Papua New Guinea
Forest Authority

Capacity Development Project for Reducing Carbon Emissions from Forest Degradation through Commercial Logging in PNG by Improving Monitoring System of Forest Logging Operations

FINAL REPORT
(Main)

May 2025

Japan International Cooperation Agency (JICA)

Kokusai Kogyo Co., Ltd.

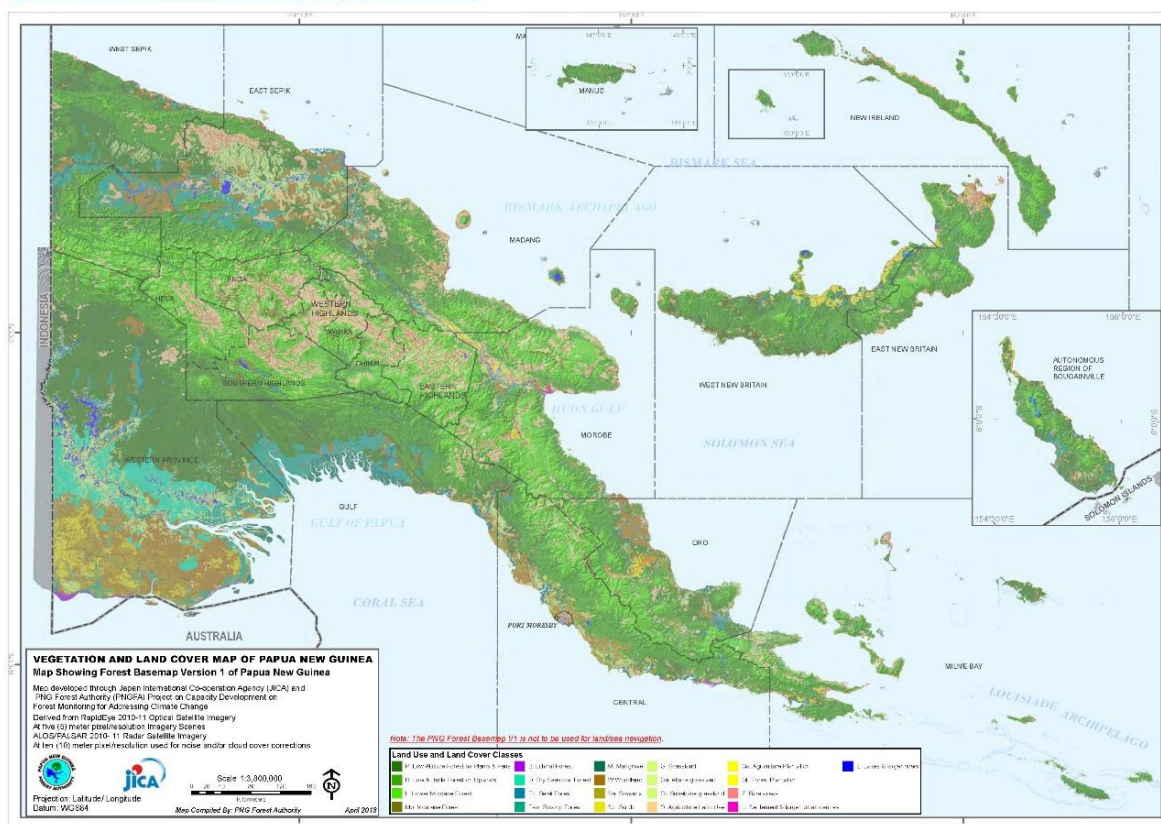| GE |
| --- |
| JR |
| 25-049 |

Project Target Area Location Map

Independent State of Papua New Guinea

Area: 462,840 km^2 (Ministry of Foreign Affairs of Japan)

Population: 8,947,027 (2020, World Bank)

GNI per capita: 2,660 USD (2020, World Bank)

VEGETATION AND LAND COVER MAP OF PAPUA NEW GUINEA
Map Showing Forest Basemap Version 1 of Papua New Guinea

Map developed through Japan International Co-operation Agency (JICA) and
PNG Forest Authority (PNGFA) Project on Capacity Development on
Forest Monitoring for Addressing Climate Change
Derived from RapidEye 2010-11 Optical Satellite Imagery
At five (5) meter pixel resolution Imagery Scenes
ALOS/PALSAR 2010-11 Radar Satellite Imagery
At ten (10) meter pixel/resolution used for noise and/or cloud cover corrections

Projection: Latitude/ Longitude
Datum: WGS84

Scale 1:3,800,000

Map Compiled By: PNG Forest Authority   April 2013

Survey Photographs

Project kick-off meeting (May 2022)

Opinion exchange meeting to create a Project activity plan (May 2022)

Efforts to restore the vegetation of commercial tree species at Forest Research Institute (FRI) test sites (impact on regeneration was observed due to the overgrowth of vines.) (May 2022)

Marshall Lagoon logging area (water pooling on the log landing) (June 2022)

PNG-FRIMS recovery training (October 2022)

Laying of logging road (October 2022)

Survey Photographs

Forest seven years after logging (covered by fast-growing trees) (October 2022)

Participants at the 2nd JCC Meeting (October 2022)

Mr. Koide, Team Leader, explaining the progress of the Project at the 3rd JCC Meeting (March 2023)

Nursery attached to logging company camp (Amanb1-4) (March 2023)

Kwila seedlings (which reach a shipping size of about 45 cm in two months) (March 2023)

Discussing enrichment planting in the logged over area with landowners (March 2023)

Survey Photographs

Marking of areas to plant (Amanab) (May 2023)	Logging company's log pond (Amanab) (August 2023)
Signing of MOU with Open Bay Timber Ltd. (OBT) (witnessed by JICA Headquarters) (August 2023)	Inspection of planting spacing at UT123 (there is not enough spacing here) (October 2023)
LCoP/PMCP training in the Momase region (November 2023)	Explanation of Mobile Offline Map at LCoP/PMCP training (November 2023)

Survey Photographs

Confirmation of current location and logging plan using Mobile Offline Map at LCoP/PMCP training (November 2023)

Exchange of opinions regarding forest residue after selective logging at LCoP/PMCP training (November 2023)

Enrichment planting by PNGFA officers at LCoP/PMCP training (November 2023)

Discussion with the logging company in the Kupiano region (November 2023)

Explanation of log measurement by Mr. Ivo Kusip at LCoP/PMCP training in NSI region (February 2024)

Exhibition of deliverables created in the Project at the mid-term Project workshop (April 2024)

Survey Photographs

Drone image processing training for Central Province officers (April 2024)

A Mapping Branch officer conducting GIS training for logging companies (Kupiano, Central Province) (April 2024)

Carbon monitoring indoor training session (July 2024)

Measuring the size of remaining trees in carbon monitoring training session (July 2024)

State of Kwila growth at UT51 (good growth seen in areas with good light environment) (August 2024)

State of Kwila growth at UT51 (damaged due to high soil moisture) (August 2024)

Survey Photographs

Field training for the first training for logging companies (September 2024)

Kwila growth at UT123 (well-grown saplings that have reached about 2.4 m) (October 2024)

Kwila growth at UT123 (slow-growing saplings that remain about 0.6 m) (October 2024)

Lecture on GPS and GIS by GIS officer of the Mapping Branch at the second training for logging companies (October 2024)

Presentation of training results at the second training for logging companies (October 2024)

Briefing to OBT on research in Open Bay (November 2024)
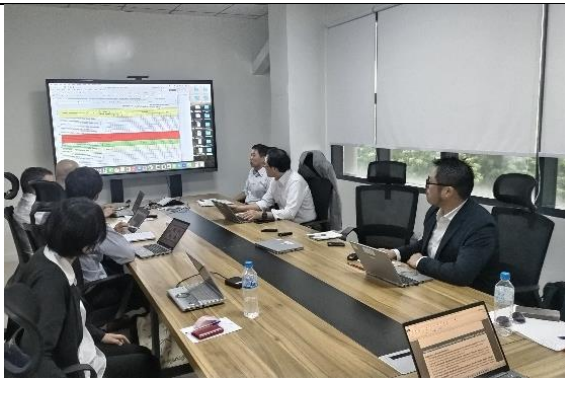
Survey Photographs

Carbon monitoring workshop (December 2024)

Growth of Kalophilum (January 2025)

Growth of Malus (January 2025)

State of planting in gap (Open Bay) (January 2025)

Mr. Okabayashi, Chief Advisor, providing an overview of the Project at the 5th JCC Meeting (March 2025)

Discussions with Expertise France about the 2025 EU-FCCB project activity plan (explaining lessons learned and recommendations from the Project) (March 2025)

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Abbreviations

Abbreviation	Name
ADB	Asian Development Bank
C/P	Counterpart
DAMS	Deforestation Alerts and Monitoring System
DBH	Diameter at Breast Height
DHCM	Digital Canopy Height Model
DSM	Digital Surface Model
DSS	Decision Support System
DTM	Digital Terrain Model
EF	Expertise France
EU	European Union
EU-FCCB	European Union-funded Forestry-Climate Change-Biodiversity
F/R	Final Report
FAO	Food and Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FMA	Forest Management Area
FRI	Forest Research Institute
GHG	Greenhouse Gas
GIS	Geographic Information System
GPS	Global Positioning System
HQ	Headquarters
ICT	Information and Communication Technology
IP	Impact Parameter
ITTO	International Tropical Timber Organization
JCC	Joint Coordination Committee
JICA	Japan International Cooperation Agency
LCMS	Logging Code / Carbon Monitoring System
LCoP	Logging Code of Practice
MAFF	Forestry Agency, Ministry of Agriculture, Forestry and Fisheries
MD	Managing Director
MOU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
NAS	Network-attached Storage
NDC	Nationally Determined Contribution
NFI	National Forest Inventory
NFM	Natural Forest Management
NGI	New Guinea Islands
OBT	Open Bay Timber Ltd.
OS	Operating System
PC	Personal Computer
PDM	Project Design Matrix

PMCP	Planning, Monitoring and Control Procedures for Natural Forest Logging Operations under Timber Permit
PNG	Papua New Guinea
PNGFA	Papua New Guinea Forest Authority
PNG-FRIMS	Papua New Guinea-Forest Resource Information Management System
PO	Plan of Operations
PR/R	Progress report
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
RIL	Reduced Impact Logging
RIL-C	Reduced Impact Logging for Climate Change Mitigation
RS	Remote Sensing
SDGs	Sustainable Development Goals
TA	Timber Authority
TOR	Terms of Reference
TRP	Timber Rights Purchase
TSI	Timber Stand Improvement
UAV	Unmanned Aerial Vehicle
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPS	Uninterrupted Power Supply
USAID	U.S. Agency for International Development
VCS	Verified Carbon Standard
WS	Workshop

Currency Conversion Rate

USD1 = ¥149.845000; PGK1 = ¥37.071600

(JICA conversion rate for April 2025)

Source:
https://www.jica.go.jp/about/announce/manual/form/consul_g/__icsFiles/afieldfile/2025/04/03/rate202504.pdf

USD = US Dollar, Y = Japanese Yen, PGK = Papua New Guinean Kina

Chapter 1.   Outline of the Project

1.1   Background of the Project

The Independent State of Papua New Guinea (hereinafter referred to as "PNG") is one of the world's largest tropical forest countries, with approximately 35 million hectares of forest. The PNG constitution stipulates that natural resources, including forests, are to be sustainably conserved and utilized, with the forestry sector accorded an important position in PNG development policies. On the other hand, greenhouse gas emissions in 2015 increased by about 29 million tons of CO2 compared to the year 2000, of which about 80%, or about 23 million tons, was attributed to commercial logging and agricultural land development. For these reasons, measures against deforestation and forest degradation are expected to play an important role with regard to both climate change and sustainable forest management.

Against this background, PNG has made REDD+ (i.e. Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries) an important policy issue, with cooperation in the forestry sector carried out with donors such as the Food and Agriculture Organization (FAO) and United Nations Development Programme (UNDP), as well as the Japan International Cooperation Agency (JICA). As part of its support for climate change countermeasures in the Pacific region, Japan, through one grant aid and two technical cooperation projects since 2010, has been involved in the development of the national forest base map, the establishment of the PNG Forest Resource Information Management System (hereinafter referred to as "PNG-FRIMS") and the utilization thereof to improve the forest management system in PNG, the improvement of forest monitoring, and the development of information related to REDD+. Through these efforts, Japan has been involved in improving the environment for sustainable forest management that contributes to climate change countermeasures. Nevertheless, some issues still remain to be solved in the guidance and supervision of PNG Forest Authority (PNGFA) officers at timber production sites and in the effective and efficient implementation of sustainable harvesting activities that are supposed to be guided by the PNGFA.

Given this background, in order to directly contribute to the improvement of forest degradation and deforestation, which are the largest contributors to greenhouse gas emissions in PNG, it was decided that the "Capacity Development Project for Reducing Carbon Emissions from Forest Degradation through Commercial Logging in PNG by Improving Monitoring System of Forest Logging Operations" (hereinafter referred to as the "Project") would be implemented, contributing to the promotion of sustainable forest management and the reduction of forest-based greenhouse gas emissions in PNG. The Project has improved the capacity of stakeholders to comply with regulations and procedures related to logging activities, and for technology transfer related to such things as natural regeneration and low environmental impact logging. Further, the Project has also improved

the capacity to measure greenhouse gas emissions from forests to improve the implementation of REDD+.

Two long-term experts, a chief advisor in charge of forest policy, and a coordinator were dispatched to PNG for the period between April 2022 and April 2025. On February 4, 2022, Kokusai Kogyo Co., Ltd. contracted with JICA to supply short-term experts to participate in the Project. This report provides a summary of the outputs of the Project, with a focus on the activities implemented by the short-term experts of Kokusai Kogyo Co., Ltd.

1.2 Purpose and Goal of the Project

The Project aimed to achieve the Project purpose through the implementation of Project activities in collaboration with the counterpart (C/P), PNG Forest Authority (PNGFA), and in cooperation with the long-term experts. The overall goal, Project purpose, outputs and activities of the Project are listed as follows. The Project Design Matrix (PDM) of the Project is shown in Annexure 33.

■ **Overall Goal**

Forests in PNG are conserved, managed in a sustainable manner and, at the same time, its conservation is promoted as an important measure against climate change.

■ **Project Purpose**

The capacity of stakeholders for enforcement of rules and procedures on logging operations and natural regeneration activities are strengthened for reducing forest degradation and promoting low emission logging.

■ **Outputs**

Output 1: The Planning, Monitoring and Control Procedures for Natural Forest Logging Operations under Timber Permit (PMCP) and the Logging Code of Practice (LCoP) are well understood and applied by project stakeholders (Government, Forest industry, etc).

Output 2: The ability of stakeholders (Government, Forest industry, Landowners, etc) to effectively carry out natural regeneration practice is improved.

Output 3: Field carbon monitoring procedures for logging operation are developed.

■ **Activities**

[For Output 1]

Activity 1-1: Challenges are identified through reviewing actual use of PMCP and LCoP, as well as information flow of logging activities.

Activity 1-2: Based on the review of the information organized in Activity 1-1, examine and identify ways to strengthen PNG-FRIMS and utilize new technologies related to GIS and remote sensing to effectively promote sustainable forest management complying with PMCP and LCoP.

Activity 1-3: Set criteria for selecting pilot site(s) to undertake trials of the effective forest management complying with PMCP and LCoP, and determine the pilot site(s).

Activity 1-4: At the pilot site(s), test the technologies identified by the Activity 1-2.

Activity 1-5: Identify effective way to disseminate PMCP and LCoP to the stakeholders, and provide necessary training for the PNGFA officers to conduct the dissemination.

Activity 1-6: Support PNGFA officers to disseminate PMCP and LCoP to timber company foresters.

Activity 1-7: Prepare programs and materials introducing outputs of the Project and help PNGFA to disseminate the outputs to the stakeholders in workshop(s).

[For Output 2]

Activity 2-1: Find out issues for managing natural regeneration after logging.

Activity 2-2: Identify key stakeholders, and examine implementation structure and technical improvement measures for solving the issues identified in Activity 2-1.

Activity 2-3: Conduct pilot-activities on natural regeneration by PNGFA officers and key stakeholders at the pilot site(s) determined in activities 1-3.

Activity 2-4: Develop the draft user manual in cooperation with the key stakeholders.

Activity 2-5: Finalize the user manual to disseminate natural regeneration techniques to PNGFA officers and key stakeholders.

[For Output 3]

Activity 3-1: Review the effects of complying with PMCP and LCoP to low emission logging activities.

Activity 3-2: Identify indicators to assess low emission logging activities (e.g. Area for roads and log landings, damaged woods due to felling, etc).

Activity 3-3: Identify and develop methodology for monitoring, recording, reporting or reducing emission level from logging operations through trials and validations in the pilot site(s).

Activity 3-4: Develop training program and provide necessary trainings to adopt carbon monitoring for PNGFA field officers.

Activity 3-5: Compile proposals to promote the implementation of low emission logging.

Activity 3-6: Compile proposals for forest carbon monitoring and reducing emissions from logging operations on the basis of the Activity 3-1 to the Activity 3-5.

Activity 3-7: Organize Workshop to disseminate the results of project activities.

■ **Project Target Group**

Target group: PNG Forest Authority (PNGFA)

■ **Project Target Areas**

Target areas: The whole of PNG

1.3   Work Flow and Input

Flow Chart of the Project

The Project is divided into two phases: the Detailed Design Survey Phase (the first contract period) and the Full Operation Phase (the second contract period); it further consists of three outputs and a series of activities related to each. Manuals for each of these outputs were created utilizing the knowledge and experience gained through the implementation of trials at pilot sites and Project activities. In addition, the dissemination of these outputs was conducted through training for PNGFA officers and other stakeholders, recommendations for policymakers, and in workshops (Figure 1.3-1).
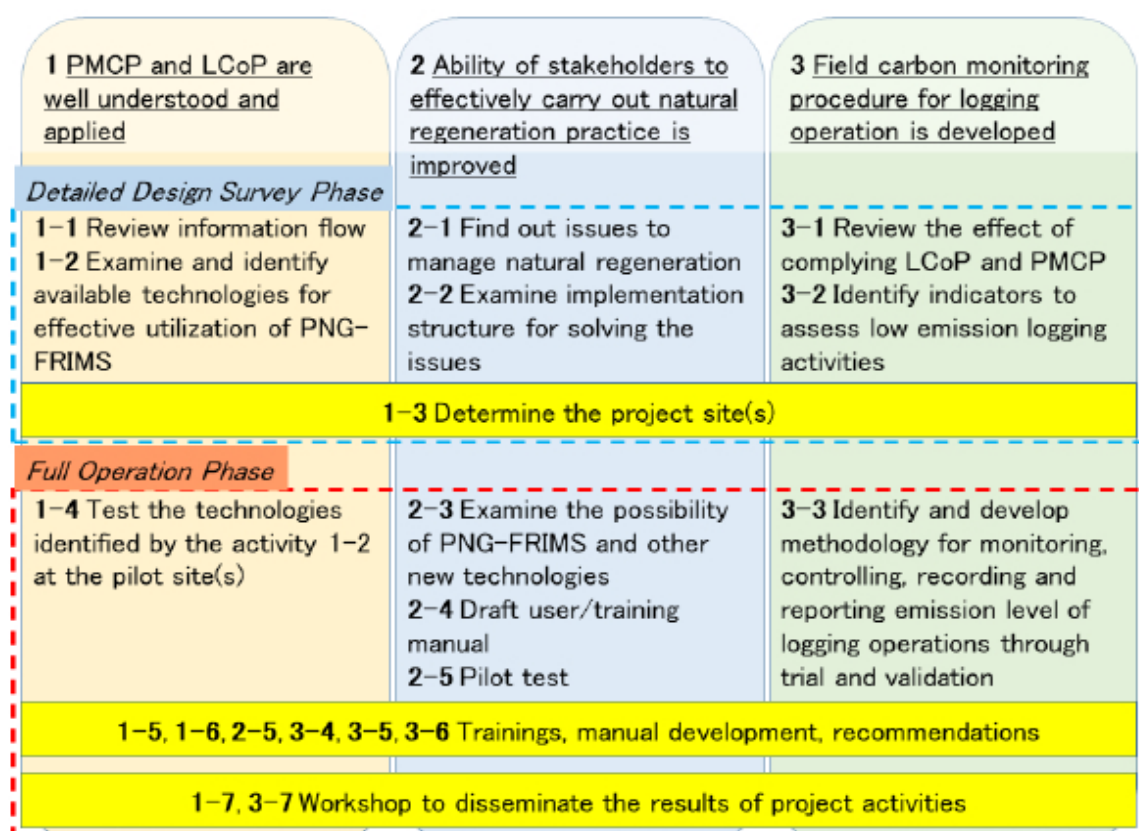
Figure 1.3-1 Structure of the Project

