACSO,i
Value applied	0.033
Justification of choice of data or description of measurement methods and procedures applied	The project has a single stratum, consisting of Bosque de Colina Baja/Bosque de Terraza Alta (these two forest types are indistinguishable in terms of tree species composition and biomass and are lumped together in the GGF forest inventory).
Purpose of Data	Calculation of project emissions

Comments	Provide any additional comments
Data / Parameter	Ai
Data unit	Ha
Description	Area covered by stratum <i>i</i>
Source of data	GPS coordinates and/or Remote Sensing data
Value applied	Value applied at project start is 183,445 ha
Justification of choice of data or description of measurement methods and procedures applied	The project has a single stratum, consisting of Bosque de Colina Baja/Bosque de Terraza Alta (these two forest types are indistinguishable in terms of tree species composition and biomass and are lumped together in the GGF forest inventory).
Purpose of Data	Calculation of project emissions
Comments	Provide any additional comments

5.3 Monitoring Plan

5.3.1

Overview of the monitoring process

Monitoring campaigns will be organized and overseen by the GGF Monitoring Coordinator. Remote sensing work will be carried out by Space Intelligence Ltd. (www.space-intelligence.com), based in Edinburgh, UK. Ground surveys will be carried out by rangers and other field staff (e.g., scientific guides) and community surveys will be carried out by the community liaison officers. Field plot measurements will be carried out by trained forest engineers and/or ecologists.

Monitoring campaigns will take place every two years from the project start date, i.e., around August/September. The process will start with the community surveys, which will help assess the risk of illegal logging and other illegal incursions into the project area, and community feedback on the implementation of project activities with the communities and/or in communal areas. The next component is the remote sensing, which may detect areas of natural and/or anthropogenic disturbance that may require a field survey. Following on from that are the field surveys that will confirm disturbances observed by remote sensing or informed by the community surveys.

In year two after project start date (the first monitoring campaign), and every four years thereafter, a field plot measurement campaign will be carried out to remeasure field plots for changes in carbon stocks. These will be used to confirm the continued applicability of the model to produce carbon maps from remote sensing data, or to recalibrate it.

In between monitoring campaigns data will be gathered from regular and irregular patrols, access point lookouts, field surveys, observations by visiting scientists, community visits and drone flights. This information will also be used in the monitoring campaigns to assess areas of natural or anthropogenic disturbance.

Scope

Monitoring is required to:

- a) Determine changes in forest carbon stocks and greenhouse gas emissions from project activity;
- b) Confirm project activity; and
- c) Determine changes in forest carbon stocks and greenhouse gas emissions from disturbance and illegal logging.

In the case of this project no monitoring is required to update stratification, as any changes in forest carbon stocks from disturbance and illegal logging will be directly quantified through comparison of carbon stock maps between verification points (or for the first verification, between the biomass map from the project start date and that of the first verification date) – see Section 3.5 on methodology deviations. Any subsequent carbon stock dynamics in the affected areas that may be different from those in unaffected areas will also be directly measured in subsequent ΔC assessments.

Remote Sensing

Remote sensing with satellite imagery will be a cornerstone of the project's monitoring strategy. It will be the primary way to assess changes in forest carbon stocks, both positive and negative. As such, it will also be used to identify areas of disturbance and illegal logging.

Ground Surveys and Observations

Ground surveys will be conducted to gather information from the Project Area. Ground surveys and observations may fall under the following categories:

- Routine Field Patrols by Rangers
- Incident Based Non-Routine Patrol by Rangers
- Incident Based Non-Routine drone flights
- Access-point lookout observations
- Permanent sample plot measurement trips
- Observations during field trips with visitors (e.g., scientists)

Each field visit, whether patrol, plot measurements or visitor trip, requires GPS tracking of the route and completion of a field sheet that records:

- observations (location, description, pictures) of human activity and disturbances, e.g., logging, fires, conversion, hunting, building, etc.
- observations of natural disturbances, e.g., fires, windfall, large tree mortality (location, description, pictures)
- observations of wildlife (location, description, pictures)

Community Surveys

Each monitoring campaign will be started off by a community Participatory Rural Appraisal (PRA) to determine if and where there is the potential for illegal extraction of trees from the project area and to determine the likely distance of illegal logging penetration ($D_{DIST_IL,i}$) from all access points, such as roads and rivers or previously cleared areas. Even if the PRA suggests there is a potential for illegal logging activities it will not be necessary to conduct the limited field sampling described in Section 8.2.2.2: Option B of VM0010, because any reduction in carbon stocks from illegal logging will be measured in the carbon stock map (see Section 5.3.7).

The project will conduct regular stakeholder meetings (at a minimum, each year) with communities to gather feedback and inputs on the project activities and to hear and discuss any

grievances, which will then be addressed by the project's grievance redress and conflict resolution procedures.

Field Plot Measurements

5.3.6

Around 30 half-hectare permanent sample plots will be established and measured according to the RAINFOR/ForestPlot.net methodology (Phillips et al, 2018) as soon after project start as the COVID-19 situation allows. The number of 30 plots is recommended by Space Intelligence Ltd. as being sufficient to calibrate their model to produce carbon stock maps (see Section 5.3.7), considering the homogenous vegetation type covering the project area. Plot locations will be determined randomly within six strata: low, medium and high canopy height (e.g., 0-10, 10-20, 20+), each divided into 'near' and 'far' from roads and settlements (thresholds to be determined based on the data). 5 plots will be placed randomly in each, reducing the placement to exclude the least accessible 30% of the area (if it is possible to do so without introducing any obvious biases), in order to reduce travel time, danger to the field crew, and fuel use.

In addition, recent measurements (not older than 6 months) from already established RAINFOR plots that are in the same vegetation type and whose location is covered by the remote sensing images, will be used for model calibration. These data can be accessed on the RAINFOR/ForestPlot.net database.

5.3.7

Determining changes in forest carbon stocks and greenhouse gas emissions from project activity and Determining changes in forest carbon stocks and greenhouse gas emissions from disturbance and illegal logging

Changes in forest carbon stocks and greenhouse gas emissions from project activity will be monitored applying the following steps (see also Section 3.6: Methodology Deviations):

Step 1. Space Intelligence Ltd. will produce a carbon stock map of the project area using space-borne LiDAR samples (25m diameter circles, 0.05 ha) collected during the 6 months before the monitoring date. The LiDAR footprints will be run through a model that has been trained (using machine learning approaches) using other satellite imagery and field plots from within and outside the project area (see Appendix 1 for a more detailed description of the imagery and modeling approach used). This model can be applied in several consecutive monitoring campaigns to produce carbon stock maps but will be checked every 4 years for error against field plot data and other current satellite imagery and, if need be, will be recalibrated.

Step 2. Run a pixel-by-pixel comparison to determine ΔC between the new carbon stock map and the one from the previous monitoring campaign (2 years previous). In the first monitoring campaign (2 years after project start) two carbon stock maps will be made using the same model: one using imagery from the start date of the project activity and one using imagery from the monitoring date. Using the timber harvest plan, delineate the areas that would have been harvested in the baseline scenario up until the monitoring date.

Step 3. Add up ΔC for all pixels within areas that would have been harvested in the baseline scenario up until the monitoring date, i.e., all areas that would have been logged in the baseline scenario, multiply by 44/12 and divide by 2 (as ΔC covers 2 years). This results in $\Delta C_{AB,t|PRJ}$ in modified Equation 32, i.e. the gross annual carbon stock change in aboveground biomass of trees accountable in year t , in tCO_2e/yr .