A workflow chart for the Project is provided in Figure 1.3-2.
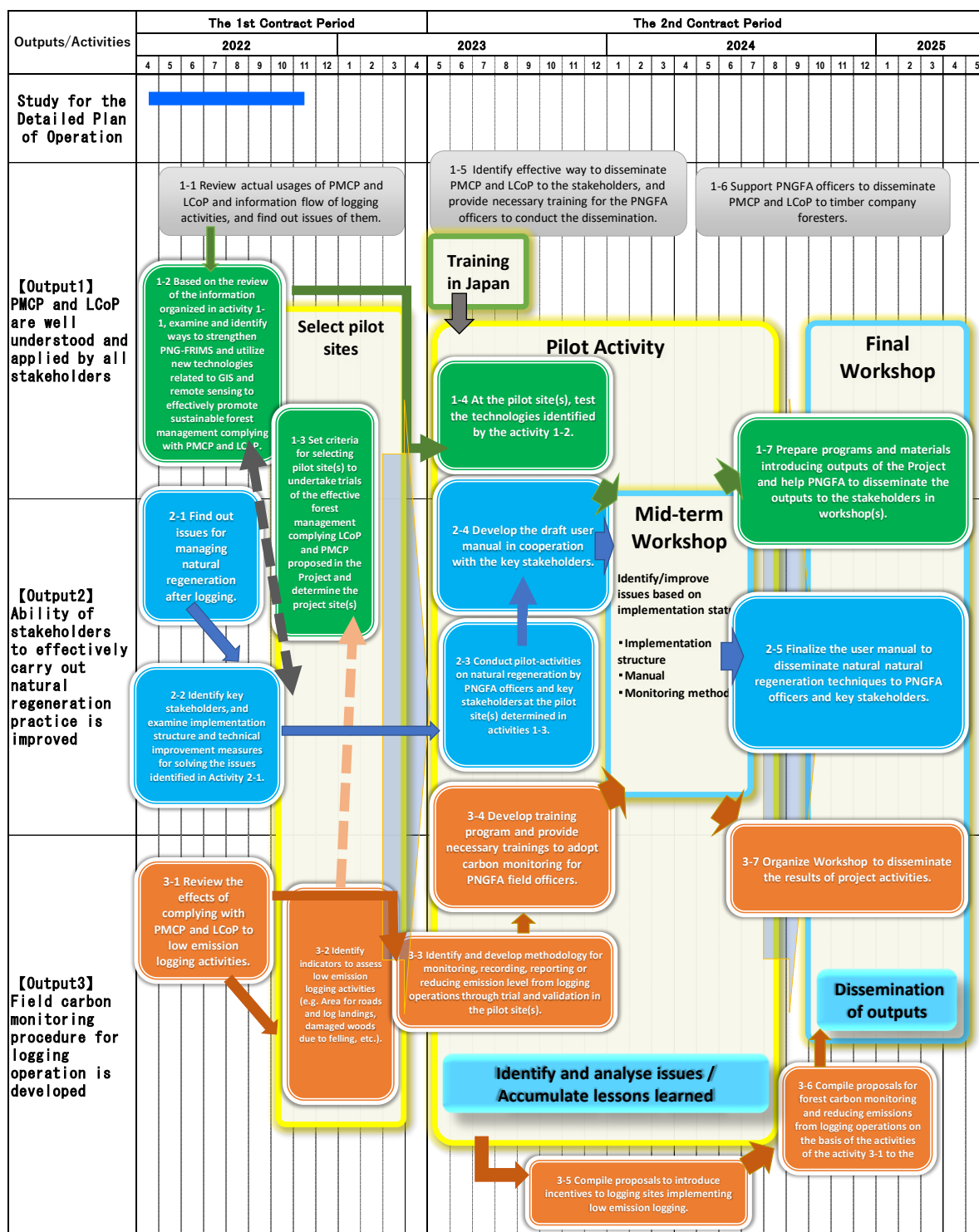
Figure 1.3-2 Work Flow Chart

Implementation Flow of the Project

A correlation table for Project activities and achievements is given in Table 1.3-1.

Table 1.3-1 Correlation Table for Project Activities and Achievements

Outputs/Activities	The 1st Contract Period / The 2nd Contract Period
【Output 1】 **PMCP and LCoP are well understood and applied by all stakeholders**	
1-1	Challenges are identified through reviewing actual use of PMCP and LCoP, as well as information flow of logging activities.
1-2	Based on the review of the information organized in activity 1-1, examine and identify ways to strengthen PNG-FRIMS and utilize new technologies related to GIS and remote sensing to effectively promote sustainable forest management complying with PMCP and LCoP.
1-3	Set criteria for selecting pilot site(s) to undertake trials of the effective forest management complying with PMCP and LCoP, and determine the pilot site(s).
1-4	At the pilot site(s), test the technologies identified by the activity 1-2.
1-5	Identify effective way to disseminate PMCP and LCoP to the stakeholders, and provide necessary training for the PNGFA officers to conduct the dissemination.
1-6	Support PNGFA officers to disseminate PMCP and LCoP to timber company foresters.
1-7	Prepare programs and materials introducing outputs of the Project and help PNGFA to disseminate the outputs to the stakeholders in workshop(s).
【Output 2】 **Ability of stakeholders to effectively carry out natural regeneration practice is improved**	
2-1	Find out issues for managing natural regeneration after logging.
2-2	Identify key stakeholders, and examine implementation structure and technical improvement measures for solving the issues identified in Activity 2-1.
2-3	Conduct pilot-activities on natural regeneration by PNGFA officers and key stakeholders at the pilot site(s) determined in activities 1-3.
2-4	Develop the draft user manual in cooperation with the key stakeholders.
2-5	Finalize the user manual to disseminate natural regeneration techniques to PNGFA officers and key stakeholders.
【Output 3】 **Field carbon monitoring procedure for logging operation is developed**	
3-1	Review the effects of complying with PMCP and LCoP to low emission logging activities.
3-2	Identify indicators to assess low emission logging activities (e.g. Area for roads and log landings, damaged woods due to felling, etc).
3-3	Identify and develop methodology for monitoring, recording, reporting or reducing emission level from logging operations through trials and validations in the pilot site(s).
3-4	Develop training program and provide necessary trainings to adopt carbon monitoring for PNGFA field officers.
3-5	Compile proposals to promote the implementation of low emission logging.
3-6	Compile proposals for forest carbon monitoring and reducing emissions from logging operations on the basis of the activity 3-1 to the activity 3-5.
3-7	Organize Workshop to disseminate the results of project activities.
【Over all】	
Conferences, Reports	
1	Study for the Detailed Plan of Operation — The survey will be completed as early as possible to finalise the project design, even in the middle of the first phase.
2	JCC
3	Workshop / Training in Japan
4	Work Plan
5	Progress Report
6	Final Report / Project Completion Report
7	Monitoring sheet

Legend: Plan — Short-term experts (black), Long-term experts (grey), Cooperation with long-term experts (cream)
Actual — Short-term experts (red)

Short-term Expert Assignment

The short-term expert assignments are shown in Table 1.3-2.

Table 1.3-2 Short-term Expert Assignments

Name (Duty)	Grading	1st Number of trips	2nd Number of trips	Year Month / Period		Man Manth		
				(Gantt chart: 2022–2025, The 1st/2nd Contract Period)		1st	2nd	Total
Work in PNG								
Takahiro KOIDE (Team Leader/Forest Management 1)	2	3	7	31 21 23 16 16 15 14 11 26 11		2.50	3.63	6.13
Ayako OCHI (Duputy Team Leader/Forest Management 2)	2	0	2	13 11		0.00	0.80	0.80
Masamichi HARAGUCHI (Forest Carbon Monitoring 1)	3	0	3	14 9 6 1 7		0.00	1.23	1.23
Hirokazu TAKAHASHI (Forest Restoration/Forest Carbon Monitoring 2/Measurement 2)	3	3	5	21 17 35 23 34 16 30 25		2.43	4.26	6.69
Masayoshi MINEGISHI (Forest Information/Measurement 2)	4	3	7	31 28 30 19 26 8 23 29 20 25		2.97	5.00	7.97
Stephane SALIM Takaaki KATO (Training/Exit Strategies)	4	1	4	16 14 28 19 7 11		0.53	2.63	3.16
Total（PNG)						8.43	17.55	25.98
Work in Japan								
Takahiro KOIDE (Team Leader/Forest Management 1)	2			3 1 2 1 1 1 1 3.7		0.45	0.24	0.69
Ayako OCHI (Duputy Team Leader/Forest Management 2)	2			2 1 1 1 2 3 1 1 2 1 1 2 2 2 1 1 3 3 2 1 2 3 1 1 2 1 2 1 2.68		1.00	1.43	2.43
Masamichi HARAGUCHI (Forest Carbon Monitoring 1)	3			1 1 7.4		0.00	0.47	0.47
Hirokazu TAKAHASHI (Forest Restoration/Forest Carbon Monitoring 2/Measurement 2)	3			4.78		0.00	0.24	0.24
Masayoshi MINEGISHI (Forest Information/Measurement 2)	4			2 3		0.00	0.25	0.25
Stephane SALIM Takaaki KATO (Training/Exit Strategies)	4			2.8		0.14	0.00	0.14
Total (Japan)						1.59	2.63	4.22

Legend: ■ Actual (works in PNG)　　□ Actual (works in Japan)

	Total	10.02	20.18	30.20

Reports, etc.	Work Plan (JPN)	★ Work Plan1 (JPN)　　★ Work Plan2 (JPN)
	Work Plan・PR/R・F/R	★ Work Plan1 ★ PR/R1　PR/R2 ★　★ Work Plan2 ★ PR/R3　★ PR/R4　★ PR/R5　F/R F/R ★
	JCC	▲ JCC　▲ JCC　▲ JCC　▲ JCC　▲ JCC
	WS・Training in Japan	☆ Training in Japan　WS ☆　☆ WS

PR/R: Progres Report　　F/R: Final Report　　JCC: Joint Coordinate Committee　　WS: Workshop

Operating Costs

Operating costs are listed in Table 1.3-3.

Table 1.3-3 Operating Costs

	1st Contract Period		2nd Contract Period			Total
	FY2022	FY2023	FY2023	FY2024	FY2025	
Specialized local staff	848,020	0	1,459,859	3,219,600	60,574	5,588,053
Vehicles	3,053,393	-19,220	2,168,675	4,446,341	0	9,649,189
Seminars	186,178	0	640,529	2,913,638	0	3,740,345
Office	0	0	0	0	0	0
Travel and transport	673,893	0	1,066,276	1,017,781	0	2,757,950
Equipment and facilities	0	0	0	0	0	0
Documentation	0	0	0	0	0	0
Miscellaneous	1,061,513	66,355	374,540	1,977,281	0	3,479,689
Total	5,822,997	47,135	5,709,879	13,574,641	60,574	25,215,226

Equipment Provided

A list of the equipment and goods provided is given in Table 1.3-4.

Table 1.3-4 List of Equipment Provided

JFY	Item	Specification, Model	Quantity	Purchase Price	Currency	In Juapanese Yen	Date of Purchase	Location	Current State
2022	Printer/ Scanner	HP Color LJ Pro M283FDN MFP	1	1,899.00	PGK	70,726	2022/5/11	PNGFA	Being used
2022	UPS (for PC, etc.)	Eaton 5S 1.6KVA 1000W G349N45391	1	1,019	PGK	40,415	2023/3/16	PNGFA	Being used
2022	Workstation for PNG-FRIMS	DESKTOP LENOVO TCENTRE M70sSSF	1	4,928	PGK	195,453	2023/3/22	PNGFA	Being used
2023	Drone Drone batteries Drone airframe warranty (for 2 years)	①DJI Mavic 3 Enterprise（DJI Care Enterprise Plus） ②DJI Mavic 3 Enterprise Series PART 01-RTK Module ③DJI Mavic 3 Enterprise Series PART 05-Battery Kit ④DJI D-RTK 2 High Precision GNSS Mobile Station ⑤DJI D-RTK 2 BASE STATION TRIPOD ⑥HELICAM D-RTK2 fixed station dedicated soft case	1	1,342,000	JPY	1,342,000	2023/4/20	PNGFA	Being used
2023	Workstation for drone image analysis	HP Z1 Tower G9 i9 32GB 1TB SSD 2TB HDD 12GNV-RTX3060 6E2J9PA	1	15,413.20	PGK	639,089	2023/10/16	PNGFA	Being used
2023	Laser ranger	LASER RANGFINDER TRUPULSE 200L LSE – AU (1750m)	3	10,350	PGK	425,184	2023/11/28	PNGFA	Being used
2023	GPS terminal	GPSMap 65s Preloaded Worldwide B Multi-Band GPS Handheld	3	4,382	PGK	180,015	2023/11/29	PNGFA	Being used
2023	Workstation for drone image analysis (pilot site)	HP Z2 SFF G9i7 16GB 512GDSSD 1TB HDD T400-4G WiFi 2xmDP W11P 3y	1	10390	PGK	423,968	2024/3/15	Provincial office (Central)	Being used
2023	Monitor (pilot site)	Philips Evnia 27" QHD Curved 16:9 1ms HDMI DP Tilt 3yr	1	1580	PGK	64,473	2024/3/15	Provincial office (Central)	Being used
2023	Laptop PC	Lenovo IdeaPad Slim 3 14" i5 8GB 512GB W11H Grey 1Yr	3	3242	PGK	396,873	2024/3/15	PNGFA	Being used
2024	Workstation for drone image analysis (pilot site)	HP Z2 SFF G9i7 16GB 512GDSSD 1TB HDD T400-4G WiFi 2xmDP W11P 3y	2	18,580	PGK	702,142	2024/9/9	PNGFA	Being used
2024	Monitor (pilot site)	HP OMEN 32C 31.5" QHD 2560×1440 Curved 1ms HDMI DP 3Yr	2	4,692	PGK	177,312	2024/9/9	PNGFA	Being used
2024	UPS	700VA/390W Brick 10A LCD CyberPower	2	1,757	PGK	66,411	2024/9/9	PNGFA	Being used
2024	Tablet devices	Samsung tab A9	3	2,097	PGK	79,246	2024/9/16	PNGFA	Being used
2024	UPS	UPS 650VA/350W Brick 3x GPO Line Interactive	1	473	PGK	17,387	2024/10/28	PNGFA	Being used
2024	Micro SD card	MICRO SDXC CARD EXTREME PRO DU 512GB 4KUHD 200MB/s/R-140MB/sW	3	2,025	PGK	74,415	2024/10/28	PNGFA	Being used
2024	Micro SD card reader	ADAPTER HUB 5IN1 CH255 M/PORT USB-C/USB-C/MSD READER	3	180	PGK	6,615	2024/10/28	PNGFA	Being used
2024	Drone Drone batteries Drone airframe warranty (for 2 years)	①DJI Mavic 3 Enterprise（DJI Care Enterprise Plus） ②DJI Mavic 3 Enterprise Series PART 05-Battery Kit	2	63,637	PGK	2,338,526	2024/10/28	PNGFA	Being used
2024	Landing pad (air photo signal)	Landing Pad for Drones 110mm	3	535	PGK	19,644	2024/10/28	PNGFA	Being used
2024	Image analysis software	WebODM * Substituted by open source software	3	0	PGK	0	-	PNGFA	Being used

Local Sub-contracting

Local sub-contracting was utilized for tasks related to the survey on the status of logging activities and forest management of natural forests in PNG. The aim of this survey was to gather site-level information necessary for the implementation of the Project, such as the state of affairs with regard to recognition by the Government of PNG and logging companies of the PMCP and LCoP and the

implementation thereof, as well as the current status of forest management of natural forests by logging companies and landowners. The Terms of Reference (TOR) and a survey report for sub-contracting is shown in Annexure 34.

Subcontract name: Survey on the Status of Logging Activities and Forest Management of Natural Forests in Papua New Guinea

Subcontractor name: Rhills PNG Limited

Contract period: From October 7, 2022 to February 28, 2023

Amount of contract: 31,044.00 USD (4,306,423 yen (1,345,841 yen: October 2022 JICA rate + 2,960,582 yen: March 2023 JICA rate)

This survey clarified the state of and implementation capacity for LCoP compliance of PNGFA officers, logging companies, landowners, and other stakeholders, as well as that of post-logging natural regeneration. The information collected in this survey was utilized in the Detailed Design Survey of the Project.

1.4   Project Operations

Joint Coordinating Committee

In the Project, a total of five Joint Coordinating Committee (JCC) meetings were held together with the long-term experts. During these meetings, the Project's achievements, progress, and challenges were explained to and discussed with the PNG side, obtaining approval for the future work plan. Table 1.4-1 provides an overview of the JCC meetings. The agenda, presentation materials, and minutes of the JCC meetings are provided in Annexure 35.

Table 1.4-1 Dates and Agenda of JCC Meetings

	Date	Items on the Agenda
1st	May 31, 2022	- Explanation of the Project's background and objectives - Approval of the annual work plan - Policy decision on pilot site selection
2nd	October 25, 2022	- Confirmation of Project progress and achievements - Report on the results of pilot site selection and Detailed Design Survey (e.g. training, issues hindering Project implementation and policies to resolve them, recovery of PNG-FRIMS, etc.) - Approval of the revised PDM and Plan of Operations (PO)
3rd	March 16, 2023	- Report on the progress of Project activities in the first year - Approval of the second-year work plan (including counterpart training in Japan and dissemination activities for the PMCP and LCoP)
4th	April 29, 2024	- Review of the progress and achievements of Project activities in the second year - Approval of the work plan for the final year

		-	Establishment of a cooperative framework with other development partners (European Union (EU), U.S. Agency for International Development (USAID))
5th	March 26, 2025	- -	Report on Project outputs and achievement status of goals Recommendations on future implementation policies for each output

Detailed Design Survey Phase and Full Operation Phase

Due to the travel restrictions caused by the COVID-19 pandemic, the initial plan was for the Project to be carried out in two phases: the Detailed Design Survey Phase (Phase 1) and the Full Operation Phase (Phase 2). The original plan allocated one year for the Detailed Design Survey Phase, followed by two years for the Full Operation Phase, but in practice the Detailed Design Survey was completed within the first six months. At the 2nd JCC Meeting on October 25, 2022, the design was approved, allowing for an earlier transition to the Full Operation Phase than initially scheduled.

Originally, the Project was expected to be structured with separate contracts for Phase 1 (one year) and Phase 2 (two years), in alignment with the planned duration of each phase. However, since the transition to Phase 2 occurred within six months, a contract modification was made during Phase 1. This was necessary to address a virus infection detected in the server storing PNG-FRIMS data, as well as to procure essential equipment for Project activities.

Recovery of PNG-FRIMS

The server storing PNG-FRIMS was attacked by a computer virus at the start of the Project. The C/P was contacted before the first dispatch to PNG to gather information, from which it was learned that the network-attached storage (NAS) set up for data backup had also been infected and that it was thought that recovery of PNG-FRIMS and the database would be quite difficult.

During the first dispatch, two points were identified from the results of a survey of the current state of PNG-FRIMS: (1) that the hardware parts were damaged (presumably due to the parts being old); and (2) that decrypting encrypted data is difficult at present. In addition, during discussions with the Information & Communication Technology (ICT) Branch of the PNGFA, it was also understood that (3) the aim is to install a new server (Windows Server 2019) at the PNGFA in the near future. Based on these three points, rebuilding PNG-FRIMS on the newly-installed server was considered the most efficient and fastest way to restart PNG-FRIMS. Accordingly, discussions were held with the C/P and the ICT Branch and agreement obtained. Furthermore, opinions were exchanged with the C/P and ICT Branch about system security strategies, with agreement being reached on the need for continual information literacy training for PNGFA officers.

Based on the results of these surveys and consultations, the virus-infected NAS was reconfigured, and the data developed in the previous technical cooperation projects and owned by the short-term expert team was organized and copied over. In addition, in view of installing a new server at the

PNGFA, the compatibility of the software used for PNG-FRIMS (SQL Server and ArcGIS Server) was researched, confirming that the operation guarantee did not cover all of the software and that there would be no additional costs involved in updating each piece of software.

In continued discussions with the C/P and ICT Branch officers, the ICT Branch expressed the opinion that Windows 7 (PNG-FRIMS Workstation), which is no longer supported, could not be connected to the server newly installed by the PNGFA. The next best solution, therefore, was to carry out the temporary restoration of PNG-FRIMS in the local environment. One concern raised during the restoration work was that in its early stages the main Workstation, which manages the ArcGIS license, was found to be experiencing a system freeze. It was conjectured that the age of both the Workstation and the uninterruptible power supply (UPS) caused the system freeze.

Further discussions were held and two conditions for migrating PNG-FRIMS to the new server were identified: (1) upgrading the Workstation OS (Windows 10 or higher) and (2) installing a UPS to protect the Workstations. Therefore, UPSs and Workstations equipped with Windows 10 or higher were procured, and working together with the ICT Branch officers PNG-FRIMS was migrated to the new server, with the operation of PNG-FRIMS checked with each software update.

At the same time, a web test (e-learning) using Google Forms was conducted with ICT Branch officers as a security risk measure against computer virus infections caused by human error. An overview of the information literacy web test is given in Annexure 19.