Step 4. Within the parcels p that would have been harvested in the baseline scenario up until the monitoring date t , detect areas where the cumulative ΔC in any grid of 3x3 pixels is greater than -10 tC. These are areas where either a natural (fire, windfall) or an anthropogenic disturbance may have occurred (intense felling, conversion). In other words, they are areas where a significant reduction in carbon stocks ($>10tC/ha$) can be observed. To detect such areas, the 3x3 pixel moving grid is used (pixel size is 30x30m, so the grid covers 8100 m², nearly a hectare).

Detect such areas that are further away than distance $D_{DIST_IL,i}$ from access routes. It is assumed these areas are affected by natural disturbances, unless field observations confirm they are anthropogenic.

A ground survey will be required to distinguish between areas of assumed natural disturbance that have burned $A_{burn,i,t}$ and that were affected by non-fire disturbance, e.g., windfall $A_{dist,i,t}$. Areas that are not ground surveyed are conservatively classed as $A_{burn,i,t}$. This is conservative because of the added combustion-related emissions (calculated applying Equation 33 of VM0010).

Detected areas that are within $D_{DIST_IL,i}$ distance from access routes (roads and navigable rivers) may potentially be affected by anthropogenic disturbance and need to be checked through a ground survey. If the ground survey concludes that the area was affected by natural disturbance (fire or windfall) these areas will be added to the appropriate category. Areas that are not ground surveyed are conservatively assumed to be affected by anthropogenic disturbance.

Step 5. Within the parcels p that would have been harvested in the baseline scenario up until the monitoring date t , calculate the hectareage of $A_{burn,i,t}$. Calculate $\Delta C_{burn,i,t}$, the annual emissions from carbon stock loss in $A_{burn,i,t}$ by adding up ΔC for all pixels in this class, multiplying by 44/12 and dividing by 2 (as ΔC covers 2 years).

Then calculate annual net greenhouse gas emissions from biomass burning in year t $\Delta C_{DIST-FR,t \text{ IPRJ}}$ by applying Equations 33 and 34 of VM0010, i.e. emissions from burning the biomass that would have been extracted by baseline logging activity in $A_{burn,i,t}$.

Step 6. Within the parcels p that would have been harvested in the baseline scenario up until the monitoring date t , calculate the hectareage of $A_{dist,i,t}$. Calculate $\Delta C_{dist,i,t}$, the annual emissions from carbon stock loss in $A_{dist,i,t}$ by adding up ΔC for all pixels in this class, multiplying by 44/12 and dividing by 2 (as ΔC covers 2 years).

Then calculate annual net greenhouse gas emissions from biomass loss in year t $\Delta C_{DIST,t \text{ IPRJ}}$ by applying Equation 35 of VM0010, i.e. emissions from biomass that would have been extracted by baseline logging activity in $A_{dist,i,t}$.

Step 7. Calculate $\Delta C_{NET,t \text{ IPRJ}}$ applying formula M1 (see Deviation#3, Section 3.6).

Step 8. Detect areas within the entire project area that are within $D_{DIST_IL,i}$ distance from access routes (roads and navigable rivers) and where within any grid of 16x16 pixels more than 6 pixels show a negative ΔC greater than 5tC. Where such areas of higher incidence (higher than natural background tree mortality) of carbon loss occur, these may be an indication of illegal logging.

In the project region illegal logging is a small-scale operation, usually taking out a tree at a time and focusing on the high-value species. Any shifting of larger volumes would require larger teams and barges and would significantly increase the risk of detection and law enforcement. Individual trees being illegally harvested may be indistinguishable from natural tree mortality in terms of observations of carbon stock reductions, especially because not more than one tree is likely to be removed per pixel area (30x30m). However, due to the limited river access routes illegal harvesting is highly likely to be concentrated along the rivers, resulting in a higher density of pixels with carbon stock reduction in those areas than in areas only affected by natural mortality.

Illegal loggers will target the larger individuals of a selection of high-value species: cumala (*Virola* spp., *Iryanthera* spp.), lupuna (*Chorisia integrifolia*), tornillo (*Cedrelinga cateniformis*), shihuahuaco or cumaru (*Dipteryx micrantha*, *Dipteryx* spp.) and capirona (*Calycophyllum spruceanum*) (EIA Global, 2012). The average volume per tree of these species in POA10 is 3.36m³ and their average wood density is 0.64g/cm³. This means the commercial volume of an average tree of the targeted species contains about 3.36 x 0.64 x 0.5 = 1.1tC (applying CEF of 0.5), though it is likely that larger trees will be preferred. Applying the Logging Damage Factor of 1.13tC/m³ from the GGF Loreto 1 Emission Reduction Calculation Spreadsheet, based on

Pearson et al (2014), the total estimated reduction in carbon stocks from the harvesting of a single large tree of the targeted species, including collateral damage from tree fall, is $1.1 + (3.36 \times 1.13) = 4.9\text{tC}$. Therefore, if the detected ΔC in a pixel is greater than -5tC this will likely indicate a large tree mortality event.

How often can a large tree mortality event be expected to occur? Dalagnol et al (2021) have researched dynamic forest canopy gaps (i.e., newly created gaps) across the Amazon using LiDAR imagery and found that in the project region the dynamic gap fraction is between 0.25-0.5% of the area per year (Fig 5a in Dalagnol et al, 2021). If we use a dynamic gap fraction of 0.5% per year this would mean that over a 2-year monitoring period 1% of pixels should be affected by dynamic gaps caused by natural mortality. This means that in any grid of $16 \times 16 = 256$ pixels 2-3 pixels should show a decrease of $>5\text{tC}$. Since these are average figures the threshold for detection of increased mortality from illegal logging is set at 6 pixels.

Since tree mortality is a stochastic event that can only be averaged out over large areas (in other words, if the sampling area is too small there is a reasonable chance that you will see above-average mortality, or no mortality at all) a relatively large grid area of 16×16 pixels ($480 \times 480\text{m}$ or 23ha) was chosen. This will be moved over the ΔC map to detect areas where 6 or more mortality events have taken place within $D_{\text{DIST_IL},i}$ distance from access routes.

Note that this is not a quantification effort (except for the calculation of related fossil fuel emissions, which are expected to be below *de minimis*), only a detection solution. It does not impact the determination of changes of carbon stocks within the project area as these are already included in the ΔC from the biomass map comparison. However, it will be necessary to visit the site and produce photographic evidence of the cause of the reduction in carbon stocks (whether illegal logging or natural mortality). All sites for which no evidence exists are assumed to be sites of illegal logging. The results of the detection of potential illegal logging and field verification will be periodically evaluated and adjustments may be made to the detection parameters in order to find the right balance between detection of real events and false positives due to backscatter and/or natural mortality.

The cumulative carbon stock changes in sites of illegal logging will then be input as $\Delta\text{C}_{\text{IL},t}$ into the modified Equation 37 (see Section 3.6 deviation #4) to calculate fossil fuel emissions related to illegal logging. (Note that carbon stock changes from infrastructure works related to illegal logging will have already been detected by the biomass map comparison and are an integral part of the $\Delta\text{C}_{\text{AB},t|\text{PRJ-Net}}$).

If they had not already been detected and addressed through regular ground surveys, the detection of illegal logging events must trigger the appropriate preventative responses depending on the size and location of the event. The area must be visited more frequently, the access points must be put under greater surveillance and any encountered intruders must be prevented from repeating the incursion in firm, non-violent and educational manner. Rangers will be trained on how to interact with intruders.

5.3.8

Monitoring of project activity implementation

All project implementation activities will be implemented and recorded according to an appropriate Standard Operating Procedure (if relevant) and/or activity log. SOPs and log templates will be presented at verifications.

Project implementation activities include:

Conservation activities

- Patrolling of the project area by boat and on land (e.g., on already established logging roads) to prevent and detect illegal incursions. Parameters to be monitored will include, *inter alia*:
 - Date and time

- GPS route tracking
 - Observations made
- Patrolling of the project area using drones to detect illegal incursions. Parameters to be monitored will include, *inter alia*:
 - Date and time
 - GPS route tracking
 - Observations made
- Permanent observation points at key access points to detect and record any entries and exits from the project area. Parameters to be monitored will include, *inter alia*:
 - Date, time and specifics of any boats, persons, groups passing the observation point in either direction
- Establishment of informative boundary boards at key access points to prevent illegal incursions. Parameters to be monitored will include, *inter alia*:
 - Presence and physical state of the boards
 - Up-to-dateness of information on the boards
- Visits to potential incursion sites to request the trespassers' departure. Parameters to be monitored will include, *inter alia*:
 - Date and time
 - GPS route tracking
 - Observations made
 - Conversations had and outcome

Community outreach activities

- Fruit growing and fruit collection enterprises. Parameters to be monitored will include, *inter alia*:
 - Any type of activity relevant for these enterprises
- Other community-based projects the VCS project may support. Parameters to be monitored will include, *inter alia*:
 - Any type of activity relevant for these enterprises
- Regular meetings to discuss project activities; the importance of conservation, biodiversity, and ecosystem services; potential grievances and conflicts and how these will be addressed. Parameters to be monitored will include, *inter alia*:
 - Date and time of the meetings
 - People present
 - Minutes of the meeting, including summary of outcomes
 - Ex-post report on how any comments, conflicts and grievances have been addressed.

Eco-scientific tourism and research

- Field excursions. Parameters to be monitored will include, *inter alia*:
 - Date and time
 - GPS route tracking
 - Observations made
- Assistance with research facilities and data gathering efforts, including through field staff and drones
 - Visitors, their purpose, their length of stay, their activities, the services provided.
- Hospitality services to visitors. Parameters to be monitored will include, *inter alia*:
 - Visitors, their purpose, their length of stay, their activities, the services provided.

5.3.9

Data archiving

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the project crediting period. All measurements will be conducted according

to relevant standards. Data archiving will take both electronic and paper forms. All electronic data and reports will be kept on remote servers.

The archives will include:

- Copies of all original field measurement data, laboratory data, data analysis spreadsheets;
- Estimates of the carbon stock changes in all pools and non-CO₂ GHG and corresponding calculation spreadsheets;
- GIS products; and
- Copies of the measuring and monitoring reports.

Quality Assurance and Quality Control (QA/QC)

Monitoring related QA/QC requirements will be documented in a series of Standard Operating Procedures (SOPs) which are summarized below:

5.3.10

- Field plot measurements
- Production of Carbon Stock/Biomass Maps and ΔC comparison (see Annex 1)
- Routine Field Patrols by Rangers
- Incident Based Non-Routine Patrol by Rangers
- Incident Based Non-Routine drone flights
- Access-point lookout observations
- Observations during field trips with visitors (e.g., scientists)
- Data archiving

These SOPs will be available at the first Project Verification.

Field data collection is managed by GGF's Monitoring Coordinator, who reports to GGF's Chief Operating Officer. Data are collected by qualified forest engineers under the supervision of an experienced field manager. Field data are checked through a field audit, where measurements, tree identifications, etc. are randomly sampled and checked. Field plots are geo-referenced and physically marked using a tag system. All data are archived electronically and uploaded as soon as practicable on return from the field.

Field data will be supplied to Space Intelligence to enable calibration of field measurements of above ground biomass with remote sensing data and as described in Appendix 2. Space Intelligence will operate its own SOPs for data processing and outputs.

Observations of intrusions, anthropogenic disturbance or natural disturbance by Rangers and lookout point wardens will be reported to the Monitoring Coordinator, who will determine the appropriate response (as detailed in the sections above).

Field plot surveyors, Rangers, lookout point wardens and other personnel involved in the project monitoring will follow SOP refresher courses twice each year. The Monitoring Coordinator will periodically check that SOPs are followed in the field, through spot checks. Non-conformances with the SOPs and the validated monitoring plan will be recorded and, where possible, measurements and/or observations will be repeated.

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APPENDIX 1

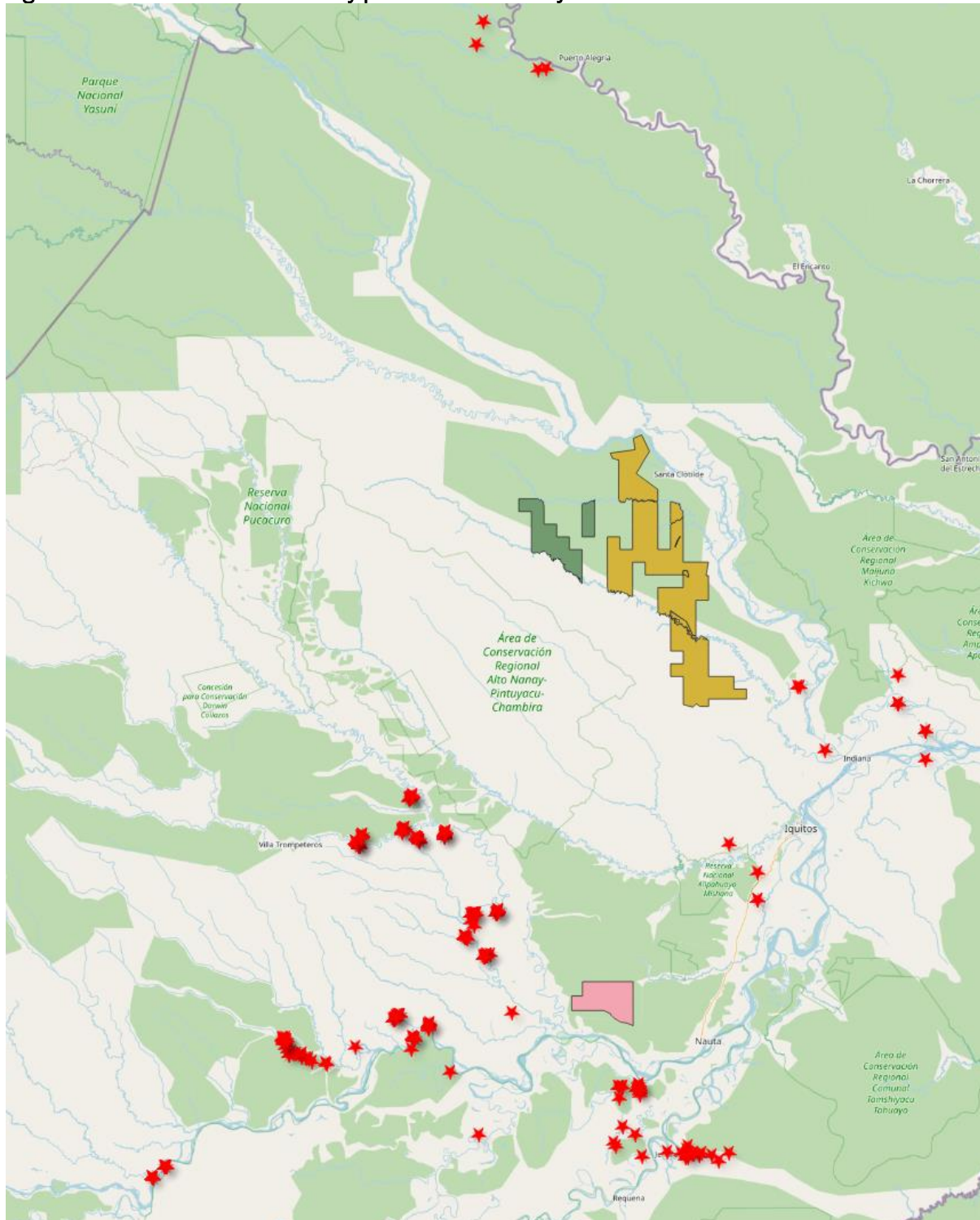
Biomass mapping methodology by Space Intelligence Ltd.