Counterpart Training in Japan

Under the lead of the long-term expert team, a training was held in Japan for five trainees over 15 days from May 24 to June 7, 2023. An overview of the training is given in Table 1.4-2. The short-term expert team worked with the long-term expert team to conduct training sessions for the action plan kick-off on May 25, practical drone skills on May 26, drone analysis on May 29, and action plan compilation on June 5. The trainees gave a report on the content of the training, including the action plan developed during the training, at the mid-term Project workshop. Training course materials, for which the short-term expert team was responsible, and the report on the results of the training are attached in Annexure 36.

Table 1.4-2 Training Schedule in Japan

Date	Format	Content	Venue
May 24 (Wed)		Arrival in Japan	
May 25 (Thu)	Discussion	Briefing Orientation **Discussion to prepare action plan for the Project**	JICA Tsukuba
May 26 (Fri)	Practice	**Basic drone knowledge** **Drone operation**	Yoshiwara Koryu Center
May 27 (Sat)		Off	
May 28 (Sun)		Off	
May 29 (Mon)	Lecture	**Actual drone usage in Japan's forests and forestry sector**	Kokusai Kogyo Co., Ltd

	Practice Discussion Lecture	**Data processing of drone image of PNG logging site** **Discussion of the action plan for drone use in logging operations in PNG** **Regulations related to drone usage in PNG**	
May 30 (Tue)	Lecture Lecture Lecture	Overview of Japan's forests and forestry Forest management projects in Japan National forest management in Japan	Forestry Agency, Ministry of Agriculture, Forestry and Fisheries (MAFF)
May 31 (Wed)	Lecture Field visit	Outline of Kiso District Forest Office Timber production and its supervision and inspection History of Goryokan and Kiso forestry	Kiso District Forest Office Goryokan
June 1 (Thu)	Field visit	Field visit: production, natural regeneration, forest maintenance, timber collection with helicopters, forest roads, and log landings	Kiso District Forest Office
June 2 (Fri)	Lecture Field visit	Outline of Kiso Forest Association Field visit to logging operation in a private forest Forest use for recreation purposes in Japan	Kiso Forest Association
June 3 (Sat)	Field visit	Wood culture and wood construction in Japan	
June 4 (Sun)		Off	
June 5 (Mon)	Discussion Presentation	**Compilation of ideas for utilizing training results in Project activities** **Presentation on how to utilize training results in Project activities**	JICA Tsukuba
June 6 (Tue)		Departure from Japan	

Outputs of the Project

The technical cooperation deliverables from the Project are shown in Table 1.4-3.

Table 1.4-3 Technical Cooperation Deliverables

Outputs	Annexure No.	Relevant Indicators in PDM
Dissemination Plan for the LCoP and PMCP	Annexure 1	Indicator 1.3, 1.4, 1.6
Future Implementation Policy for Natural Regeneration	Annexure 2	Indicator 1.1
Future Implementation Policy for Forest Carbon Monitoring	Annexure 3	Indicator 1.8

The appendices of the "Dissemination Plan for the LCoP and PMCP" contain the following materials.

・ Mobile Offline Map User Manual

・ PMCP Check app User Manual

・ LAN Map2 Manual

・ Training on Customized Deforestation Alerts and Monitoring System (DAMS) as Logging Code/Carbon Monitoring System (LCMS)

・ UAV ortho-mosaic image generation procedure manual

- ・　Posting GIS data to PNGFA
- ・　Introduction to QGIS
- ・　Specification for the Exchange of Digital data
- ・　Application of advanced technologies to create a setup plan

Dissemination of Outputs and Public Relations

With the aim of disseminating its activities to Project stakeholders and to people inside and outside of PNG, the Project used the following public relations and social media tools (Facebook and YouTube). In addition, newsletters and factsheets introducing the activities (Mobile Device Tools for Forest Monitoring, Assisted Natural Regeneration After Logging, Training for the PMCP/LCoP) were prepared as materials, posted on Facebook, and distributed at workshops.

- Project News on the JICA technical cooperation project website (https://www.jica.go.jp/oda/project/201904492/index.html)
- Project page on the official PNGFA website (https://www.pngfa.gov.pg/index.php/projects/aid-projects/36-projects/101-jica)[1]
- Project Facebook page (https://www.facebook.com/pngfacdrelog/)
- Project YouTube channel (https://www.youtube.com/@CDRE-LOG)
- Newsletters (introduction of activities by year)
- Factsheets (Overview of the Project, Mobile Device Tools for Forest Monitoring, Assisted Natural Regeneration After Logging, PMCP/LCoP Training)
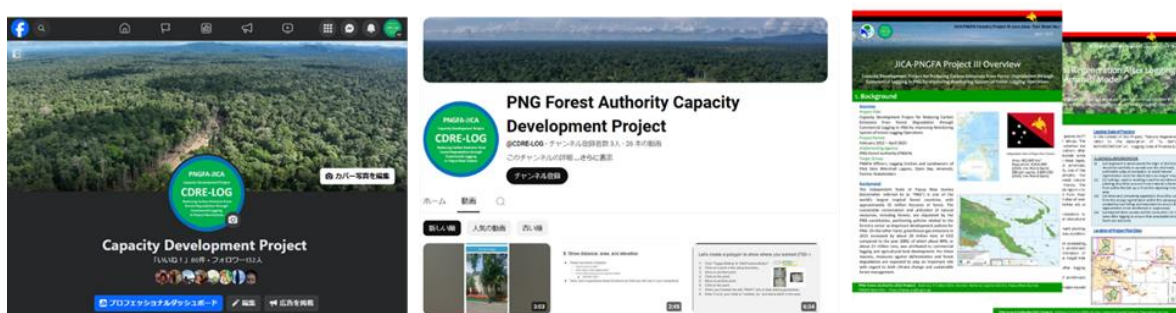
Figure 1.4-1 Public Relations Tools for Project Activities

The newsletters and factsheets that have been produced are included in Annexure 4.

Information Sharing and Collaboration with Other Donors and Relevant Organizations

Discussions were held with the JICA Global Environment Department, JICA PNG Office, the long-term expert team, and PNGFA on the direction of support to the PNGFA, with a view to developing synergy with the European Union-funded Forestry-Climate Change-Biodiversity (EU-FCCB) Programme for Papua New Guinea (the national component of which is "Support to Papua New Guinea at the national/institutional level with spillovers at the local/community level"), scheduled to

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[1] The official PNGFA website is currently suspended as of May 2025 due to site renewal.

be implemented for four years beginning in July 2023, and an Asian Development Bank (ADB) project (Supporting Sustainable Forest Development in Papua New Guinea).

In addition, discussions were held with Expertise France (EF), one of the implementing agencies responsible for the national component of the EU-FCCB Programme, and the PNGFA regarding activities in the PNGFA under the EU-FCCB Programme. These include: (1) updating the content of PNG-FRIMS (e.g. preparation of forest cover maps in accordance with the new Verra methodology) and designing system upgrades (e.g. cloud computing and Decision Support System (DSS) linkages); (2) measuring carbon emissions from logging operations; and (3) PMCP/LCoP training for logging companies. The project manager of the EU-FCCB Programme also participated in the 4th JCC Meeting on April 29, 2024, where agreement was reached on a proposal to develop these activities in a coordinated manner.

Chapter 2. Achievements of the Project Activities

2.1 Activities for Output 1

Activity 1-1: Challenges are identified through reviewing actual use of PMCP and LCoP, as well as information flow of logging activities.

The items described in the LCoP take the form of monitoring items in the PMCP, with the methodology intended to put the 24 Key Standards in the PMCP into practice (see Annexure 20). In order to initiate activities related to Output 1, a field survey and information flow research were conducted to identify issues for the implementation of the current PMCP and LCoP.

（1） Identification of issues through field survey (forest conditions in logging sites)

A field condition survey was conducted at a concession site in Central Province (Marshall Lagoon Forest Management Area (FMA)) from June 1-2, 2022. Although each logging concession site is thought to have a variety of issues related to LCoP compliance, the following are examples of target issues for improvement.

Figure 2.1-1 Log Landing (Marshall Lagoon FMA June 2022) (Right: Drainage Channel)

In the central log landing shown in Figure 2.1-1, water is rising along the road. This situation indicates that logging might have been carried out beyond the area stipulated in the LCoP for the construction of the log landing. This situation needs to be improved. In addition, when water is allowed to flow onto logging roads and into other logging areas, more extensive logging is required to dry out the soil. Whether this type of logging can be avoided is an issue that needs to be addressed.

Figure 2.1-2 Logging Road and Shoulder of the Road after Logging Is Finished

In general, logging roads are cut widely along the sides of the road, and after logging the recovery of vegetation is often disturbed by the overgrowth of vines and weeds. In fact, a logging road that was visited was actually covered by vines after logging had been completed (Figure 2.1-2). In addition, a road shoulder that had collapsed in the valley was observed in this area.

Figure 2.1-3 Example of Logging Road Installation (Amanab 1-4 May 2019)

Figure 2.1-3 shows an example of a logging road that extends into the river. The buffer zone is not properly set up and driftwood can be seen in the river. In other cases, logged trees are left abandoned if buyers are not available.

（2） Identification of issues in the actual use of the PMCP and LCoP and information flow

As a long-term expert-led activity, interviews and site visits were conducted with PNGFA officers regarding the actual status of PMCP and LCoP use. Issues related to current PMCP and LCoP practices were identified and compiled into the Activity 1-1 Report (Annexure 21). The following information is taken from that report.

The procedures for natural deforestation as stipulated in the PMCP/LCoP are as follows.

① The PMCP/LCoP procedure starts with a logging company submitting a Five-Year Plan to the Managing Director (MD) of the PNGFA. This is received, reviewed and approved by PNGFA headquarters.

② After the Five-Year Plan has been approved, the logging company prepares an annual plan and submits it to PNGFA headquarters for substantial review by the district office.

③ After approval of the annual plan, the logging company submits a setup plan with a maximum area of 150 ha to the project supervisor. Each forestry concessionaire is stationed under the project supervisor, who evaluates each setup plan and approves it if deemed appropriate. After approval, the logging company is allowed to start road construction and logging operations.
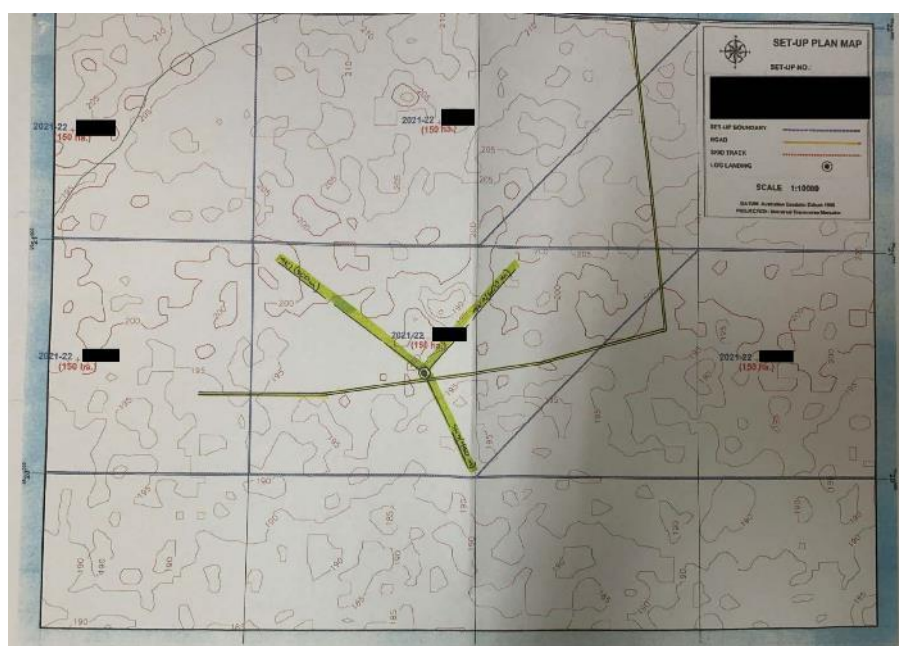
Figure 2.1-4 Example of a Setup Plan

④ The logging company reports completion of the logging project to the project supervisor, who checks the logging concession areas and documents to complete the project in about one week.

PNGFA project supervisors are required to conduct three on-site inspections (pre-operation, during the operation, and post-operation completion) for each setup plan when conducting monitoring as stipulated in the PMCP. This means that supervisors manage a vast logging concession area of up to

150 ha per setup, which is estimated to be 60 projects (9,000 ha) per year. Moreover, the supervisors have to provide technical advice to project companies and perform a vast number of other tasks. With multiple logging companies operating at the same time, this means that the workload is huge.

Furthermore, logging companies submit paper-based documents and the PNGFA is unable to proactively manage aspects related to project maps, tending to rely on logging companies to confirm project plans. In many cases, therefore, field monitoring is conducted while carrying paper-based maps and documents — one reason monitoring is difficult to conduct for supervisors. Other points targeting efficient and effective monitoring were raised by several stakeholders at the kick-off meeting, JCC meetings, and in interviews. These included the opinion that monitoring could be improved by requiring logging companies and other stakeholders to submit the information necessary for monitoring to the PNGFA. The situation is such that there is a need, from the aspect of quality maintenance, for the efficient and effective implementation of monitoring operations for these huge logging concession sites.

（**3**）Identify issues related to natural regeneration following the revision of the LCoP

With the revision of the LCoP in 2020, new provisions regarding natural regeneration have been added to it, but the details of the new provisions have not been clearly defined. Advanced efforts have been made in areas such as Amanab to establish nurseries, produce seedlings, and implement enrichment plantings. However, records have not been kept nor monitoring conducted in a sufficient manner on the implementation of operations, and individual documents and data on the status of natural regeneration after logging have not been collected or stored. Managing such activities for each setup — which is the smallest unit from the logging plan — is thought to be efficient. Further, it is also thought necessary to link location information as GIS data, use mobile devices in the field to check maps, and establish a system to record monitoring results in relation to the data of the setup plan. Finally, yet another issue is how to expand advanced precedents in PNG being implemented in Amanab and by other companies to the whole of PNG.

Activity 1-2: Based on the review of the information organized in Activity 1-1, examine and identify ways to strengthen Papua New Guinea-Forest Resource Information Management System (PNG-FRIMS) and utilize new technologies related to GIS and remote sensing to effectively promote sustainable forest management complying with PMCP and LCoP

（**4**）Examine and identify issues related to enhancement of PNG-FRIMS

　1）Interviews with PNGFA officers regarding issues in field monitoring using the PMCP

PNGFA officers were interviewed about issues in field monitoring when using the PMCP, with two issues being identified: (1) paper-based maps and PMCP checklists are brought to field monitoring, but paper-based maps are complicated to manage; and (2) with paper-based maps, time is required to understand one's current location.

In order to solve these two issues, consideration was given to creating a system that enables the PMCP to be checked in an offline environment using mobile devices (the PMCP Check app), as well as allowing PNG-FRIMS data (plans) to be viewed in an offline environment using mobile devices (Mobile Offline Map). A trial was conducted at a pilot site.
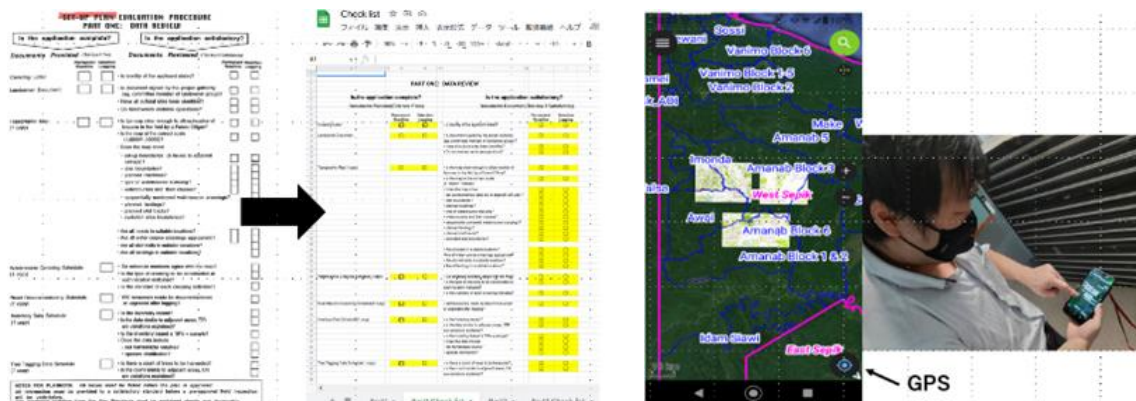
Figure 2.1-5 Conceptual Image of Mobile Device Utilization

2）Interviews about requests for redevelopment of LAN Map

The web map for the intranet (called LAN Map, which allows PNGFA officers to view forest cover maps and other information on the web even if GIS is not available), which was developed in the previous technical cooperation projects mentioned above, would no longer be available after the end of December 2020 due to support ending for Adobe Flash Player. In order to redesign LAN Map, to begin with interviews were held with relevant officers regarding LAN Map (see Annexure 22). As a result of these interviews, to efficiently promote forest management in compliance with the PMCP and LCoP, the need to develop a new LAN Map (LAN Map2) using topographic data (such as rivers and contour lines) stored in PNG-FRIMS was identified.

After these interviews, PNGFA officers provided feedback at workshops and other events on the LAN Map2 prototype that had been developed in advance. Reflecting this feedback, LAN Map2 was finalized. In addition, from the perspective of LAN Map2 sustainability, training was provided for Mapping Branch officers on how to update LAN Map2 data (Annexure 1 - Appendix 3).

Figure 2.1-6 PNGFA Officer Using LAN Map2

（**5**） Examination and identification of methods for utilizing new technologies related to GIS and Remote Sensing.

In logged forests, commercial target tree species do not regenerate as they were before being logged. In order to improve forest conditions after logging, enrichment planting or other silvicultural treatments such as timber stand improvement (TSI) are required and on-site monitoring activities are essential. On the other hand, interviews revealed that PNGFA officers are faced with an overwhelming amount of work, including on-site surveys for setup plans and technical support for logging companies, and they do not have time to conduct on-site monitoring in addition to their regular duties. In order to resolve this issue, a pilot site was set up to examine and test the possibility of using satellites and drones to monitor the site.

（**6**） Presentation and trial implementation of LCoP and PMCP monitoring techniques

Based on the results of the interviews mentioned in (1) and (2) above, information flow in the Project was summarized in line with the implementation of the PMCP and LCoP. A proposal was made with regard to the scope of what was to be covered by the methodology developed in the Project related to Output 1 (Annexure 23). This was confirmed with PNGFA officers on November 14, 2023, and agreed to by the parties.
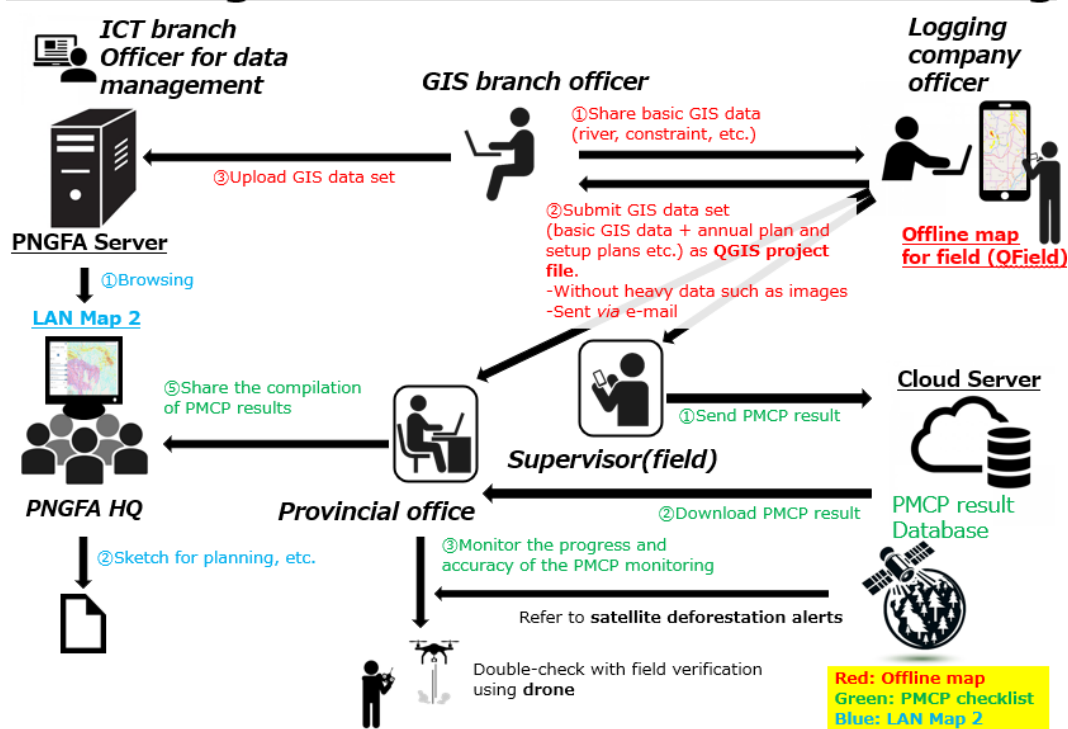
Figure 2.1-7 Proposed Scope of Methodology to Be Developed for in the Project Related to Output 1

Activity 1-3: Set criteria for selecting pilot site(s) to undertake trials of the effective forest management complying with PMCP and LCoP, and determine the pilot site(s).