In order to produce wall-to-wall high-resolution maps of aboveground biomass we will use an established approach of combining spaceborne LiDAR data with field data and other remote sensing layers. This is built on established published methods on combining spaceborne LiDAR and Synthetic Aperture Radar (SAR) data to map biomass (Collins et al 2015, Mitchard et al. 2012), but taken further by Space Intelligence to add optical satellite data too, and use a machine learning framework. The approach is essentially similar to that taken by Baccini et al. (2017) to map biomass change at a pantropical scale, but at a 230x higher resolution (0.09 ha pixels compared to 21-hectare pixels), and with considerably higher accuracy as this resolution is almost identical to that of the spaceborne LiDAR instruments (~0.07 ha) and smaller than field plots, enabling reliable local calibration and validation.

The method involves first taking the top height (first return) metric from the satellite LiDAR waveforms - in the case of this 2020 map, this will be the NASA GEDI instrument, but in the future depending on data availability could be ICESAT-2, MOLI, or other spaceborne LiDARs that are available. All these instruments collect circular footprints with diameters ranging from 17 - 25 m along long parallel transects, and the top height data from all is comparable (unlike full waveform characteristics, which are quite sensitive to instrument design). The LiDAR data will be filtered for quality and cloud cover, with only high quality, cloud-free data retained - we anticipate this being thousands to tens of thousands of footprints per year over the 250,000 ha Area of Interest.

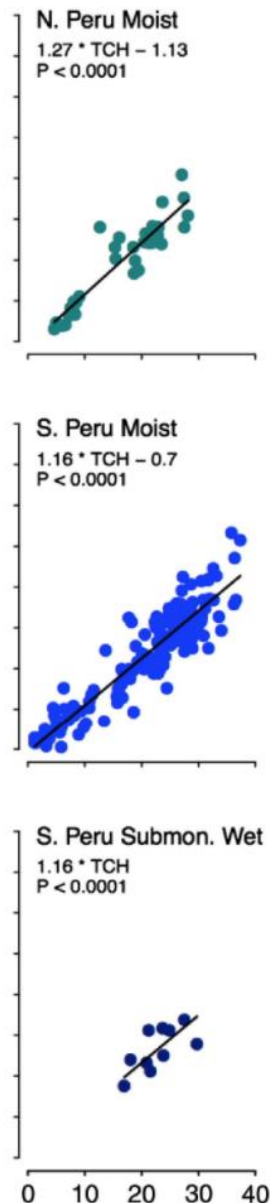
Next, these LiDAR height estimates will be converted to aboveground biomass (AGB) using forest inventory data from field plots of a similar size (or larger, e.g., 1 ha field plots, cut up into sections with similar area to the LiDAR footprints). During the project, once allowed by COVID-19 related restrictions, we will collect new field plots within the project area, specifically designed for calibrating and validating our carbon stock models. However, as it is not possible to collect field data at the moment, we will instead rely on field plots that have already been collected by scientists in the region, see the red stars in the Figure 1 below (the polygons are the Project Areas).

Figure 1: Location of forest inventory plots around the Project Areas



We will filter these plots by forest type, ensuring that we only use plots for calibration that are of the same forest type as the project area. Normally it is easy to find strong and direct relationships between canopy top height as measured from the LiDAR (and in the field) with field-measured AGB, as shown in Figure 2 taken from Asner & Mascaro, 2014).

Figure 2: Example of Peruvian LiDAR Top Canopy Height (X axes) to AGB (Y axes) for three sites, showing strong linear relationships (Asner & Mascaro, 2014)



The conversion of LiDAR stand heights into AGB will result in individual errors on each plot, but when locally calibrated no biases (Asner & Mascaro, 2014), meaning the contribution of error to the overall landscape carbon stock and carbon stock changes estimates from this approach is negligible.

With tens of thousands of AGB estimates from across the region, we will use our proprietary machine learning approach to create a wall-to-wall biomass map through bringing in high resolution satellite imagery in the optical and SAR domains (Sentinel-1, Sentinel-2, Landsat 8 and ALOS-2 PALSAR-2). This extrapolation in space produces biomass maps at a 30 m resolution, which can be tested against the field plots from the region, or within the Project Area given time, to assess the accuracy of the biomass estimation. Based on previous work we expect it to produce highly accurate estimates of biomass within polygons ($\pm 5\%$ at a 95% Confidence Level for 1000+ ha compared to estimates of field data), and better than $\pm 15\%$ at a 95% level for individual pixels - but this will be formally assessed during the work.

We intend to repeat this methodology through time. Ideally this would be based on new field and LiDAR data each time, but we do not anticipate rapid changes in the LiDAR calibration so new field data will not be necessary for each census. Similarly, the relationship between the LiDAR AGB estimates and the other remote sensing layers will not change rapidly, so it is possible to produce continuous maps even if there is no spaceborne LiDAR operating - though in that case it would be desirable to have contemporaneous field data to ensure the map remains accurate.

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APPENDIX 2

Responses to PD auditor comments by Professor Edward Mitchard, Space Intelligence Ltd.

17 January 2021. ed@space-intelligence.com

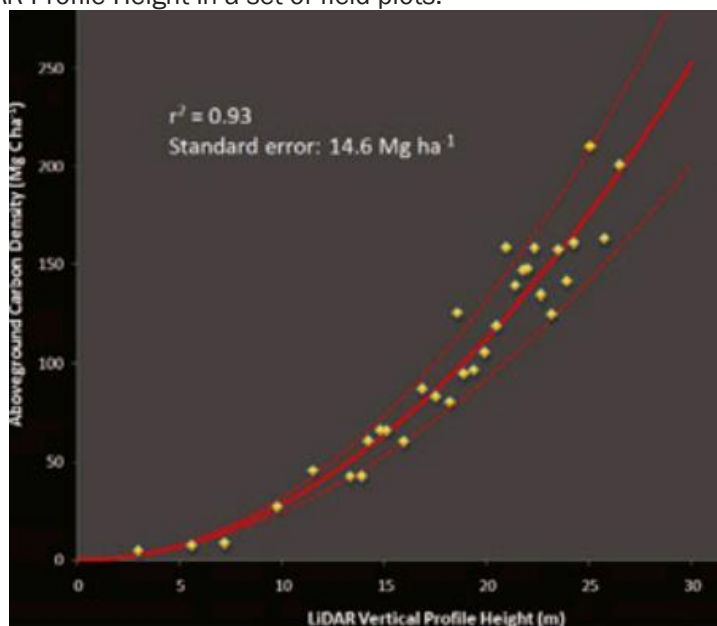
“Section 3.17.2 of the VCS Standard requires that “Methodology deviations shall not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, except where they result in increased accuracy of such quantification”.

In order to allow the audit team to assess whether or not methodology deviation 3, in Section 3.6 of the PD, will result in increased accuracy of the quantification of GHG emission reductions, please provide the following information:

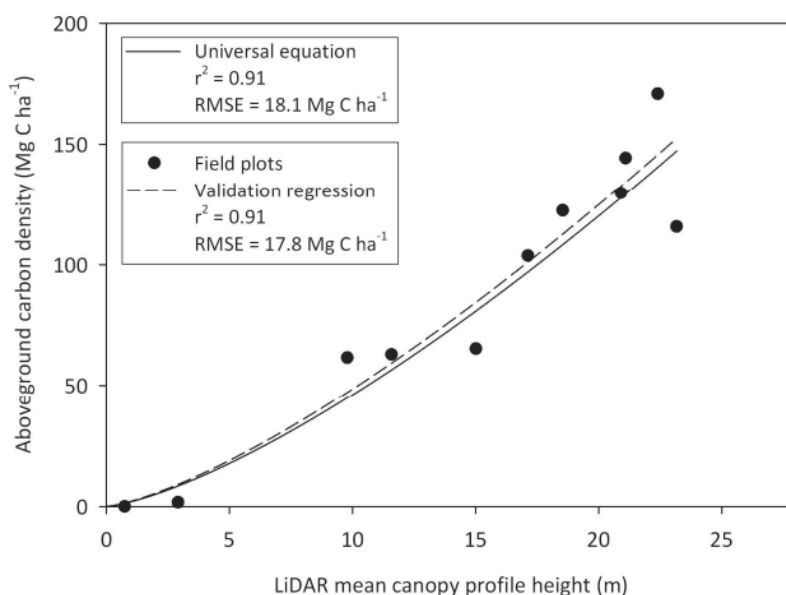
1. *Since LiDAR data typically is well-positioned to provide information regarding tree height but does not directly provide information regarding volume or biomass, please provide detailed information regarding how biomass is to be estimated from LiDAR data.*
2. *Please clarify whether the approximately 30 “field plots”, as mentioned in the PD, will be used to calibrate the biomass prediction process or to estimate its uncertainty.*

Satellite LiDAR data gives information on both the height and density of vegetation within a footprint. As the auditor states, it does not directly measure tree volume or biomass: but neither do the tree diameter measurements of forest plots - in both cases allometric equations are used to convert between a measured physical parameter of the forest and biomass. LiDAR data will increase the accuracy of the estimated biomass compared to using field plots alone because at least tens of thousands of independent measurements of plot-scale forest height will be made every year across the project area every year (through the operational GEDI or ICESAT-2 instruments, or future planned platforms such as MOLI).

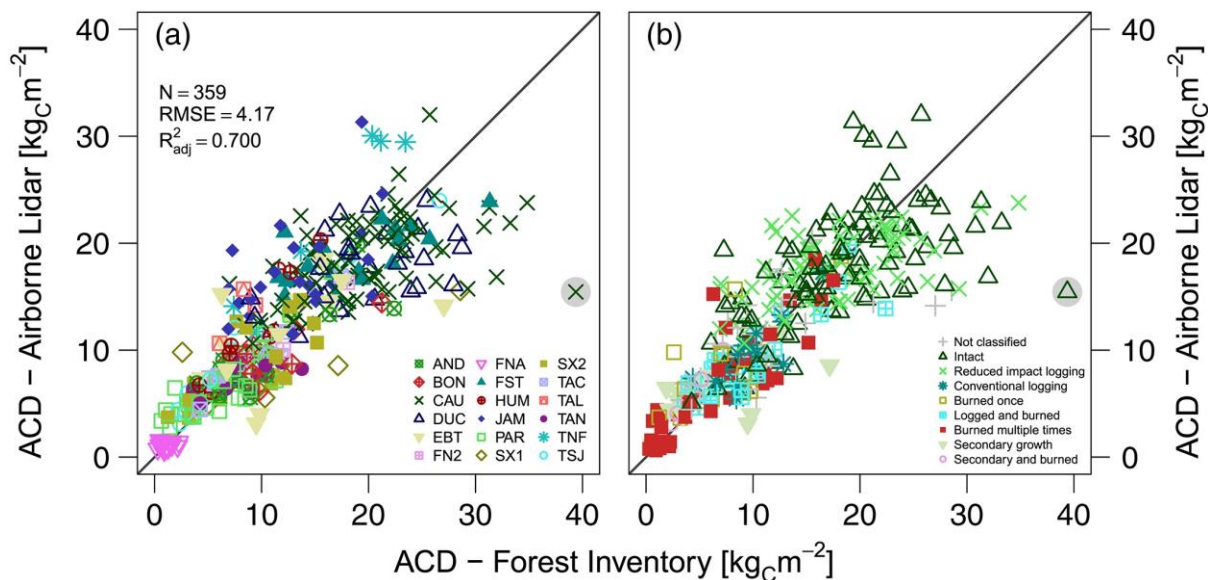
The height measured by LiDAR has been shown to be strongly related to biomass in a number of academic studies, with stand-level allometries used to convert height metrics into biomass (typically using field plots for this calibration). For example, in Amazonian Peru, Asner et al. (PNAS, 2010, <https://doi.org/10.1073/pnas.1004875107>) found a strong relationship between the Aboveground Biomass Density and LiDAR Profile Height in a set of field plots:



Similar strong relationships have been found throughout South America, including in Colombia (Asner et al. 2013, *Biogeosciences*, <https://doi.org/10.5194/bg-9-2683-2012>)



And in Brazil, where a study covering multiple sites (a) and forest conditions (b) shows a similar linear relationship between modelled biomass from LiDAR and forest inventory plot data (Longo et al. 2016 *Global Biogeochemical Cycles* <https://doi.org/10.1002/2016GB005465>):



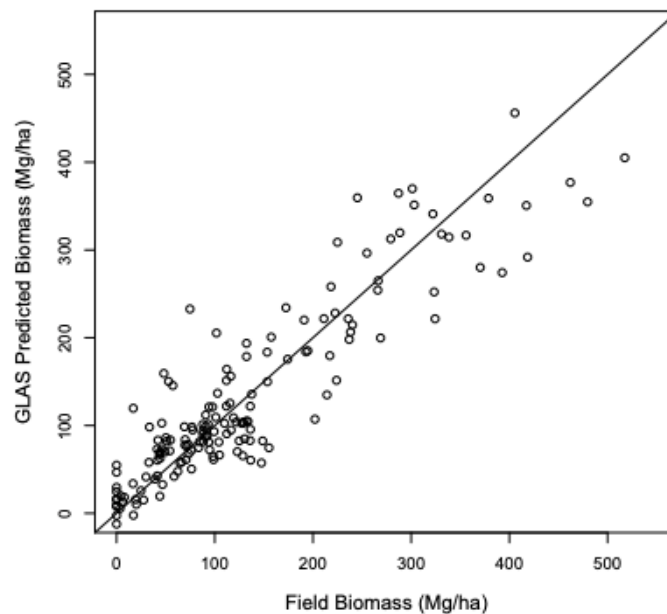
All the above studies use airborne LiDAR. We will use satellite LiDAR, which has similar properties to the plot-averaged airborne LiDAR shown in the figures above. The reason for using satellite LiDAR rather than airborne LiDAR is threefold:

- Costs are considerably lower
- Emissions are lower - satellites once launched operate at very low carbon costs, whereas repeated plane flights over a study area have a clear carbon cost

- The geographical spread and repeat time of data can be better - satellites routinely collect LiDAR footprints over the study site every few days. Only with a near-unlimited budget could the whole area be repeatedly sampled with airborne LiDAR, meaning the data would be spatially biased and likely sparse in time.

We are not aware of peer reviewed studies yet published that demonstrate this approach with GEDI (the LiDAR satellite we intend to use) in the tropics, but this approach was widely used by a previous generation of satellite LiDAR sensors. For example, many studies mapped AGB using the ICESAT GLAS satellite that operated in the 2000s. This had a 70m footprint, to GEDI's 25m, so we would expect its accuracy to be lower, but nonetheless good results were obtained, resulting in the first pantropical maps of aboveground biomass (Saatchi et al. 2011 *PNAS*; Baccini et al 2012 *Nature Climate Change*).

Here is the calibration figure from Baccini et al. as an example (it used plots from across the tropics located under GLAS footprints):



Following the approach in all these papers, we will estimate the relationship between satellite LiDAR-based height and AGB using, if necessary, during a transition period for COVID, relationships from the literature: appropriately converted airborne LiDAR-AGB relationships from Peru e.g., Asner et al. 2010 or Asner & Mascaro 2014. And once fieldwork is possible, a set of 30 new field plots (as described on page 36). These field plots will be 0.5 hectare in size, and located under GEDI footprints already collected within the last 6 months, such that a direct relationship can be built between the AGB in these footprints and GEDI-estimated tree height. The plots will be stratified to cover a full range of GEDI height values observed.

In these plots the diameter of all trees with a DBH >10cm will be measured, along with their species (identified at least to genus to obtain wood density). They will be converted to biomass using the allometric model as described in the PD section 5.1. We will test a variety of GEDI metrics (including canopy cover, RH98 - effectively top height, RH10 - a measure of canopy density, and others) to develop the best fitting equation.

We will then apply this best fit equation to all the LiDAR footprints in the dataset. We will subsequently use machine learning to extrapolate a biomass map across the whole concession at a 30 m resolution, using other remote sensing data layers as described on page 36 (and performed in many of the studies described above, e.g., Asner et al. 2010, 2013; Baccini et al. 2012; Saatchi et al. 2011).

3. Please provide more information regarding how uncertainty will be quantified, as required by Section 8.4.1.1 of the methodology.”

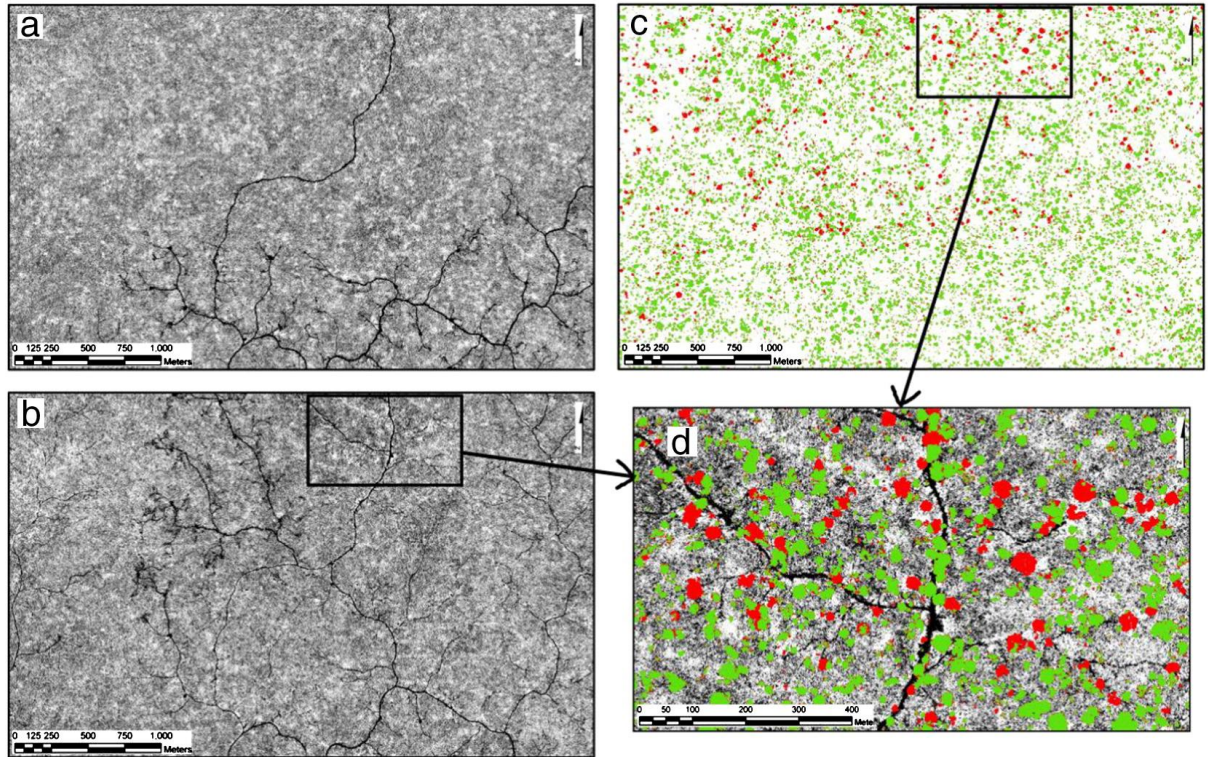
This extrapolated biomass map will be independently tested and validated using further field plots (already existing and remeasured), which are unlikely to be located under GEDI footprints but will provide validation of the extrapolated map. At least 50 such plots have already been identified in and around the project area (figure page 80) and more are known within the project site. This will allow an estimation of the 95% confidence interval around the AGB in each 30 m pixel. We expect this error to be low, around or less than $\pm 15\%$, and consistent across the biomass range, but this can only be assessed with the field data. Given many of these errors are random, when summed within a polygon of the field data the extrapolated errors in the LiDAR map are likely to be $\pm 5\%$, with this high accuracy justifying the use of this method over more traditional field inventory alone.

And

“Section 3.17.2 of the VCS Standard requires that “Methodology deviations shall not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, except where they result in increased accuracy of such quantification”. In order to allow the audit team to assess whether or not methodology deviation 4, in Section 3.6 of the PD, will result in increased accuracy of the quantification of GHG emission reductions, please provide a detailed justification as to the ability of the proposed LiDAR technology to detect impacts of illegal logging, supported with literature references as relevant. While the field of LiDAR-assisted remote sensing is quickly evolving, the conventional wisdom is that remote sensing approaches lack the precision necessary to detect biomass loss due to degradation. A limitation of most remote sensing technologies, which is shared by LiDAR to some extent, is the limited ability to detect biomass loss in the understory. Please justify why LiDAR technology is capable of providing the required levels of precision and accuracy.