The criteria for selecting the pilot sites were determined in consultation with the PNGFA in cooperation with the long-term experts. Five candidate pilot sites were selected from forestry concessions under the jurisdiction of PNGFA regional offices in different provinces, taking into account the regional characteristics of PNG and the status of project implementation. The pilot sites were selected after conducting information gathering surveys and field studies. The selection criteria used in the selection process were as follows:

- Access: the project site should be easily accessible by plane, boat, road, etc;
- Project type/status: the site should be an existing active forestry concession (FMA);
- Cooperation of logging companies: whether the logging companies (the permit holders) are willing to participate and adapt to work to be carried out by the Project;
- Landowner agreement: the willingness of landowners to give initial consent for the implementation of the Project and to adapt to the implementation of the Project;
- Technology: the technical capacity of the logging companies to utilize GIS, GPS, etc;
- Labor: labor is to be provided by local residents, and training should be provided as needed.

After consultation with the C/P and long-term experts, a total of three pilot sites were selected in the 2nd JCC Meeting: Kupiano District, Central Province (Marshall Lagoon); Amanab District, West Sepik Province (Amanab 1-4); and Open Bay District, East New Britain Province (Open Bay).

Table 2.1-1 Pilot Site Candidates, Selection Criteria and Evaluation Summary

Name	Marshall Lagoon	Amanab 5&6	Amanab 1-4	Open Bay Timber	Rottock Bay Consolidated
Province name	Central	West Sepik	West Sepik	East New Britain	West New Britain
Access	Good (Car)	Fair (Plane + car)	Fair (Plane + car)	Fair (Plane + boat)	Fair (Plane + boat)
Project type	FMA	FMA	FMA	Plantation + natural forest area	FMA
Logging company technology	Fair (GIS)	Good (GIS, GPS)	Good (GIS, GPS)	Good (GIS, GPS, drone)	Unknown
Landowner cooperation	Good	Good	Good	State land	Good
Local labor	Unknown	Good	Good	Good	Unknown
Remarks	Easily accessible from Port Moresby	Adjacent to Amanab 1-4	Advanced in natural regeneration assistance activities	Logging companies are cooperative in natural regeneration and carbon monitoring	Logging companies were difficult to contact
Selection result	Selected	-	Selected	Selected	-

The logging companies operating in the Amanab area (Amanab 1-4 & Imonda, Consolidated FMA) are regarded as good operators in terms of LCoP practices and, moreover, they are engaged in advanced efforts such as using GIS and mobile devices. In addition, a seedling nursery field for the major tree species Kwila was established within the concession as a Natural Forest Management (NFM) activity, and enrichment planting was conducted by the logging company and the PNGFA.

The Kupiano District (Marshall Lagoon & UNU Amau Consolidated FMA) is located within easy driving distance of Port Moresby and is characterized by accessibility. Although planting is planned as part of the NFM five-year plan in this area, it has not yet been implemented. It is expected to be developed by analyzing issues in developing the methodology established in the Amanab area.

The Open Bay area (Open Bay timber rights purchases (TRPs) and timber authorities (TAs)) is a concession operated by Open Bay Timber Ltd. (OBT), a Japanese company. Kamarere *(Eucalyptus deglupta*) plantations are its primary undertaking in the area, but it is planning natural forest activities on unused land, including plans for selective logging and enrichment planting. The Project aims to implement advanced practices such as individual tree management and achieve best practices in PNG.
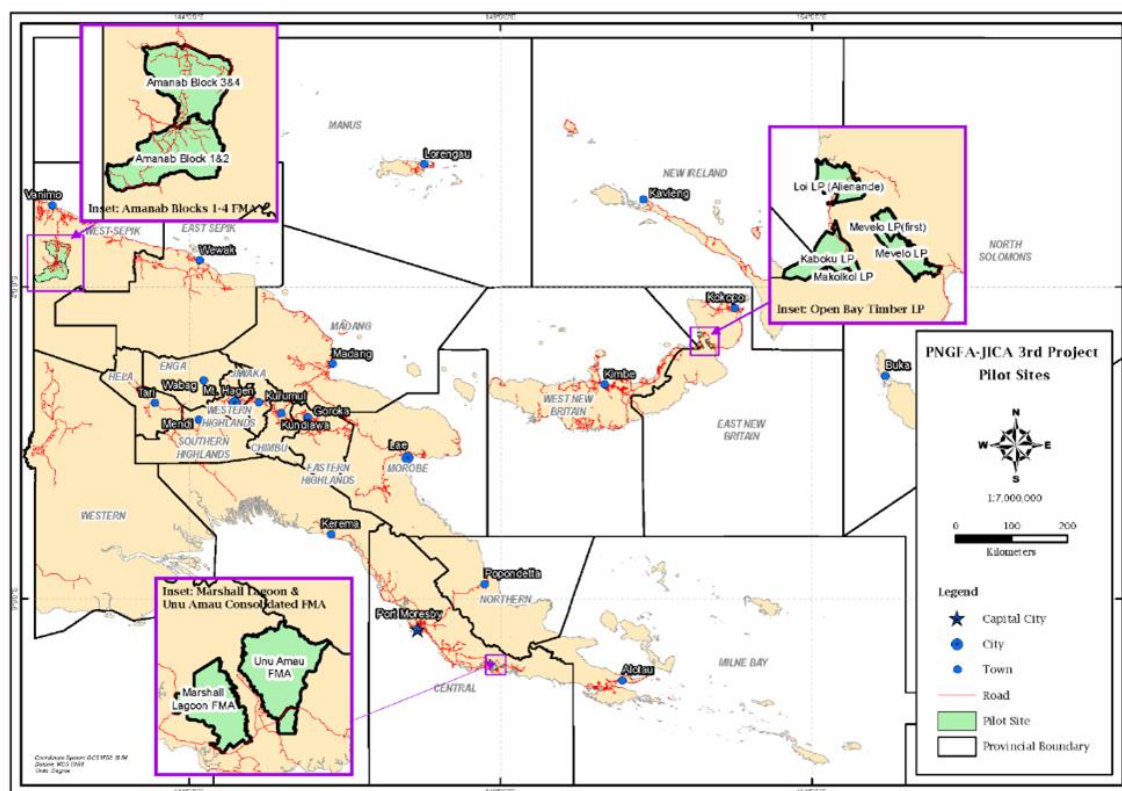
Figure 2.1-8 Pilot Site Location Map (Forestry Concession)

Following determination of the pilot sites, the tree species targeted by the Project were determined at the 3rd JCC Meeting as per Table 2.1-2, based on inventory information and field survey results. The production method for seedlings of Mersawa (*Anisoptera thurifera*) and Kwila (*Intsia bijuga*) is summarized in Annexure 24.

Table 2.1-2 Target Species

Pilot Site 1: Marshal Lagoon & UNU Amau Consolidated FMA in Central Province	Remark
Taun (*Pometia pinnata*) * Hopea Heavy (*Hopea iriana / Hopea. Glabrifolia*) PNG Walnut (*Dracontomelon dao*) Rosewood (*Pterocarpus indicus*) * Mersawa (*Anisoptera thurifera*)	*Overlapping with pilot site 3
Pilot Site 2: Amanab Block 1-4 & Imonda Consolidated FMA in West Sepik Province	Remark
Kwila (*Intsia bijuga*)	
Pilot Site 3: Open Bay in East New Britain Province	Remark

Taun (*Pometia pinnata*) * Kalophilum (*Calophyllum euryphyllum*) Rosewood (*Pterocarpus indicus*) * Malus (*Homalium foetidum*) Kamarere (*Eucaluptus degulpta*)	*Overlapping with pilot site 1

Activity 1-4: At the pilot site(s), test the technologies identified by the Activity 1-2.

（**7**） Mobile Offline Map trial

In Kupiano, Central Province, one of the pilot sites, a trial of Mobile Offline Map was conducted using mobile devices with the project supervisor and Kupiano logging company personnel based on the manual (Annexure 1 - Appendix 1) prepared. The procedures followed in the trial are shown in Table 2.1-3. Both participants commented on the usefulness of Mobile Offline Map in the field, indicating that "the ability to view the annual logging plan on a mobile device, which is usually viewed on paper, and to visualize one's location on the annual logging plan will improve field work and field survey operations."

Table 2.1-3 Mobile Offline Map Trial Procedure

Procedure	Description	Trial Participants
1	Copy Mobile Offline Map data (GIS data) to the mobile device before leaving for the site.	Project supervisor Logging company representative
2	View Mobile Offline Map at the site and check location (GPS) information on the annual logging plan.	Project supervisor Logging company representative
3	Acquire GPS data such as skid track using Mobile Offline Map	Project supervisor Logging company representative

Mobile Offline Map screen	Logging company representative testing Mobile Offline Map

Figure 2.1-9 Mobile Offline Map Trial

On the other hand, trials conducted on the GPS performance of Mobile Offline Map highlighted some issues. Specifically, the acquisition of GPS data for forest road data was tested. Figure 2.1-10 shows

an image obtained by overlaying forest road GPS data acquired on Mobile Offline Map, using as a background map the annual logging plan submitted by the logging company to the PNGFA.

For comparison, a satellite image overlaid with the acquired forest road GPS data is also displayed. As a result it was found that although the forest roads visible in satellite images and the acquired forest road GPS data generally overlapped, there was a large gap (approximately 500 m) between the annual logging plan submitted by the logging company to the PNGFA and the location information in the acquired forest road GPS data.

Satellite image and acquired forest road GPS data	Annual logging plan and acquired forest road GPS data
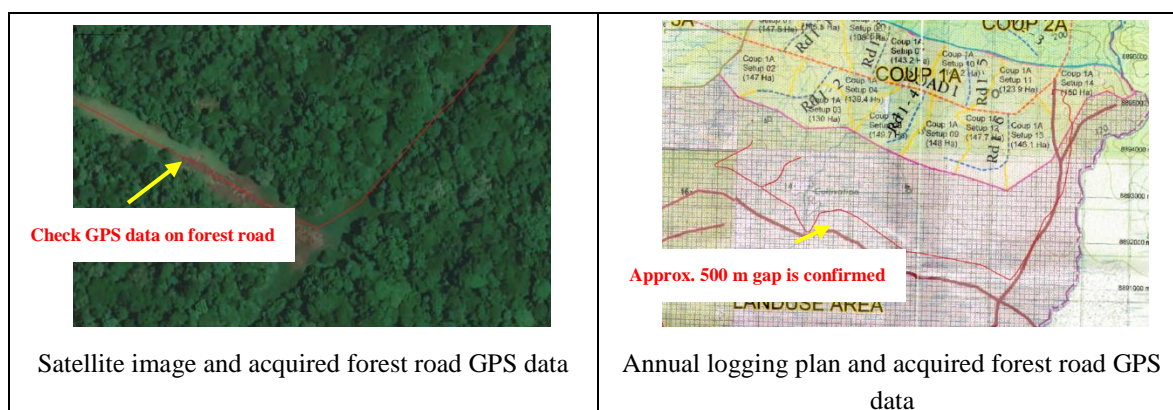
Figure 2.1-10 Location Gaps in Annual Logging Plan

Since the location information in the satellite images and the forest road GPS data were generally consistent, it was concluded that there were no errors in the forest road GPS data. It was hypothesized that the location information gap was caused during the process of preparing the annual logging plan submitted by the logging company to the PNGFA. As a result of interviews with the logging company, it was found that the coordinate reference system for PNG topographic map data (such as rivers and contour lines) was not set properly, resulting in the misalignment of all location information, including the forest road data that was created. This misalignment occurred not only at the Kupiano logging company, but also in annual logging plans submitted by logging companies at other pilot sites. This indicates that many of the logging companies may be using topographic map data with incorrect coordinate systems.

（8）Draft documents related to electronic data and data sharing methods

Since it is necessary for electronic data to be shared between the PNGFA and logging companies as part of the implementation of Mobile Offline Map, proposed in the Project, the specifications and sharing method were discussed with the Mapping Branch officers at PNGFA headquarters, and draft specifications were prepared. The Mapping Branch officers explained the specifications to participants in the mid-term Project workshop and the training for the dissemination of the PMCP and LCoP to logging companies' staff.

Explaining draft specs at the mid-term Project workshop	Explaining draft specs at the logging company training

Figure 2.1-11 Explanation of Draft Specifications by Mapping Branch Officers

（9） PMCP Check app trial

At one of the pilot sites, Kupiano in Central Province, a PMCP Check app trial using mobile devices was conducted with the project supervisor and officers from the Central Province office based on the manuals prepared (Annexure 5 and Annexure 1 - Appendix 2). The procedures tested are shown in Table 2.1-4. Both participants greatly appreciated the fact that the results of the field survey, which used to be managed in a paper-based system and were complicated, were automatically compiled into a database and could be shared. Additionally, since both entered or unentered data could be checked on a list, it was seen as useful for state forest office officers to check how well monitoring of the setup was progressing. All told, the field survey results obtained using the PMCP Check app received high evaluations from the trial participants..

Table 2.1-4 PMCP Check App Trial Procedure

Procedure	Description	Trial Participants
1	Check the PMCP using the PMCP Check app in an offline environment and save the results of the check on the mobile device application.	Project supervisor
2	Upload the PMCP check results saved in step 1 to the cloud server after returning from the site to the Kupiano center where the network environment is available	Project supervisor
3	Check the database on the cloud server to confirm that the PMCP check results are reflected in the database	Project supervisor Officers from the Central Province office
4	Check setup progress using the PMCP check results in the database on the cloud server or mapped on a map	Officers from the Central Province office

| PMCP Check app screen | Project supervisor's PMCP Check app trial |

Figure 2.1-12 PMCP Check App Trial

（**10**）Monitoring of the area to be selectively logged by drone on a trial basis

At Open Bay, one of the pilot sites, a drone was used to conduct a general survey of the area where selective logging was to be conducted. Drone photography was conducted to create a synthesis of orthoimages, and various types of information owned by OBT were collected. Based on the field survey, Open Bay used the Digital Surface Model (DSM) created by the drone and the Digital Terrain Model (DTM) owned by a local logging company as an advanced analytical model to contribute to the planning of selective logging operations and conducted a simplified forest canopy and tree top analysis (DCHM: Digital Canopy Height Model). The data was provided to OBT for reference. In preparation for the implementation of activities at the Open Bay site, a progress report was given and discussions about the prospects of future activity were held with Sumitomo Forestry, the parent company of local subsidiary OBT. The activity will be implemented as one plan, from selective logging to enrichment planting. The activity plan for the Open Bay site is provided in Annexure 9.
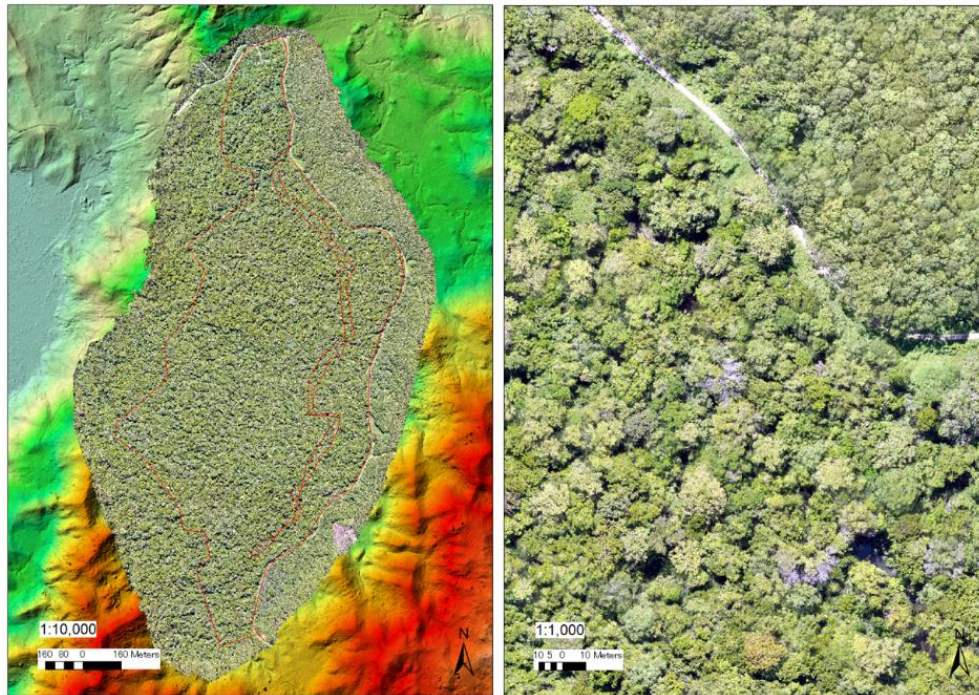
Figure 2.1-14 Orthoimage of the Planned Activity Site Created for Activity Planning

(Orthoimage created from images taken by drone. The red line indicates the planned activity area. Image resolution is 20 cm.)
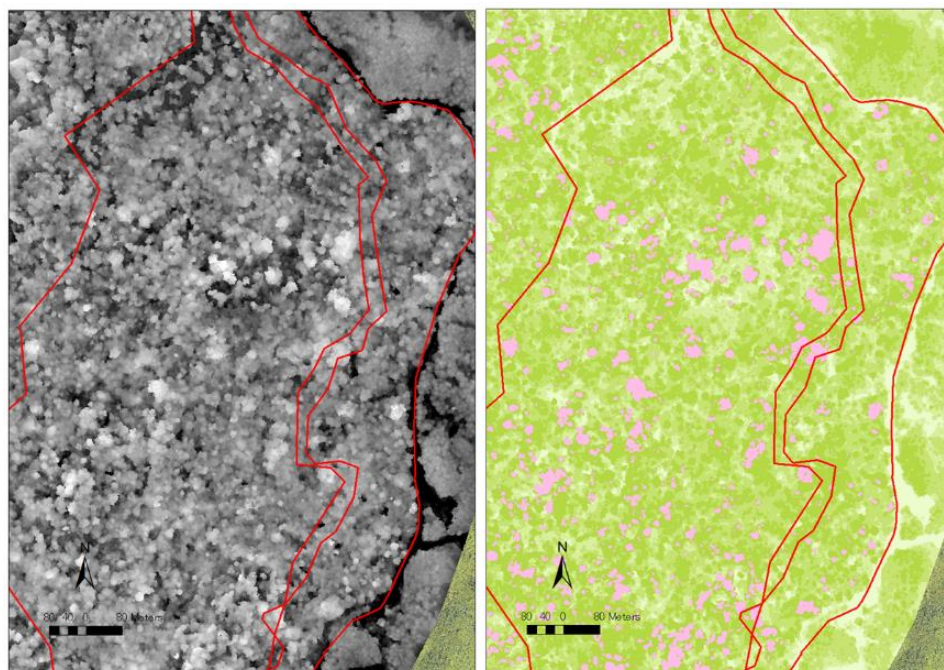
Figure 2.1-13 Forest Canopy and Tree Top Analysis

(Left: DCHM obtained from the analysis of elevation data. Right: pink-colored images of candidate trees for selective logging in areas with crown heights of 45 m or higher.)