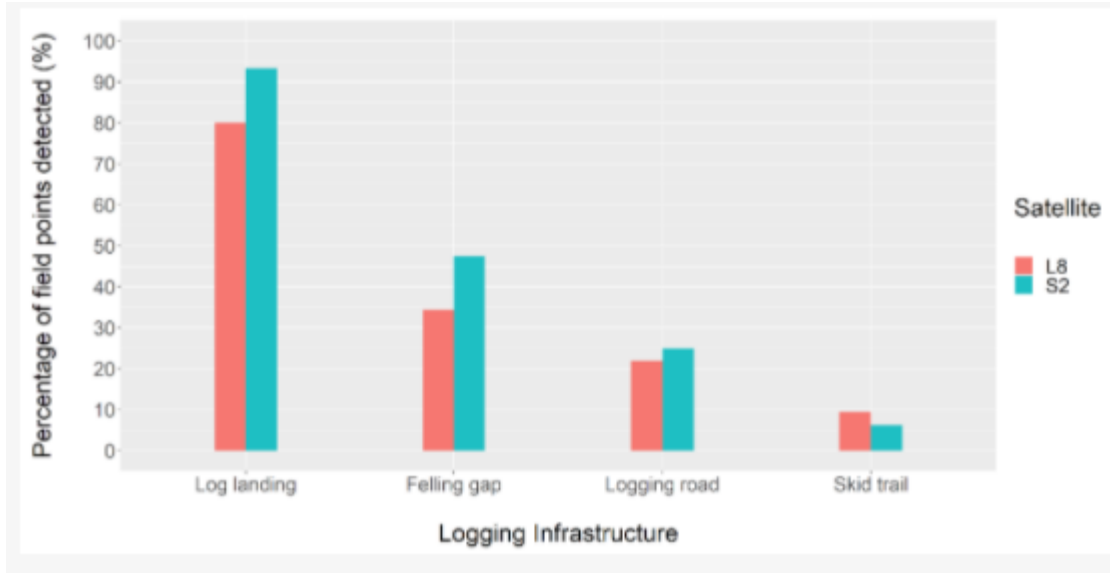
We understand the concerns of the auditor here: detecting biomass loss due to degradation is challenging, and until recently was at the limit of what was possible using remote sensing. However, it is now possible, and has significant advantages over a field-based methodology: every pixel across the whole area can be observed if needed multiple times per year, enabling degradation not just to be monitored, but to be quickly stopped in its tracks. We believe this use of satellite technology greatly increases the chances of success of the project, reducing the risks of carbon stock losses from degradation through timely and complete monitoring, and increasing the accuracy and precision of the quantification of carbon stock changes from any degradation that does occur.

That airborne LiDAR can successfully monitor forest degradation is now entirely accepted. For example as far back as 2014 Andersen et al. (*Remote Sensing of Environment*, <https://doi.org/10.1016/j.rse.2013.08.049>) showed that LiDAR height data collected in 2010 (a) and 2011 (b), before and after low intensity selective logging, was able to see individual tree clearings (c/d). This study is based in the Western Brazilian Amazon, a similar forest type to the one in this project.



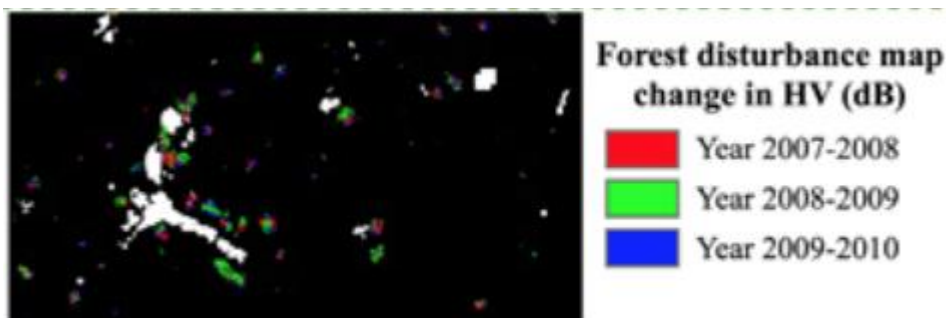
Similar results have been shown elsewhere, e.g. Rangel Pinage et al (2019, *Remote Sensing*, <https://doi.org/10.3390/rs11060709>) and Alberto Silva et al. (2017, *Remote Sensing*, <https://doi.org/10.3390/rs9101068>).

However, we are using satellite LiDAR, where only a subset of pixels will be directly imaged by the LiDAR. Therefore, most of the area where we hope to detect change will be extrapolated using a range of other satellite datasets, including active sensors (e.g., Sentinel-1 and ALOS-2 PALSAR-2 synthetic aperture radars), and passive sensors (Landsat 8/9 and Sentinel-2). This method has not been proven in the academic literature, but is a proprietary service offered by Space Intelligence that has been used successfully in tropical forests. Its applicability to detect logging is proven in the literature, for example using single datasets (just Landsat-8 or Sentinel-1) damage due to logging was visible in the Brazilian Amazon (Almeida Lima et al. 2019, *Remote Sensing*, <https://doi.org/10.3390/rs11080961>):