In April 2024, a sampling survey of trees to be harvested was conducted at the Open Bay site to obtain and organize relevant information such as tree species, diameter class, and location information

necessary for detailed planning. Based on this survey, a site visit was conducted with concerned parties from May 5 to 10, 2024 to prepare a setup plan. In this survey, the locations of trees to be cut were estimated in advance using GPS data from the field survey and the DCHM created in the previous survey (detailed on the previous two pages), with a topographical analysis map created from the DTM used as a reference. In addition, the elements necessary for a project plan, such as the planned felling area, buffer area, haul-out road, and planned soil area were examined in the field and discussed with PNGFA officers (Annexure 1 – Appendix 9-B). In addition, a variety of spatial information data and aerial photo image data acquired in the Project were used as basic data for the enrichment planting plan related to Output 2.
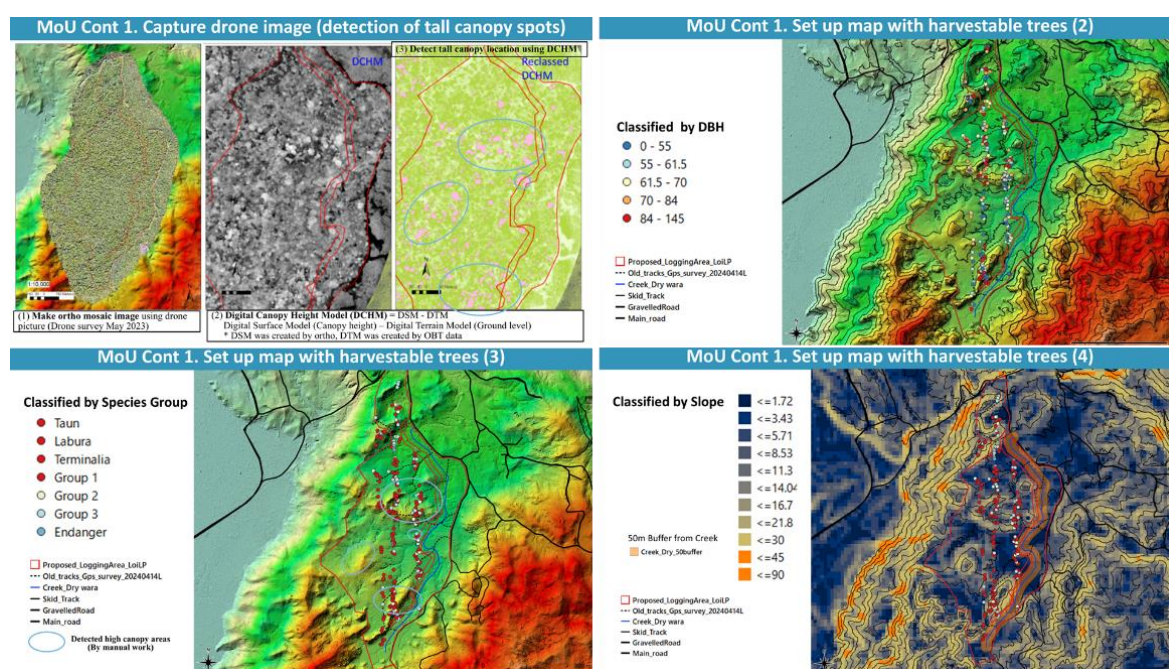
Figure 2.1-15 Resource Distribution and Topographic Analysis Map Created from Field Survey, DCHM and DTM

（**11**）Satellite monitoring trial

The results of a study on how to verify the feasibility and limitations of satellite monitoring, including spatial and temporal resolution, forest degradation/regeneration events, size verification, and target site selection, were reported to the PNGFA and long-term experts and discussed on November 21, 2023 (Annexure 25 and 26). The conclusion confirmed that logging roads and soil sites could be adequately identified, but that selective logging locations and skid trails were not adequately identified even with high temporal resolution satellite data (Planet). Moreover, it was also confirmed that conducting a quantitative assessment was difficult due to resolution limitations (alerts were confirmed to be effective for early intervention).

Integrated Deforestation Alert (from 2020 to November 10, 2023)

| Planet 2023 (first half) | Integrated Deforestation Alert (from 2020) |
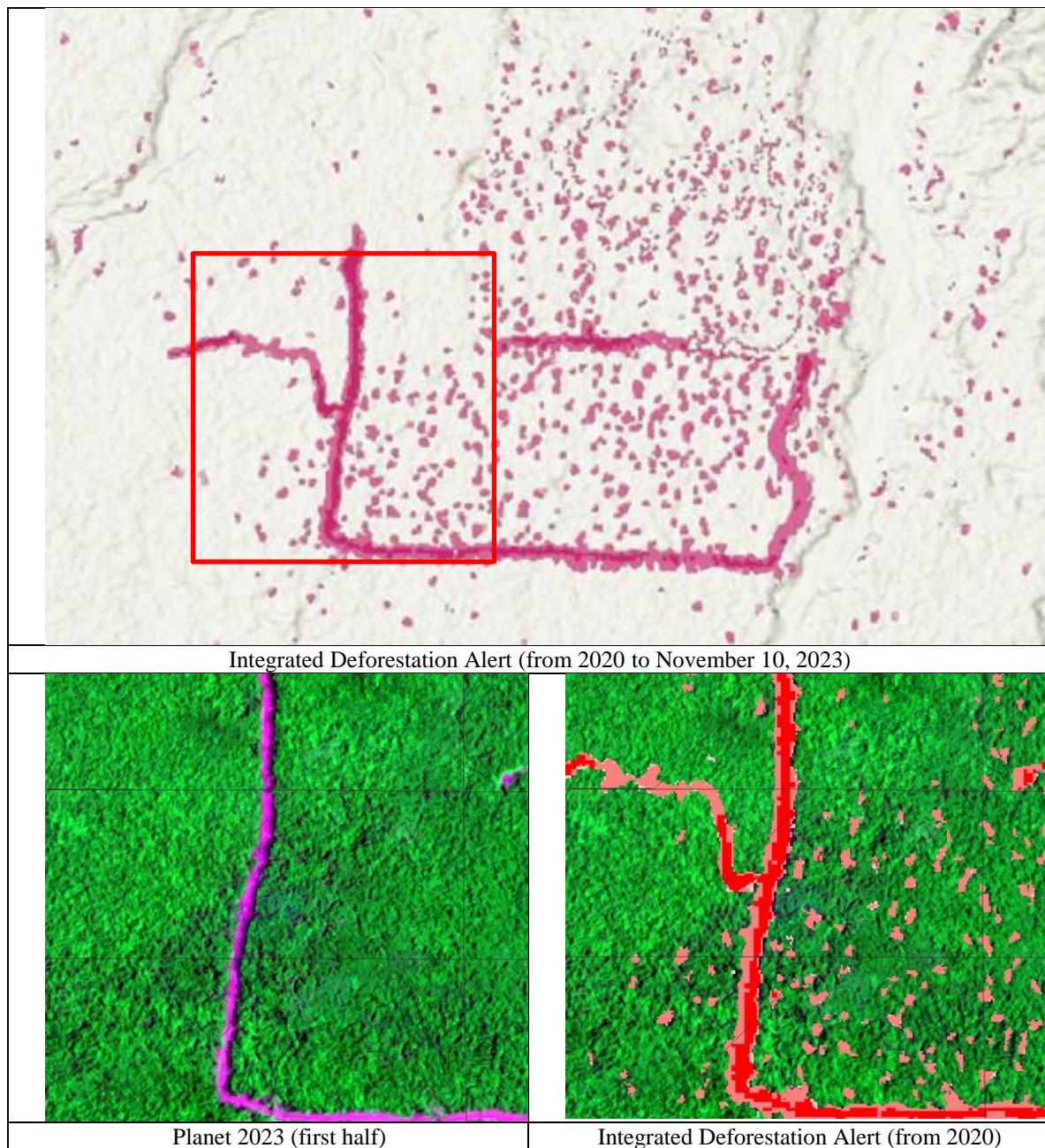
Figure 2.1-16 Status of Deforestation Alerts in the Pilot Site Setup

（**12**） Development of a dissemination plan for the PMCP and LCoP

Considering the background and current state of forest management in PNG, a draft dissemination plan for the PMCP and LCoP was developed. This document consolidates the key technical elements introduced in the Project to facilitate the efficient implementation of the PMCP and LCoP. The draft was presented to PNGFA officers on March 26, 2024, as well as during the mid-term Project workshop, where the following comments were received:

✓ A variety of GIS software is used within the industry to create data, so it is necessary to standardize data submission requirements. QGIS is free software, making it well-suited for creating standardized data.

    ✓   A legal basis is required for data exchange with logging companies. The revised PMCP currently under development should incorporate the data exchange procedures proposed by the Project to establish such a legal basis. In the previous project (the second technical cooperation project), similar discussions of data exchange were held but were not implemented. This time, it is crucial to ensure its execution.

    ✓   Intensive capacity-building for Mapping Division personnel is necessary to continue disseminating the methodologies developed in the Project after its completion.

    ✓   In addition to written methodologies and manuals, it would be beneficial to create video materials to support the wider dissemination of the technologies developed in the Project.

Based on these comments, various manuals, materials, and documents were refined and the final dissemination plan for the PMCP and LCoP was completed (see Annexure 1).

Activity 1-5: Identify effective way to disseminate PMCP and LCoP to the stakeholders, and provide necessary training for the Papua New Guinea Forest Authority (PNGFA) officers to conduct the dissemination.

（**13**）Training for PNGFA officers to develop human resources for implementation of the PMCP and revised LCoP

In order to promote understanding and implementation of the PMCP and revised LCoP, training was conducted in three sessions for each region (Southern Region: September 25-29, 2023; Momase Region: October 30-November 3, 2023; New Guinea Islands (NGI) Region: February 27-March 1, 2024). The training was planned under the leadership of the PNGFA and the long-term experts, with the short-term experts also providing training on the establishment of field training sites and the use of Mobile Offline Map. The training was conducted mainly via lectures by Mr. Geno Kini and Mr. Simon Peter Tomiyavau, former employees of the PNGFA and logging companies, respectively, with on-the-job training on the contents of the revised LCoP and PMCP. Additionally, Mr. Ivo Kusip, an active PNGFA officer, gave a lecture on log measurement.

In the Mobile Offline Map lecture, the participants learned how to operate a mobile application that uses GIS data from the logging map of the logging area in an annual logging plan. The data used for the training was created by logging companies and modified for training purposes (Figure 2.1-17).

Mobile Offline Map was introduced during the September training. It was recognized as being very effective in understanding the planning of logging concession areas, resulting in a full-scale introduction training that was conducted starting with the October training (Annexure 27). In addition, since the application can be easily used on Android devices, many training participants wanted to personally monitor its effectiveness in ordinary operations. Furthermore, many participants (about 10) in the February training requested that the application be installed on individual devices. In the future, it will be important to develop GIS data in each jurisdiction for full-scale dissemination and to create an environment that facilitates use of the application.

It was confirmed that the PNGFA had only conducted training for PNGFA officers on the PMCP and LCoP in the 1990s, when the previous version of the LCoP was established, and that no training on logging codes had been conducted since then. Although a revised LCoP was prepared in 2020 with the aim of improving logging operations, the revised LCoP has not yet been implemented because its contents have not been disseminated to PNGFA officers and logging companies. In light of this situation, the training was highly significant for discussing differences in understanding of the LCoP among PNGFA officers and for coordinating perspectives and inspection methods for the proper implementation of PMCP- and LCoP-based monitoring of logging operations.
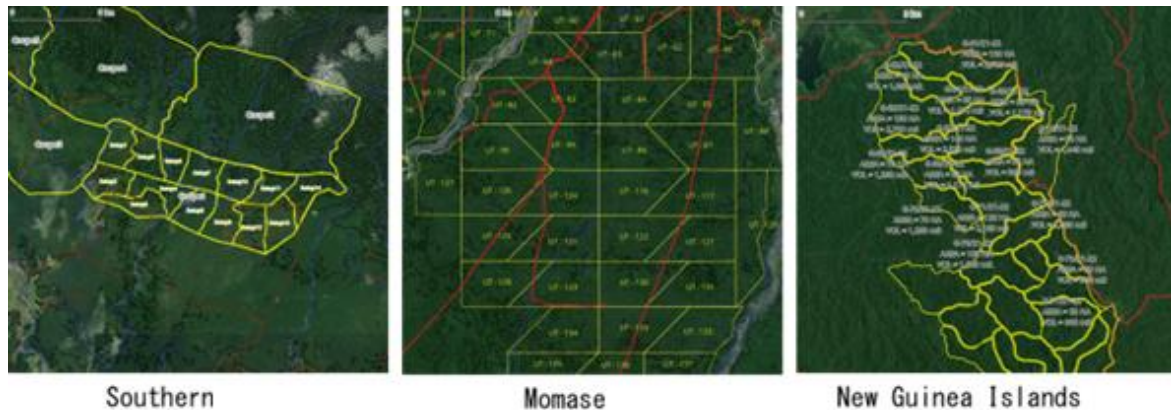
Figure 2.1-17 Annual Logging Plan Used in the Training

（**14**）Intensive capacity building for Mapping Branch officers

In March 2024, the contents of the "Dissemination Plan for the PMCP and LCoP" was explained to the Mapping Branch officers at PNGFA headquarters, with feedback obtained. Among the comments received was that "intensive capacity building for Mapping Branch officers is needed to promote dissemination of the methodologies to be developed after the Project is completed" and that "it would be useful for dissemination if the technologies to be developed are not only documented in manuals and other documents, but also in videos." In response to these comments, a meeting was held with the Mapping Branch's GIS officers, where a training plan (training content, schedule, and training materials to be prepared) for the Mapping Branch's GIS officers was explained and agreed upon (see Annexure 28). Based on the plan, training materials and video manuals were prepared and training was conducted for the GIS officers of the Mapping Branch.

Example of Mobile Offline Map Video Manual	Training for PMCP Check app
Training for drone image processing	Training for LAN Map2
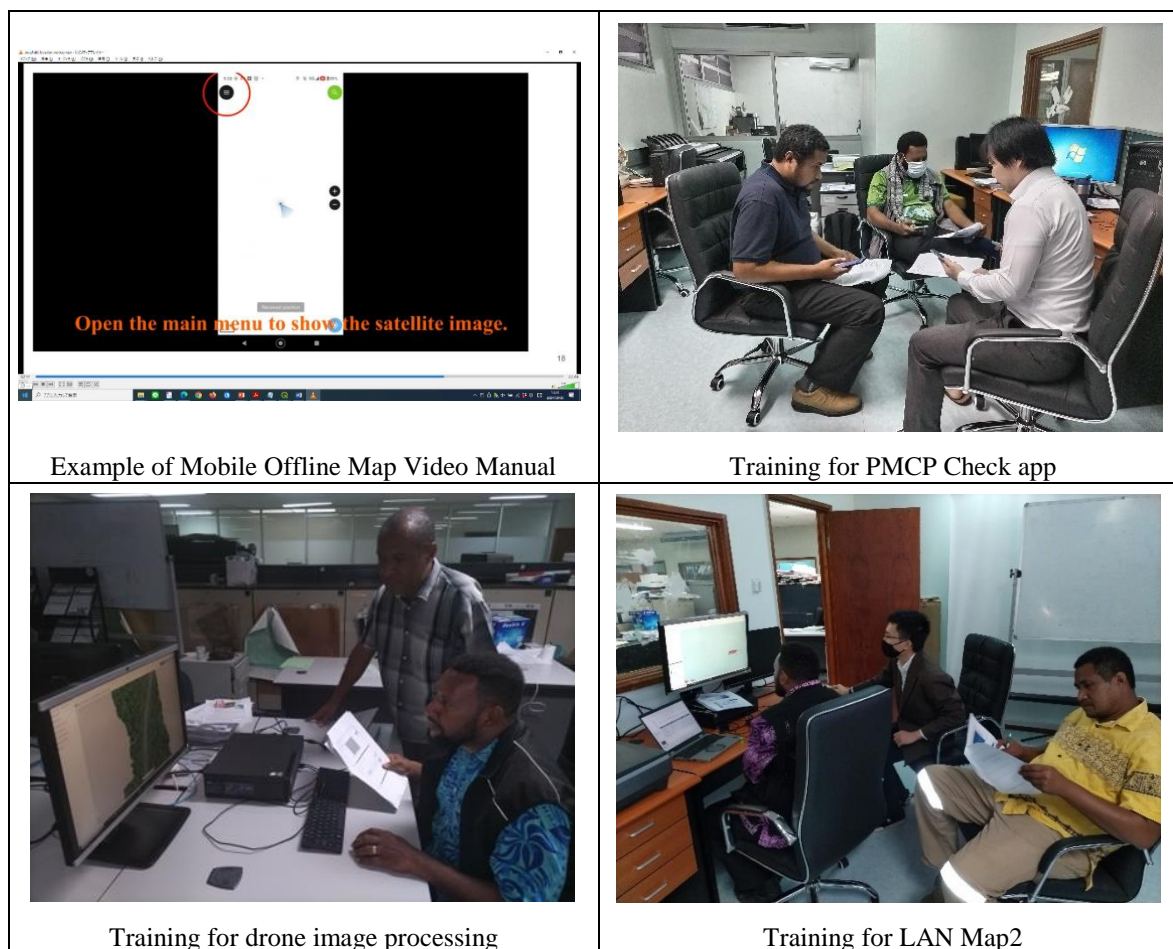
Figure 2.1-18 Training for Mapping Branch GIS officers

Activity 1-6: Support PNGFA officers to disseminate PMCP and LCoP to timber company foresters.

Under the leadership of the long-term experts, PNGFA officers conducted training on dissemination of the PMCP and LCoP for logging company staff in the three provinces listed in Table 2.1-5. The short-term experts conducted lectures and practical training on GPS and GIS in the first two provinces, West New Britain and Central, together with GIS officers from the Mapping Branch. The training program is shown in Table 2.1-6.

The third training in Madang Province was accomplished with lectures and practical training on GPS and GIS conducted by Mapping Branch GIS officers only, utilizing manuals (Annexure 6, 7, 19, 30, and Annexure 1 - Appendix 6 and 8) prepared by the short-term experts. Based on the results, the technology transfer of the training sessions on GPS and GIS in the dissemination activities for the PMCP and LCoP is evaluated as being adequate.

Table 2.1-5 Training Location for PMCP and LCoP Dissemination for Logging Company Staff

Region	Participant Province (Number of Projects)	Training Province	Planned Period	Field (Host Company)	Collaborative Partner
NGI	West New Britain (NB) (7)	West NB	Sep 23-28, 2024	SBLC	JICA-EF
Southern	Central (4),Western (5), Gulf (4)	Central	Oct 21-26, 2024	TA in Vanapa	JICA-EF
Momase	Madang (6), Morobe (1)	Madang	Nov 18-23,2024	Kumil TRP	JICA-USAID

Table 2.1-6 2nd Training Program for Logging Company Staff

Day/ Time	Subject	Topic/Activity	Presenter/ Facilitator
Day 1			
8.30 - 9.00	Registration	Registration of participants	MC
9.00 - 9.20	Introductions	Introduction and welcoming of officials and participants	MC
9.20 - 9.50	Official opening of the training program	Keynote address and official opening of the training program	Ms. Magdalene Maihua (Chief Operating Officer)
9.50 - 10.00	Group photo		MC
10.00-10.20	Morning tea		
10:20-10:50	Training objective	Training objective and JICA-PNGFA Project	Mr. Okabayashi (Chief Advisor)
10.50-11.10	EU-FCCB project	Introduction of EU-FCCB project by Expertise France	Mr. Sam Moko
11.10-11.40	LCoP (A), etc	Introduction, planning, natural and cultural values	Mr. Geno Kini (Trainers)
11.40-12.00	Q & A	Questions and answers and open discussion	MC/Trainers
12.00-13.00	Lunch		MC
13.00-13:30	LCoP (B)	Timber harvesting, soil	
13.30-14:00	LCoP (E)	Felling and skidding	
14.00-15:00	LCoP (C, D, F, H)	Road construction and maintenance, log ponds, log landings, forest health	Mr. Simon Peter (Trainers)
15.00-15.30	Afternoon tea		MC
15.30-15.50	LCoP (I, J)	Base camps, workshops, monitoring and enforcement	Mr. Geno Kini
15.50-16.20	LCoP appendix	Soil / slope / biodiversity	
16.30-17.00	Q & A Test	General discussions and test of participants understanding of the LCoP	Trainers/MC
		Logistics and other announcements	MC, Organizer
Day 2			
8.00- 9.00	Key Standards	24 Key Standards	Mr. Simon Peter
9.00- 10.00	Planning, Monitoring & Control Procedures (PMCP)	Introduction to the PMCP, planning levels, setup clearances and waste assessment Monitoring of operations, setup monitoring	Mr. Simon Peter

Time	Topic	Description	Presenter
10.00-10.30	Morning tea		
10.30-11.30	PMCP	Same as above	
11.30-12.00	Q & A		
12.00-13.00	Lunch		
13.00-13.30	Log scaling	Procedures for log identification and scaling	Mr. Ivo Kusip (Chief Scaler)
13.30-14.30	Introduction of GIS and GPS session	Introduction of GIS and GPS session Knowledge of GPS and GIS	Mr. Masayoshi Minegishi Mr. Patric Laa Mr. Jehu Antiko
14.30-15.00	Afternoon tea		
15.00-16.00	GIS data exchange	Exchange of GIS logging plan data between the PNGFA and logging companies	
16.00-17.00		Installation of QGIS and QField	
17:00-		Logistics announcement	MC, organizer
Day 3			
8.00-10.00	QField (GPS)	Introduction of Qfield and its usage	Mr. Masayoshi Minegishi Mr. Patric Laa Mr. Jehu Antiko
10.00-10.30	Morning tea		
10.30-12.00	GPS	GPS usage, practical session of Qfield and GPS	
12.00-13.00	Lunch		
13.00-15.00	GIS	Introduction of QGIS and its basic usage (add, create, editing points, lines and polygons)	
15.00-15.30	Morning tea		
15.30-17.00	GIS	QGIS usage (digitizing paper maps, creating layers)	
Day 4			
8.00-10.00	GIS	QGIS usage (legend, layout, PDF export)	Mr. Patric Laa Mr. Jehu Antiko
10.00-10.30	Afternoon tea		
10:30-11:00	Group exercise	Planning exercise and group work	Mr. Okabayashi
11.00-12.00	Mapping exercise	Set-up map planning exercise (paper map by trainer, set-up plan by company)	Mr. Simon Peter and company
12.00-13.00	Lunch		
13.00-14.30	Mapping exercise	Set-up map making using QGIS (or a paper map) by group	Participants/ trainers
14:30-15:00	GIS data exchange	Trial posting of a GIS dataset to PNGFA using WhatsApp	Mr. Minegishi
15.00-15.30	Afternoon tea		MC
15.30-16.00	Mapping exercise	Group presentation of set-up plan map by voluntary group(s)	MC
16.00-17.00	Field work	Field exercise instruction (field guide and planning guidelines for natural and cultural values)	Mr. Simon Peter
		Logistics and other announcements	MC, organizer
Day 5			
7.00- 9.00	Travel	Leave Lamana Hotel for logging site	All
9.00-14.00	Field exercise	**Post-Logging Set up**: Discussion of logging implementation **Pre-Logging Set up**: Discussion of planning Practice using Qfield	All
14.00-16.00	Travel	Return from logging site to Lamana Hotel	All
		Logistics and other announcements	MC, organizer
Day 6			

8:00- 9:00	GIS, GPS	Practical session to import field data recorded by QField into QGIS	Mr. Minegishi and others
9.00- 10.00	Group work (preparation)	Prepare for group presentation and discussion. Theme: "Application of the LCoP and PMCP from the Industry Perspective"	Trainers/ participants
10.00-10.30	Morning tea		MC
10.30-12.00	Group presentation	Groups presentation on the "Application of the LCoP and PMCP from the Industry Perspective"	MC/participants
12.00-13.00	Lunch		
13:00-14:00	Group discussion	Theme: "Application of the LCoP and PMCP from the Industry Perspective"	Mr. Simon Peter
14.00-14.40	Summary	Summary of the training program	Mr. Geno Kini
14:40-15:00	Questionnaire	Filling out and submission of questionnaire	Participants
15.00-15.30	Afternoon tea		
15.30-17.00	Official closing	Official closing remarks (Mr. John Mosoro, Managing Director, PNGFA, and others) Presentation of certificates	MC/PNGFA/JICA/EF/industry representatives
1800-	Dinner		All
Day 7	Travel	Return of participants	

*The sessions in blue were conducted by the short-term experts and GIS officers of the Mapping Branch

Lecture session	GIS practical training session

Figure 2.1-19 Lecture and Practical Training by GIS Officers of the Mapping Branch

Activity 1-7: Prepare programs and materials introducing outputs of the Project and help PNGFA to disseminate the outputs to the stakeholders in workshop(s).

The Project held a total of 10 workshops, as shown in Table 2.1-7, to disseminate the Project outputs.

Table 2.1-7 List of Workshops to Disseminate Project Outputs

Workshop Title	Dates	Venue	Participants	Activity	Collaboration
PMCP/LCoP Training workshop for PNGFA officers (Southern)	September 25 - 29, 2022	Port Moresby (Lamana Hotel)	20*	Activity 1-5	-
PMCP/LCoP Training workshop for PNGFA officers (Momase)	October 30 - Nov 3, 2022	Vanimo (Vanimo Beach Hotel)	24*	Activity 1-5	-

PMCP/LCoP Training workshop for PNGFA officers (NGI)	February 27 - March 1, 2023	Kimbe (Hotel Genesis)	28*	Activity 1-5	-
Mid-term Project workshop	22 April 2023	Port Moresby (Lamana Hotel)	39	-	-
PMCP/LCoP Training workshop for logging companies (NGI1)	September 23 - 28, 2023	Kimbe (Hotel Genesis)	12*	Activity 1-6	EF
PMCP/LCoP Training workshop for logging companies (Southern1)	October 21 - 26, 2023	Port Moresby (Lamana Hotel)	14*	Activity 1-6	EF
PMCP/LCoP Training workshop for logging companies (Momase2)	November 18 - 23, 2023	Madang (Madang Resort Hotel)	13*	Activity 1-6	USAID
Forest carbon monitoring workshop	February 24-26, 2025	Port Moresby (Lamana Hotel)	20	Activity 3-7	EF
Workshop on finalizing the User Manual for Assisted Natural Regeneration at Natural Forest Logging Sites	March 4 - 6, 2025	Port Moresby (Lamana Hotel)	17	Activity 2-5	EF
Final Project workshop	March 25, 2025	Port Moresby (Crown Hotel)	42	-	-

* The PMCP/LCoP Training workshops are for trainees only (excluding the JICA expert team, PNGFA trainers, and two chief trainers).

During the mid-term Project workshop, the new technologies developed by the Project, the "Draft Dissemination Plan for the LCoP and PMCP," the "Draft Document on Specifications and Sharing Methodology for Electronic Data to Be Shared between PNG Forestry Authority and Logging Companies," and the "Future Implementation Policy for Natural Regeneration" were presented (see Annexure 37). Feedback was obtained from the participants.

Presentation by short-term experts	Comments from participants

Figure 2.1-20 Mid-term Project Workshop

The final Project workshop included presentations and discussions of the final Project outputs and recommendations for future proposed activities to disseminate the Project outputs to a wide range of stakeholders (Annexure 38).

- Technical development of monitoring tools on PMCP/LCoP
- Natural regeneration activities at the Marshall Lagoon pilot site
- User Manual for Assisted Natural Regeneration at Natural Forest Logging Sites
- Overview of carbon monitoring of logging operations

- Field carbon monitoring (method and monitoring results)

| Presentation of Project outputs, lessons learned and recommendations | Exchange of opinions among participants |

Figure 2.1-21 Final Project Workshop

2.2 Activities for Output 2

Activity 2-1: Find out issues for managing natural regeneration after logging.

（1） Current status of natural regeneration after logging

It is recognized that there are various views within the PNGFA. While plantations are being established in some areas, the PNGFA has a desire to maintain so-called NFM. Furthermore, it does not envision plantation reforestation after natural forests have been logged out. In addition, it has been confirmed that Kwila (*Intsia bijuga*), one of the major commercial tree species in the Amanab region and elsewhere, cannot grow to maturity as a single species forest. For this reason, the PNGFA is considering placing importance on the department that implements NFM activities (the Natural Forest Management (NFM) Branch) to promote the growth of seedlings after logging and hopes to increase the resource of the target tree species in the forest area by removing small-diameter trees of non-targeted tree species. On the other hand, since selective logging operations result in the harvesting of all available commercial tree species, the subsequent status of successional trees remains uncertain.

（2） Status of major target tree species as commercial tree species

The target tree species were selected based on inventory information in the target concession area (Table 2.2-1, Figure 2.2-1), with the target range of commercial tree species classified as Group 1 and Group 2 in "Procedures for Exporting Logs". The selection was made after considering the results of interviews with relevant parties in the implementation of the pilot activities.

Table 2.2-1 Major Commercial Tree Species (Extract)

No	Commercial Tree Species	No	Commercial Tree Species
1	Burckella	11	**Malas (*Homalum foetidum*)**
2	Crey Canarum	12	PNG Mersawa
3	**Calophyllum**	13	Red Planchonella
4	Red Canarium	14	White Planchonella

5	Pencil Cedar	15	**Taun (*Pometia pinnata*)**
6	Dillenia	16	Terminalia
7	Erima	17	PNG Walnut
8	Hekakoro		
9	**Kwila (*Intsia*)**		
10	Lophopetalum/Perupok		

Kupiano
Project Name: Marshall Lagoon (2018)
Pometia pinnata   22.15%
Intsia   11.27%
Sterculia   6.39%
Project Name: Cloudy Bay (2018)
Pometia pinnata   26.54%
Artocarpus   7.73%
Buchanania   5.33%

Amanab
Project Name: Amanab BK4&3 (2018)
Intsia   23.39%
Pometia pinnata   11.27%
Terminalia (red-brown) 6.39%

Rottock Bay
Project Name: Inland Rauto Miu (1998)
Pometia pinnata   23.00%
Homalium foetidum   11.12%
Octomeles sumatrana 5.60%
Project Name: Vanu tamu (1998)
Calophyllum   17.14%
Homalium foetidum   12.69%
Syzygium   12.15%

Figure 2.2-1 Selection of Major Target Tree Species (Inventory Around Potential Pilot Sites)

（3）Enrichment planting

As an advanced initiative in NFM activities, seedling production (nurseries) and enrichment planting have been implemented in West Sepik, Madan, Manus, and elsewhere. Efforts are also underway to expand these activities to neighboring concessions, but these have yet to be realized. Landowners and logging companies are also involved in these efforts, with landowners planting trees and weeding and logging companies building nurseries. The PNGFA is the lead agency for these projects, in many cases bearing the costs, which is a challenge for continued and expanded projects.

Kwila Nursery (Amanab 2007)	Line planting (Amanab 2019-2022)
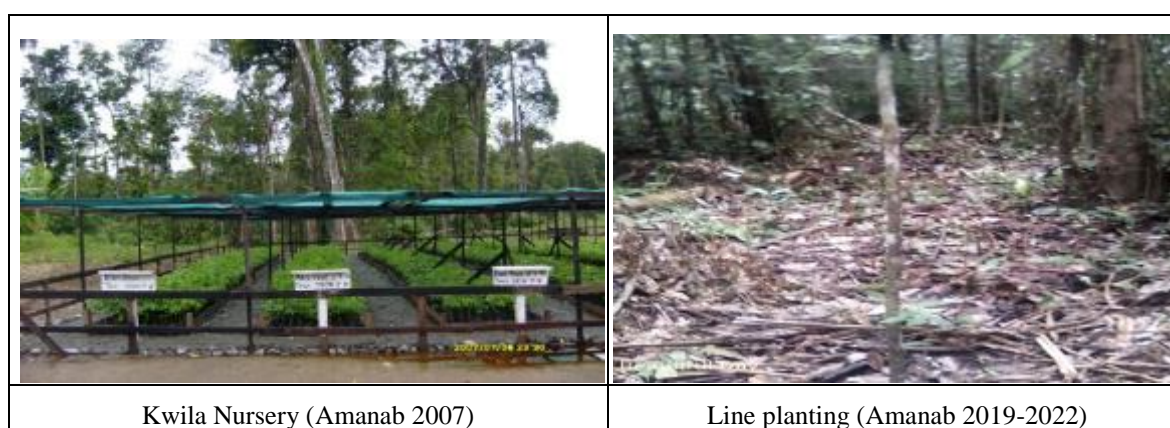
Figure 2.2-2 Enrichment Initiatives

Activity 2-2: Identify key stakeholders, and examine implementation structure and technical improvement measures for solving the issues identified in Activity 2-1.

In PNG, a concession named Amanab 1-4 FMA is one of the advanced sites for enrichment planting. When planning activities to promote natural regeneration in the Project, activities at the concession were positioned as the Amanab model, while the status of the post-logging set-up (the standard unit for selective logging operations in concessions) was reviewed. In addition, in order to establish this as a model for the dissemination of enrichment planning in concessions as a demonstration activity, some issues were identified with respect to understanding the current situation and implementing activities. These are as follows.

（**4**）Logging situation at Amanab 1-4

The main commercial logging species at Amanab 1-4 FMA is Kwila (*Intsia bijuga*), while the logging company in Amanab 1-4 FMA harvests only Kwila and no other commercial species. This is because Kwila is priced at PGK35/m^3, while Group 1 commercial tree species listed in the "Procedures for Exporting Logs" are traded at around PGK15/m^3; and, furthermore, because the logging is relatively far inland from Vanimo Town, where the shipping port is located, considerations of higher transportation costs come into play. In addition, at the immediate post-logging setup, although seedlings were observed growing around the mother tree, the number of seedlings was limited. Moreover, at the setup where seven years had passed since logging, no Kwila growth was observed in the target study area.

（**5**）Seedling production system

A Kwila nursery has been constructed in Amanab 1-4 near Maka Camp, the main camp of the FMA. Although details about the year of establishment are unknown, seedling production began in 2008. Seeds are purchased by the PNGFA from local residents, and the nursery is equipped with 15 beds. Production capacity is 15,000 seedlings per cycle (three months), with an estimated production of 100,000 seedlings by 2021. In addition, although budgetary constraints may have been a factor during the COVID pandemic, it was observed that the production of seedlings was not being carried out in line with appropriate planting plans. Some seedlings were left unplanted after more than a year had passed since germination and they had shed their leaves. The Amanab region is expected to have a certain amount of precipitation in both the wet and dry seasons, while it was also confirmed in interviews that the planting of Kwila is not limited to any particular season of the year.

（**6**）Growth status and silvicultural practices in areas where enrichment planting has been implemented

As an advanced NFM activity, seedling production and enrichment planting have been implemented in West Sepik, Madang, Manus, and other areas. Efforts to expand these activities to neighboring concessions are underway, but have yet to yield results. Since the PNGFA is the lead agency, it bears the majority of the costs, so the need to expand the size of its budget is an issue in connection with

continuing operations and dissemination. Although at the field level the desirability of carrying out weeding every three months is recognized, the plan is for it to be conducted every four months over a two-year period, due to budget constraints. The results of tending and of discussion of its frequency are described below in Section （7）. In addition, the monitoring of enrichment areas where weeding has been finished has not been fully implemented, and poor growth has also been observed, possibly due to the growth of planted seedlings and the effects of the light environment.

Table 2.2-2 Cost of Silvicultural Practices

Operation	Unit Rate
Planting	PGK66/ha
Tending (Weeding 1)	PGK23/ha
Tending (Weeding 2)	PGK15/ha
Tending (Weeding 3)	PGK12/ha
Tending (Weeding 4-6)	PGK10/ha
Total	PGK146/ha

In this study, past enrichment sites were sampled to check the growth conditions. Even in areas planted in the same year, poor growth was observed in areas with a poor light environment. It was confirmed that with additional treatments the situation could be expected to improve.

Amanab1-4 YE42 :
3 years old 2m (no record)

Amanab1-4 IT47 :
5 years old, 4m (no record)

Amanab1-4 FW15 :
15 years old, over 10 m
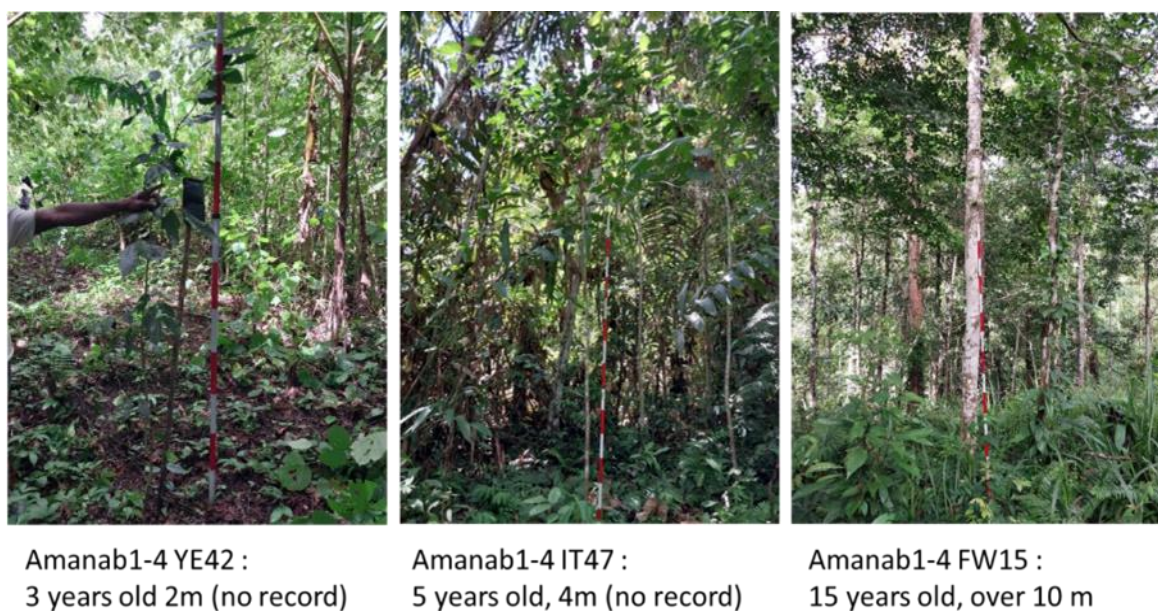
Figure 2.2-3 Comparison of Growth Status by Tree Age
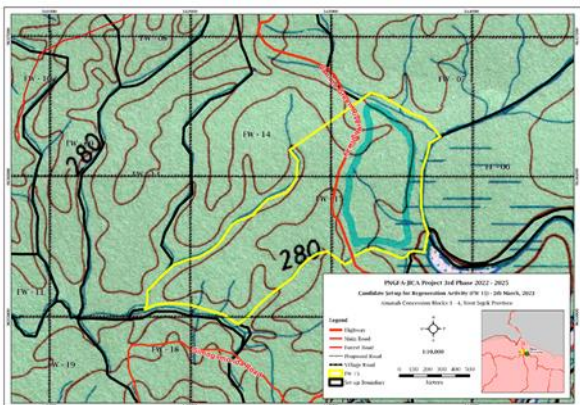
It was decided at the 3rd JCC Meeting that, for the implementation of pilot activities at each pilot site, a demonstration site would be identified and a detailed plan prepared for each activity. The detailed activity plans for each pilot site are included in Annexure 8, 9, and 10. Where the PNGFA, a logging company, and a landowner are the main actors, a Memorandum of Understanding (MOU) will be signed, and where the PNGFA or a logging company is to conduct the activities with the landowner,

an agreement will be signed to divide roles and preserve rights. The draft MOUs and agreements are provided in Annexure 12 - Appendix 2.

<table>
<tr><td>Activity 2-3: Conduct pilot-activities on natural regeneration by PNGFA officers and key stakeholders at the pilot site(s) determined in activities 1-3.</td></tr>
</table>

（7）Amanab 1-4 site

At this site, activities related to assisted natural regeneration, mainly enrichment planting, were conducted based on a detailed plan with the main objective of establishing model practices. The schedule for planting and silvicultural practices is given in Table 2.2-3. The activity plots were managed by utilizing the setup units established at the time of natural forest logging, with the logging units given such names as "UT123". Seedling production was conducted in the existing nursery established by the logging company, and planting was conducted at the locations given in the same table below. Management by logging unit has the advantage of making it easier to manage information on planting years, tree species, and other topics.

Table 2.2-3 Activities in Each Activity Plot at Amanab 1-4 Site

 Plot Name: Amanab 1-4　UT123	Activity: Enrichment Planting Kwila, the main commercial tree species in the Amanab area, was logged[2] as the sole target tree. It was planted on skid trails and in gaps after natural forest logging. In the image at left, yellow indicates the setup boundary, while the red line in the upper left is the main skid trail.
 Plot Name: Amanab 1-4 UT51	Activity: Enrichment Planting Line planting of Kwila was done as assisted natural regeneration activity, since the growth of Kwila was not confirmed due to pioneer species thriving in the logged area. Yellow indicates the setup boundary. The red line in the lower left indicates line cutting that was set up.

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[2] In West Sepik Province, it has been confirmed that commercial tree species other than Kwila have been logged in the second round of logging in the coastal region, but no second entry of logging is currently taking place in the Amanab region.

 Plot Name: Amanab 1-4 FW15	Activity: Clearing/Brushing (Tending) This is an advanced plot where Kwila was planted in the past. In some of the plots, the growth of Kwila was not sound due to the cover of other competitive weeds and trees, so a silvicultural operation was conducted and the plots were cleared. Yellow indicates the setup boundary. The light blue line in the center is the area to be cleared.

Enrichment planting in UT123 and tree removal in FW15 were conducted in October 2023. In addition, since work in UT51 differed from the plan, technical guidance was given again to ensure that work was conducted in accordance with the plan. In November of the same year, an enrichment planting activity was conducted with PNGFA officers who were participants in the PMCP/Revised LCoP training. Additional clearing was also carried out during weeding in areas where clearing was considered insufficient prior to planting.

At the two sites where the seedlings were planted, a survey was conducted on the state of growth and the implementation of weeding in April and September 2024. Dried-out seedlings identified during weeding were replanted. In addition, during replanting Taun was planted at the UT51 site as a tree species other than Kwila. Survival rate was calculated by counting the number of live and dead seedlings on a 50-m line (Annexure 31). The April survey showed that 80% or more of the seedlings survived, while the September survey found that 75% or more survived. A striking characteristic of the dried-out seedlings was that they were planted near areas where water collects. In addition, the health of the planted seedlings was also considered a factor. The initial assumption was that seedlings would require weeding about once every three months, but in fact it was found that competitive weeds and trees did not grow so thickly and that weeding once every six months for one year would be sufficient to maintain growth. However, since vines were observed in some areas, it is necessary to plan weeding (or vine cutting) based on continuous monitoring. The results of the activities at the site, except for monitoring, are shown in Table 2.2-4. The clearing at FW15, the enrichment planting at UT123 and UT51, and the subsequent implementation of silvicultural practices have generally resulted in good growth. Subsequent enrichment planting sites were planned based on the results of this study.