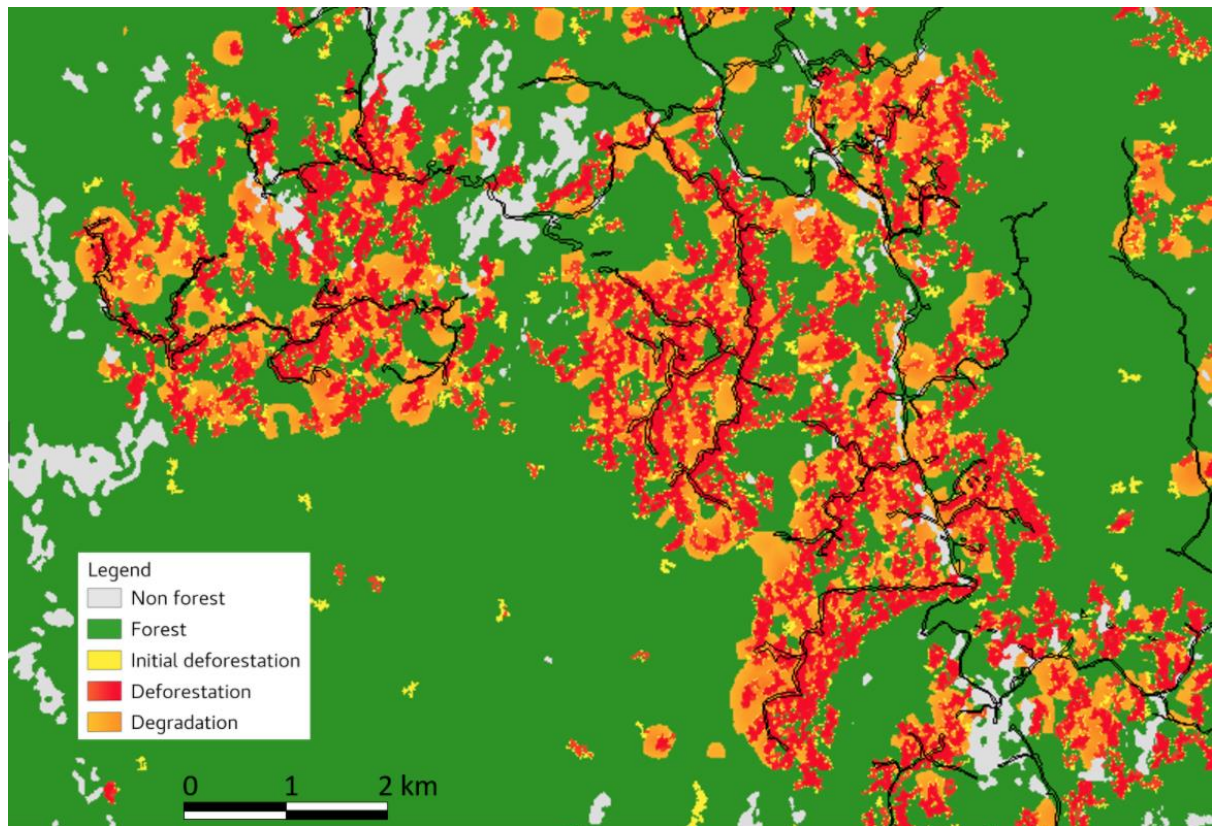


Others have found similar results in terms of the ability of simple optical satellite data being able to detect forest degradation using machine learning, including Hethcoat et al. (2019, *Remote Sensing of Environment*, <https://doi.org/10.1016/j.rse.2018.11.044>)

And degradation was detected using just ALOS PALSAR in the Peruvian Amazon (Joshi et al, 2015, *Environmental Research Letters* <http://dx.doi.org/10.1088/1748-9326/10/3/034014>), where forest degradation, the creation of pasture (i.e., deforestation), and clearance for gold mining, were all distinguishable from areas that remained intact:



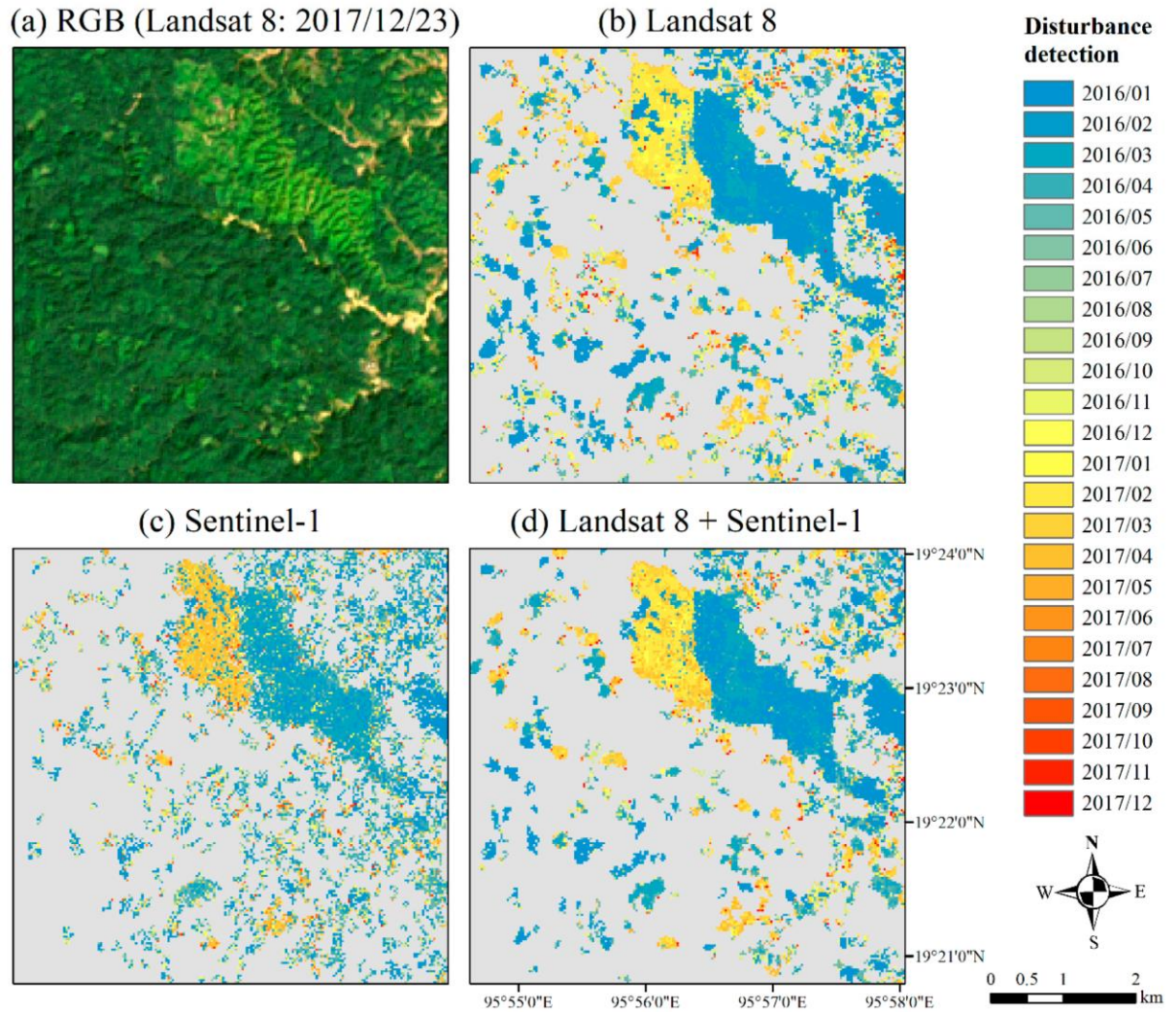
Similarly, Sentinel-1 was used to detect deforestation and degradation in the Amazon and Borneo by Hoekman et al. (2020, *Remote Sensing*, <https://doi.org/10.3390/rs12193263>).



Detection of deforestation and degradation with Sentinel-1

This type of active remote sensing data is particularly useful for seeing changes below the canopy (the understory degradation mentioned by the auditor). For example, understory damage caused by insect outbreaks were detected with an accuracy of up to 88% using ALOS PALSAR in a Bavarian forest (Tanase et al. 2018, *Remote Sensing of Environment*, <https://doi.org/10.1016/j.rse.2018.03.009>). And forest types typified only by differences in the understory could be differentiated successfully by Varghese et al. (2015, *International Journal of Remote Sensing*, <https://doi.org/10.1080/01431161.2015.1136448>) using a C-band radar similar to Sentinel-1.

And while so far poorly tested, a combination of both types of remote sensing data will clearly increase accuracy, as shown for example in Shimizu et al. (2019, *Remote Sensing*, <https://doi.org/10.3390/rs11161899>), where omission errors were in the range of 5-40% for different types of disturbance in a Bornean logging concession using a combination of Landsat 8 and Sentinel-1, and accurate maps of disturbance date could be produced:



We are therefore confident that this approach will be able to detect forest degradation and selective logging with high precision, including changes in the understory. Indeed, we believe this method will produce more reliable and useful results than a field-based method, with the massive advantage that every patch of forest in the project will be imaged multiple times per year.