Kwila grew well in relatively well-lit areas of the forest, with the fastest-growing seedlings reaching 1 m as of August 2024 and more than 2 m as of October 2024. It was found that taking care to create a good light environment during ground preparation or weeding was important for smooth growth. On the other hand, a completely open space hinders growth because light conditions are too strong.

A simple measurement of relative illuminance for a study[3] yielded the following results: 13% in the seedling nursery; 1.08% in the UT123 setup where light conditions were considered good; 0.54% in the UT123 setup where light conditions were considered poor; and 0.97% in the YE42 setup where growth was good in past planted seedlings. Taken together, these results suggest that a relative illuminance of about 1% was necessary. As mentioned above, one of the reasons for poor growth is insufficient growth management in the nursery. Healthy growth and an adequate number of seedlings are expected to improve the establishment and subsequent growth of the seedlings at the planting site.

Table 2.2-4 Status of Implemented Operations in Each Setup

Month	Oct 2023	Nov	Dec	Jan 2024	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
UT123 Enrichment	Ground preparation and planting Kwila						Weeding, replanting, survey					Survey
UT51 Enrichment	Ground Preparation	Planting Kwila・Taun					Weeding, replanting, survey					Survey
FW15 Clearing	Clearing											

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[3] Measurement errors are possible due to the simplified implementation, and the relative illuminance in the case of a dense tropical rainforest is estimated to be less than 1%. However, the amount of illuminance itself is considered important for the growth of seedlings.

Figure 2.2-4 Change in State of Clearing Areas (Left: October 2023; Right: April 2024)

Well-grown Kwila seedling in UT51 reaching about 1.0-1.4 m (October 2024)

Kwila seedling in UT123 open area have yellowing leaves and show poor growth (April 2024).

Well-grown Kwila seedling in UT123 has reached about 1.2 m (April 2024).

Well-grown Kwila seedling in UT123 has reached about 2.4 m (October 2024).

Figure 2.2-5 Growth of Seedlings in the Amanab Site
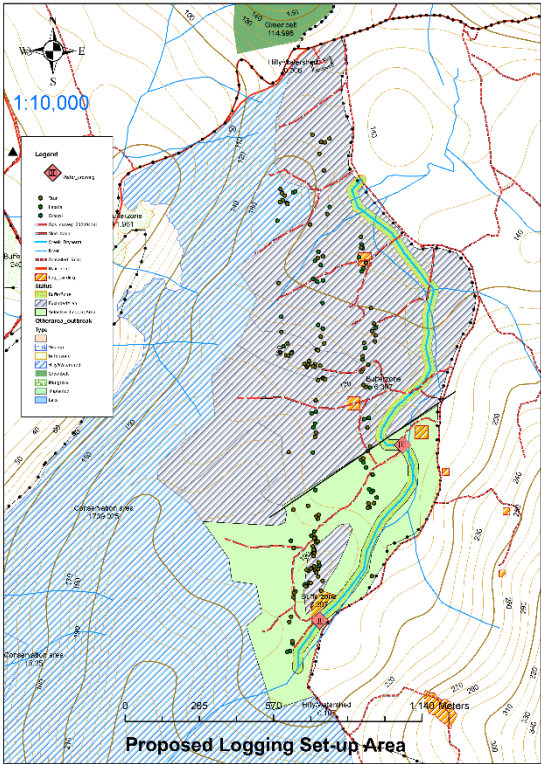
In addition, enrichment planting has been implemented on the skid trails in UT123 from the perspective of restoring the logging site. However, surveys and interviews with the logging company to date have confirmed that the skid trails established in the first logging are reused in the second and

subsequent selective logging operations. Accordingly, in the future, planting in gaps created by logging or line planting within the forest stand may be effective options in PNG.

（8） Open Bay site

At the Open Bay site, the Project was implemented as a model led by the logging company. Selective logging in the Loi area was followed by enrichment planting. Crown height was measured using existing data and drone image analysis. In addition, a tree-by-tree survey was conducted, with a GPS survey implemented to record the location of each tree to be logged. This data was used to estimate candidate locations for felling trees and the results applied to plans for logging and planting. Details are described in Section 2.1 （10）. The activities are summarized in Table 2.2-5.

Table 2.2-5 Activities at the Open Bay Site

 Proposed Logging Set-up Area Plot Name: Open Bay Loi Compartment	Activity: Selective Logging and Enrichment Planting Forest conditions had recovered from past selective logging, so even though such logging had been conducted before, a new skid trail was to be opened for selective logging. Crown height was estimated using a drone and in other ways to identify the trees to be logged, after which a field survey was conducted to determine the harvest area (the green area in the image to the left). After logging, enrichment planting was conducted with wildings, mainly in the gaps.

Logging was conducted at this site in October 2024, followed by planting in December of that year. The drone photos shown in Figure 2.2-6 were taken to create an orthoimage to utilize in monitoring logging and planning the enrichment planting. This allowed for the clear management of planted areas by mapping.

Enrichment Plan   Ortho Image before Logging   Ortho Image after Logging
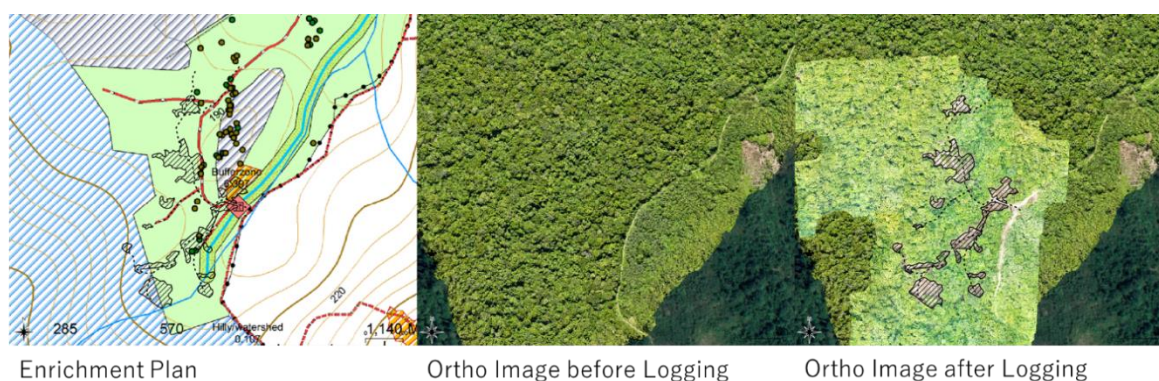
Figure 2.2-6 Logging Monitoring and Planting Planning by Drone
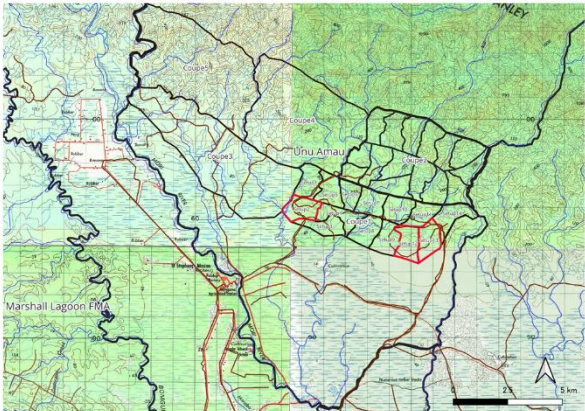
（**9**） Marshall Lagoon site

This site was implemented in a model format, with the PNGFA taking the lead and the landowner community (clan) implementing the activities. A field survey was conducted to determine three activity sites for the implementation of enrichment planting on the logging site for the purpose of detailed planning. Since assisted natural regeneration activities had been planned but not implemented in this concession, simple nurseries were developed at each of the following activity sites, and enrichment planting was conducted by line planting in the forest stand. Since the Marshall Lagoon site was led by a long-term expert, the details are given to the long-term expert's report.

Table 2.2-6 Pilot Activity and Location

No	Clan	Activity	Location	Remark
1	Binudi	Enrichment planting	Coupe 1 Setup 13	Establish a simple nursery Enrichment planting after logging and weeding
2	Libani	Enrichment planting	Coupe 1 Setup 12	Establish a simple nursery Enrichment planting after logging and weeding
3	Mawabura	Enrichment planting	Coupe 1 Setup 2	Establish a simple nursery Enrichment planting after logging and weeding

Table 2.2-7 Activities at the Marshall Lagoon Site

Plot Name: UNU & Amau Setup 2, 12, 13	Activity: Enrichment Planting Line planting was conducted in the forest stand in setups where selective logging operations had been conducted in the past. The red line boundaries are the target setups, and each clan (the landowners) conducted the work. Since the concession did not have nursery facilities, simple nurseries were set up in the vicinity of the community to grow wildings taken from the forest and conduct enrichment planting.

（**10**）Other

Existing data on seedling production methods for commercial tree species used in enrichment planting were collected and working methods summarized (Annexure 11).

Activity 2-4: Develop the draft user manual in cooperation with the key stakeholders.

Assisted natural regeneration activities have been implemented in some areas of PNG, but they are not being implemented in all logging concessions. Moreover, specific procedures for implementation have not been arranged within the PNGFA. Therefore, a draft manual was developed, intended to serve as a guideline for PNGFA officers and logging companies to implement assisted natural regeneration activities in order to disseminate the activities. The draft manual was prepared in April 2024 and, in addition, a visit was made to the PNG Forest Research Institute (FRI) to explain its contents and obtain the FRI's understanding. Comments were also obtained from the FRI, such as points to keep in mind regarding variety identification (variation) of the tree species to be planted (wildings). The contents of the draft manual were continuously modified in accordance with the status of activities at the Marshall Lagoon and Open Bay sites, where activities had already started, as well as with the actual conditions of the C/P's work.

Table 2.2-8 Contents of Manual for Assisted Natural Regeneration Activities

No	Contents
1	Background
2	Mechanism for the Promotion of Natural Regeneration
3	Preliminary Survey Phase
4	Consensus Building Phase
5	Planning Phase 　(1)　Explanation to Relevant Parties 　(2)　Boundary Determination and Mapping of Activity Area 　(3)　Determination of Worker Group

	(4) Technical Training for Worker Group (5) Baseline Survey (6) Selection of Regeneration Methods (7) Determination of Planting Systems and Spacing (8) Determination of Tree Species to Be Planted (9) Tending (10) Preparation of Activity Schedule (11) Financial Planning (12) Preparation of Detailed Plan
6	Implementation Phase (1) Nursery Development (2) Enrichment Planting (3) Methods Other than Enrichment Planting (4) Monitoring

Activity 2-5: Finalize the user manual to disseminate natural regeneration techniques to PNGFA officers and key stakeholders.

At the Amanab 1-4 site, Open Bay site, and Marshall Lagoon site, an explanation of the draft user manual was provided to those involved in the pilot activities, along with a review of Activity 2-3, to confirm Project results and explain future activity plans. In addition, the draft user manual as of April 2024 was explained at the mid-term Project workshop and bound editions were made available to participants. The contents of this manual were re-edited and finalized based on the results of current activities (Annexure 12).

2.3   Activities for Output 3

Activity 3-1: Review the effects of complying with PMCP and LCoP to low emission logging activities.

At the outset, as a result of discussion between JICA HQ and the PNGFA, both sides mutually confirmed that the concept of "low-emission logging" (as stated in the PDM), was interpreted, and should be understood, as emissions reduction achieved through compliance with the LCoP and PMCP. Under Activity 3-1, a comprehensive review and systematic analysis was conducted of the effects of compliance with the PMCP and LCoP on low-emission logging, or "Reduced Impact Logging for Climate Mitigation" (RIL-C), activities in PNG. Initially, during the second of two prior technical cooperation projects, the effects of PMCP and LCoP compliance on low-emission logging had been assessed and documented. During the Detailed Design Survey Phase of this Project, a review and in-depth analytical investigation of these findings were carried out. As part of this process, alignment was also assessed between PNG's logging regulations (the LCoP and PMCP) and international guidelines and principles for RIL-C (which contribute to low-emission logging) developed by international organizations such as the International Tropical Timber Organization (ITTO) and the

FAO. As clearly exhibited in Table 2.3-1, the assessment results substantiated that, while gaps exist to a certain extent, overall there is a significant level of alignment. This analysis implies that strict adherence to the compliance frameworks of the LCoP and PMCP, as well as thorough enforcement, can contribute to the effective implementation and promotion of the RIL-C.

Table 2.3-1 Alignment between PNG LCoP/PMCP and International Guidelines/Principles of Reduced Impact Logging for Climate Mitigation

International RIL-C Principles	PNG LCOP/PMCP Compliance and Recommendations
Planning	
1) Long term plans: Term > 10y; Map: 1 / 50,000	Term: 30-year plan Map accuracy: no specifications
2) Mid-term plans: Term: 3 to 1y; Map: 1 / 25000	Term: 5- (or 2- to 4-) year plan Map accuracy: 1 / 50 000 (PMCP)
3) Annual plans: Term: 1y; Map: 1 / 1-5000	Term: 1-year plan Map accuracy: 1 / 25 000 (PMCP)
4) Setup plans: No specifications	Term: Determined depending on the setup[4] Map accuracy: 1 / 5000 sketch (PMCP)
Felling	
Logging system: Selective logging of larger diameter trees	- Restricted to selective logging, which is greater than 50 cm in diameter at breast height (DBH) - Must retain a certain basal area (i.e. 9-10 m^2/ha in setup area of 150 ha)
Felling method: Directional felling	Directional felling is recommended to avoid collateral damage
Allowed tree species: Country/site specific	Allowed merchantable trees species (restricted species listed)
Improve bucking	*No provision*
Stumps: Low-height cutting	Low height cutting, shorter than 50 cm, is recommended by applying back-cuts above scarf-cutting
Preparation: Prescription and vine cutting	- Prescription of all harvesting trees in the setup plan and tree marking in advance is required - Vine cutting is recommended to avoid collateral damage
Skidding	
Machinery: Ensure dozers remain on skid track and roads	*No provision*
Skid track construction: Minimize skid area by planning bulldozer trails	- Skid track area < 10% of the area of the setup - Skid track width < 6 m
Skidding method: Use long line winching (or skyline)	*No provision*
Landing	
Size: Narrow log landing area	Log landing size not exceeding 0.25 ha
Number: Minimize number of log landings	No more than three (3) landings per setup
Hauling	

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[4] "Setup" is the smallest operation unit of commercial logging concession.

Narrow width of haul road corridors	Maximum road clearance width between cleared edge to cleared edge: 40 m *(This allows for a maximum road width (pavement plus table drains) of 15 m plus a cleared zone of about 12.5 m on either side to allow for drying of the road surface and to provide safe sight lines.)*
Post-harvest treatment	
Mandatory post-harvest treatment	- To improve conditions in which a track or log landing is left following use for harvesting - Landing and log pond area should be returned to a state close to natural - Cuttings, seeds or seedlings used for enrichment planting should be sourced from material collected from within the setup or adjoining area - Vines and competing vegetation should be cut from young regeneration within the canopy gaps created by tree felling and extraction to ensure that regeneration is not smothered or suppressed - Regeneration surveys will be conducted two to three years after logging to ensure that acceptable stocking levels are achieved

It was also confirmed that parameters monitored under the PMCP and LCoP can be broadly classified into two categories: 1) environmental parameters, including factors related to soil, water, and biodiversity; and 2) carbon parameters, involving biomass reduction resulting from logging operations, such as felling, skidding, and extraction, which in turn influence carbon storage and emissions dynamics. Regarding carbon parameters, as shown in Table 2.3-2, it was revealed that most of the parameters necessary for calculating on-site carbon emissions are already incorporated in the monitoring frameworks established under the current LCoP and PMCP. Based on this information, it was clarified that by implementing monitoring in accordance with the LCoP and PMCP and systematically collecting data, it is feasible to quantify emissions resulting from logging activities. Furthermore, this would also enable comparative assessment of the emission-reduction effects of improved logging operations, or so-called RIL-C, in the future.

Table 2.3-2 Carbon Parameters and Source Documents (As of 2022)

Source of Degradation		Data Unit	Source Document
Logging Infrastructure	Forest clearance for camp site	Length (m) & Width (m), or Area (ha)	Camp Plan
		Merchantable timber volume (m3)	Setup Log Scaling Sheet
	Forest clearance for permanent roads	Length (m) & Width (m), or Area (ha)	Road lines, Setup Plan
		Merchantable timber volume (m3)	Setup Log Scaling Sheet
	Forest clearance for feeder and spur roads	Length (m) & Width (m), or Area (ha)	Setup Plan
		Merchantable timber volume (m3)	Setup Log Scaling Sheet
	Forest clearance for log landings	Length (m) & Width (m), or Area (ha)	Setup Plan
		Merchantable timber volume (m3)	Setup Log Scaling Sheet
	Forest clearance for skid tracks	Length (m) & Width (m), or Area (ha)	**NO RECORDS**
		Merchantable timber volume (m3)	Setup Log Scaling Sheet
Logging Damage	Disturbance from felling to surrounding trees	Deadwood in felling gaps (m3)	**NO RECORDS**
	Log waste volume	Wasted log pieces (stump, log pieces, top logs, buttress, abandoned logs)	Post-harvest Assessment Report (in theory, but there are **NO RECORDS**)
Log Extraction	Extracted log volume	Merchantable timber volume (m3)	Setup Log Scaling Sheet

However, it was confirmed that there is a significant obstacle to the actual calculation of logging-related carbon emissions, as corrected data are not fully digitized, and certain parameters — such as skid track length and incidental damage to residual trees caused by felling and skidding operations, as indicated in Table 2.3-2 — remain unmeasured under current regulations. Given these findings, it is necessary to develop a method to correct all required data, including unmeasured parameters, and establish a simplified approach for estimating carbon emissions from logging activities. Furthermore, based on interviews conducted as part of the survey, it was found that PNGFA field officers are already managing numerous tasks, and as a result the monitoring of logging sites is not being fully conducted as comprehensively as it should be. To address this, concerned Project members mutually confirmed that any newly developed carbon monitoring technologies and methods under this Project must be designed to minimize additional workload for field officers.

Based on these findings, a report summarizing the climate change mitigation potential of LCoP and PMCP implementation in PNG and key monitoring indicators for logging-related carbon emissions was compiled and finalized after being reviewed by PNGFA officers (see Annexure 13). Additionally, a preliminary review of economic analyses of RIL-C in other countries indicates that while RIL-C implementation yields long-term economic benefits through increased timber recovery rates, the high initial costs associated with RIL-C adoption — including technical training, equipment procurement, and pre-logging site assessments — pose a significant burden on logging companies, resulting in a bottleneck that constrains RIL-C promotion. It is, therefore, crucial to establish financial incentives. Based on this fact, a cross-analysis of LCoP requirements and climate change mitigation potential was conducted, the results of which were organized as shown in Table 2.3-3. Using these findings, further examination of appropriate carbon monitoring indicators and parameters was pursued with a focus on incentive creation through emissions reduction in commercial logging operations.

Table 2.3-3 Summary of LCOP Requirements and Climate Change Mitigation Potential

LCoP Items	Potential for Mitigating Climate Change	REDD+[5][6]
Logging system		
Logging system: conventional extraction	Reduce pressure on forest by avoiding alternative extraction systems more destructive to the environment	SFM
Type of logging: selective	Reduce pressure on forest by limiting extraction to one category of tree species	SFM
Types of trees: merchantable	Reduce waste by limiting extraction to timber species of which most of the volume will be used + Most of the logs may be transformed into wood products (like furniture) for long-term sequestration	SFM
Size of trees DBH > 50 cm	Reduce pressure on forest by limiting extraction to a tree dimension range + Protect young stems that are the guarantors of future large trees and whose biomass increase rate is high	SFM
Setup design		
Setup area < 150 ha	Reduce degraded area + Facilitate conservation of unlogged forest area	CON
Revegetation of sites: recommended	Increase natural forest regeneration rate + Enhance carbon stocks	CSE
Reforestation of setups: recommended	Increase natural forest regeneration rate + Enhance carbon stocks	CSE
Roads & Landings		
Number of roads: minimum	Reduce deforested area by limiting road length	DEF
Road construction: recognized standards	Reduce deforested area because most standards urge a limit to forest-to-non-forest conversion	DEF
Road width < 40 m	Reduce deforested area by limiting road area	DEF
Number of landings < 3 per setup	Reduce deforested area by limiting ponds	DEF
Area of landings < 0.25 ha	Reduce deforested area by limiting pond area	DEF
Skidding		
Area of skid tracks < 10% of setup area	Reduce deforested area + Reduce degraded area + Limit forest fragmentation due to skid networks	CON
Width of skid tracks < 6 m	Reduce deforested area	DEF
Felling		
Slope of logging area < 30 deg.	Reduce pressure by limiting extraction to terrains + Limit collateral damage facilitated by steep slopes (erosion, uncontrolled felling direction) + Limit access to zones often hosting high conservation value (HCV) & pristine habitats	CON
Felling direction: avoiding adjoining trees	Reduce deadwood (uprooted, leaning, standing dead and bark-removed trees)	DEG
Felling techniques: avoiding retained trees	Reduce deadwood (uprooted, leaning, standing dead and bark-removed trees)	DEG
Height of stump: as low as practical	Reduce log waste	DEG
Partial cut and left standing: no	Reduce deadwood (standing dead trees)	DEG

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[5] REDD+ is a framework under the United Nations Framework Convention on Climate Change (UNFCCC) that refers to the "reduction of emissions from deforestation and forest degradation in developing countries, as well as forest conservation, sustainable forest management, and the enhancement of forest carbon stocks."

[6] DEF = avoided deforestation; DEG = avoided forest degradation; SFM = sustainable forest management; CON = conservation; CSE = carbon stock enhancement.

Activity 3-2: Identify indicators to assess low emission logging activities (e.g. Area for roads and log landings, damaged woods due to felling, etc).

As outlined in Activity 3-1, it was necessary to digitize logging monitoring data and develop survey methods for unmeasured parameters. For this purpose, it was decided that activities related to Output 3 would also be implemented in the logging concessions selected as pilot sites for Output 1 and Output 2. Prior to field surveys at the pilot sites, a methodological framework utilized by other countries such as Indonesia was reviewed, in order to identify appropriate indicators for PNG.

As previously mentioned, pursuing RIL-C through compliance with the PMCP and LCoP could potentially create additional opportunities for PNG to access international carbon finance. However, to become qualified for such funding opportunities, a solid, internationally-recognized methodology must be used to evaluate RIL-C outcomes in terms of emissions reduction. Nevertheless, since developing an entirely new methodology would be time-consuming and require huge financial investment, it was reasonable and justifiable to assess the feasibility and applicability of existing RIL-C methodologies in PNG, instead of crafting one from scratch. To this end, the VCS0035: Methodology for Improved Forest Management through Reduced Impact Logging,[7] developed under the Verified Carbon Standard (VCS) — internationally one of the most widely used carbon credit certification standards for greenhouse gas (GHG) reduction — was reviewed. Additionally, an in-depth analysis was conducted on Indonesia's World Bank FCPF-Carbon Fund emissions reduction program, which is implementing RIL-C through a jurisdictional approach that has adopted this same VCS methodology. Through this review, key indicators, as well as possible challenges for implementing RIL-C methodology in PNG, were identified. A provisional set of indicators, developed based on the literature review (including the VCS methodology) during the Detailed Design Survey Phase, is summarized in Table 2.3-4 to Table 2.3-6.

Table 2.3-4 Provisional Field Indicators for Logging-associated Carbon Monitoring (as of 2023)

Emission Sources	Field Indicators
Felling emissions	Locations of stumps
	Number and dimensions (height, DBH) of trees felled and harvested
	Number and dimensions of trees felled and abandoned (entire logs)
	Number and dimensions of logs abandoned
	Number and dimensions of trees damaged
Skidding emissions	Skid track length (alternatively: skid length per ha)
	Skid track width
	Skid track area
	Carbon loss per length or area unit (all trees 20 cm < DBH < 50 cm)
Road emissions	Haul road length (alternatively: road length per ha)
	Haul road width
	Haul road area

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[7] https://verra.org/wp-content/uploads/imported/methodologies/VM0035-RIL-C-Methodology-v1.0.pdf.

	Carbon loss per length or area unit (all trees and non-tree vegetation corresponding to natural vegetation carbon stock)
Log pond emissions	Number of log ponds (alternatively: number of ponds per ha)
	Log pond length
	Log pond width
	Long pond area
	Carbon loss per pond or area unit (all trees and non-tree vegetation corresponding to natural vegetation carbon stock)

Table 2.3-5 Provisional Monitoring Parameters and Necessary Data for Logging-associated Carbon Monitoring (As of 2023)

Monitoring Parameters	Necessary Data or Information
Tree damage categories	G: uprooted, laying on ground
	S: trunk snapped below first branch
	L: leaning ≥10° from vertical
	C: ≥50% of crown lost
	B: ≥100 cm^2 of bark loss
Logging areas	Concession areas
	Annual block areas
	Cutting block areas without evidence of prior logging vs. those with evidence of prior logging (ex: 40/60)
	Setup areas
Actual harvested volumes	Concession volumes
	Setup volumes
	Road volumes
	Landing volumes
	Skid gap volumes
	Felling gap volume
Unlogged forest biomass	Count (all species, not only merchantable) trees
	Identify tree species
	DBH
	Height, width or length (alternatively take minimum and maximum DBH)

Table 2.3-6 Provisional Impact Parameters to Assess Emissions Reduction (Data Collection Method and Sampling Scale. As of 2023)

Impact Parameter (IP)	Measurements (Reported on a 1-year Cutting Block)	Data Acquisition Methods	Sample Size Requirements
Felling impact	Average percentage of abandoned felled trees / total (abandoned + harvested) felled trees	- **Tally** felled trees - **Tally** abandoned entire logs or trees - **Tally or get records** of harvested trees	More than 200 felled trees in sampled skid tracks (log search is limited to skid tracks with full length and width of 50 m, i.e. 25 m both sides)

Felling impact	Average percentage of length of felled logs left (excluding entire logs) / total harvested trees	- **Tally** left logs - **Tally or get records** of harvested trees	Same as above
Skidding impact (trail density)	Average length of skid track per ha in logging block (m/ha)	- Skid length by **handheld GPS** - Skid area by **GIS vector map**	More than 5 km skid track length Buffer 50 m on either side of the skid track network vector map to get the skid area
Skidding impact (tree damage)	Average number of trees killed per meter of skid track (number/m)	- Measure skid length by **handheld GPS** - **Tally** damaged trees	More than 5 km skid track length. Types of trees killed: snapped or uprooted. Size of trees killed: DBH ≥ 20 cm
Hauling impact including infrastructure	Average haul road corridor area including log yards / total coupe area (m²/ha)	- Logging road width: **Field or RS (image resolution < 2 m)** - Logging road area and length: **GIS maps or RS (image resolution < 30 m)**	Road length: exhaustive Road width: more than 30 samples per coupe

In parallel, an assessment was conducted to evaluate the applicability of remote sensing technologies — including free satellite imagery (Landsat, Sentinel-2, Planet) and drone imagery — for mandatory monitoring, reporting, and verification (MRV), as defined by VCS methodology for RIL-C. The examination process involved comparative analyses that considered spatial resolution, temporal resolution, detection of forest degradation and regeneration events, event size, and the selection of target sites. As shown in Figure 2.3-1 to Figure 2.3-3, the findings indicated that while logging roads and log landings are visible and identifiable with remote sensing data, small open canopy spots created by selective logging operations (felling gaps) and skid tracks running beneath the canopy remain challenging to detect even with high-resolution satellite data (Planet) as well as drone imagery data. Resolution limitations also make it difficult to conduct a quantitative assessment of these objects (for a more detailed comparison, see Annexure 26).

Visibility of Drone Images (Overlaid with Hauling Road and GIS Watercourse Data)

Visibility on High-resolution Satellite Images
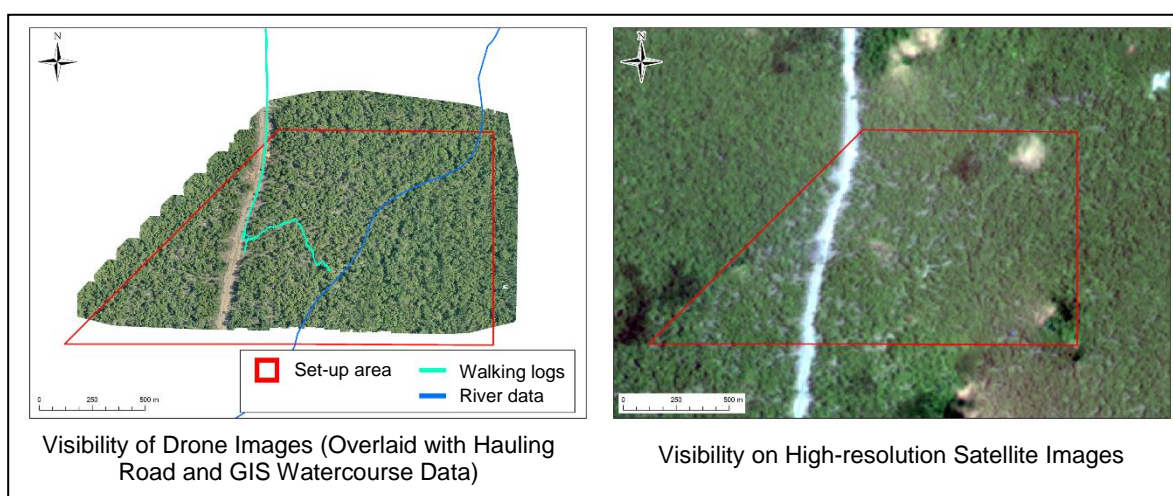
Figure 2.3-1 Visibility of Drone and Satellite Image Data

Integrated Deforestation Alert (from 2020 to November 10, 2023)

| Planet 2023 (first half) | Integrated Deforestation Alert (from 2020) |
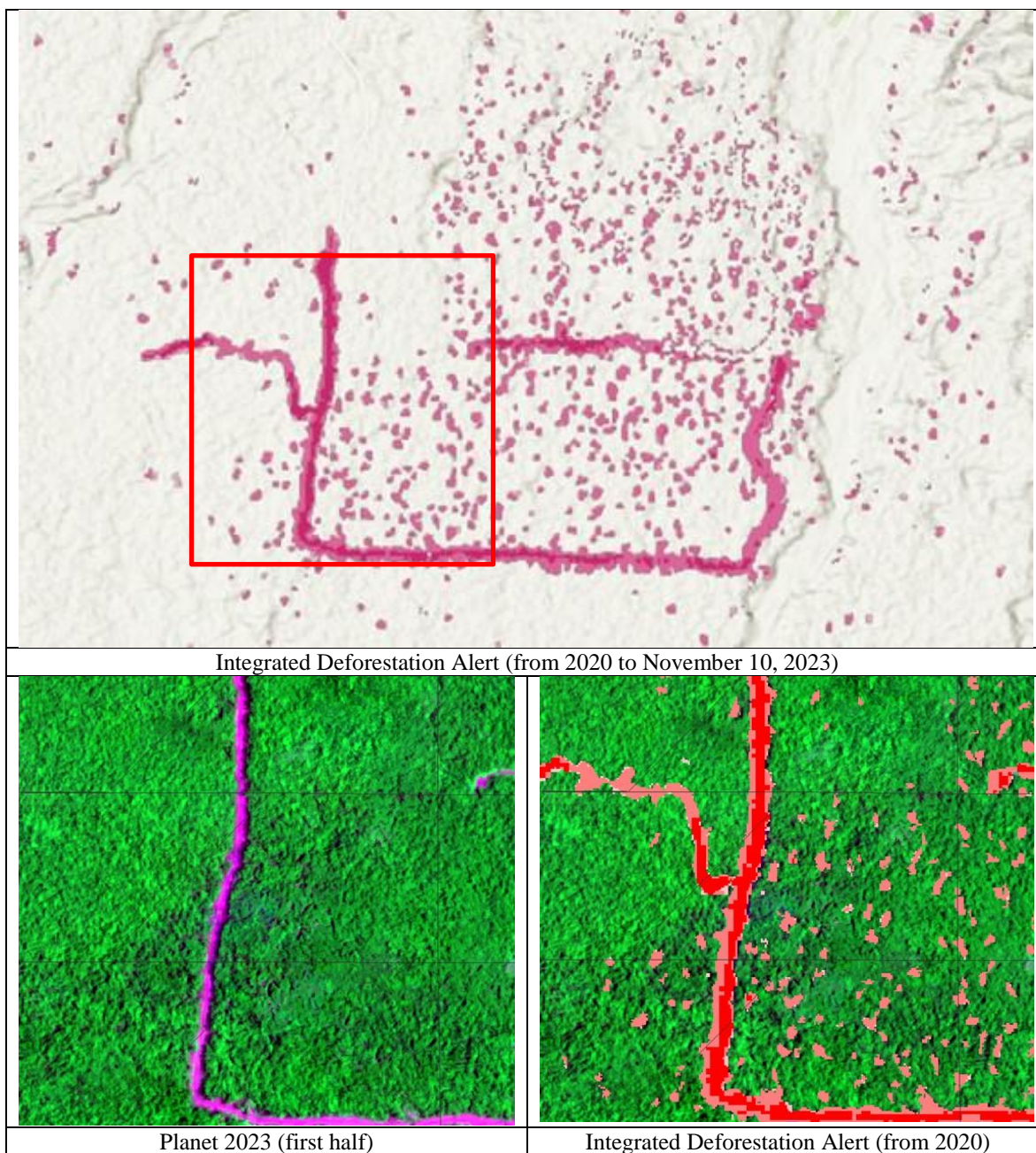
Figure 2.3-2 Detection Result of Integrated Deforestation Alert

| Planet Natural Color (enlarged) | Integrated Deforestation Alert (enlarged) |
| UAV (March 2023) RGB Color (enlarged) | Integrated Deforestation Alert (enlarged) |
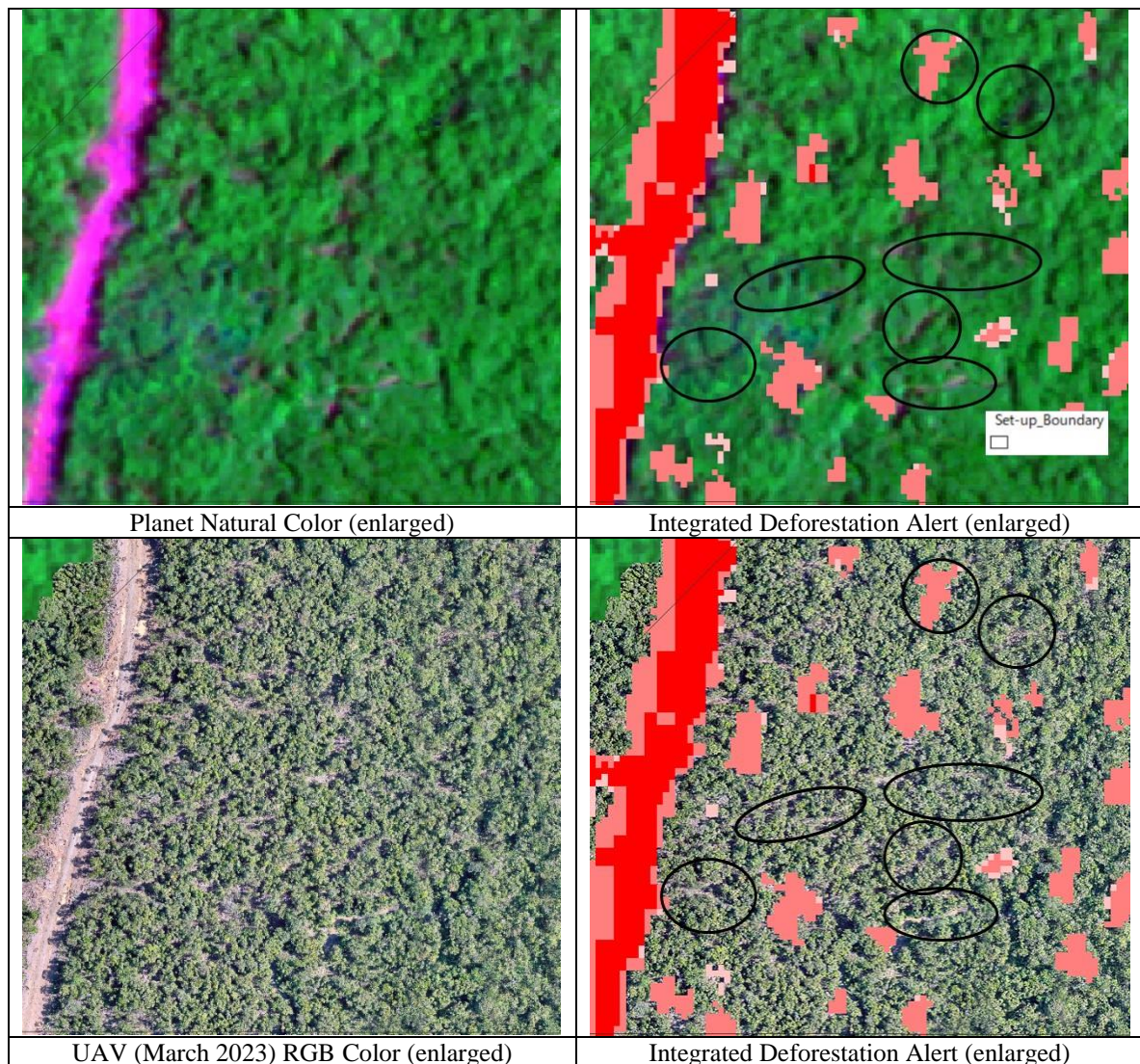
Figure 2.3-3 Comparison of High-frequency Observation Satellite Images, High-resolution Drone Images, and Integrated Deforestation Alert

Based on the examination of provisional indicators and verification of the limitations of remote sensing-based monitoring, a trial field measurement test and a technical training, which also served as a discussion session to exchange opinions, was conducted in March 2024. From the test results, field monitoring indicators and parameters were systematically organized, focusing on the evaluation of identified emission sources (see Figure 2.3-4). Through this field study, it became evident that critical factors for emissions reduction include optimizing the skid track network (including limiting skid track width), minimizing the area and number of log landings, and improving felling and skidding processes to reduce collateral damage to surrounding trees. Building on these findings, the development of methodologies under Activity 3-3 has been advanced accordingly.
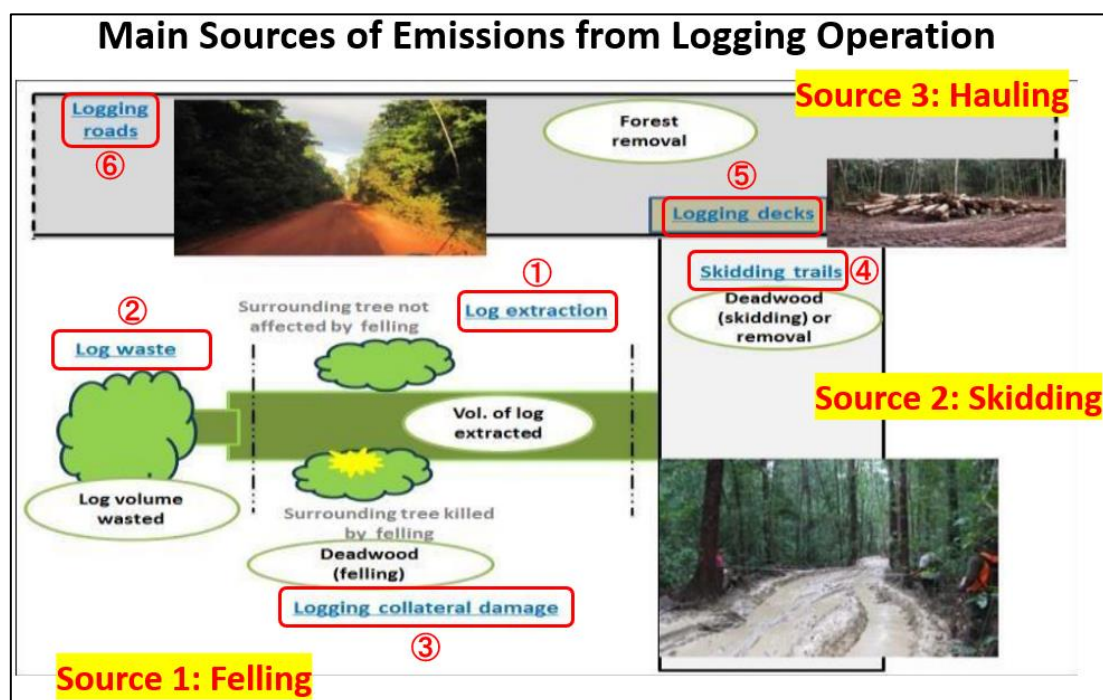
Figure 2.3-4 Sources of Emissions from Logging Operations

Table 2.3-7 List of Indicators and Parameters to Be Assessed Field Carbon Monitoring

Source of Emissions				Measurement Objects	Measurement Values
Logging-caused forest carbon stock damage	Carbon stock damage in felling gaps due to felling	Timber-trees	Log volumes — Extracted log volumes	Removed deadwood	Length (L), Diameters of top and bottom of logs (D1–D4)
			Log volumes — Non-extracted log volumes (incl. offcuts, abandoned logs)	Lying deadwood	Length (L), Diameters of top and bottom of logs (D1–D4)
			Non-log volumes — Stump	Stump	Height (H), Diameters of stump (D1–D2)
			Non-log volumes — Tops logs	Lying deadwood	Length (L), Diameters of top logs (D1–D2)
		Other trees	Uprooted volume	Lying deadwood	Length (L), Diameters of uprooted trees (D1–D2)
			Snapped trees — Above the first branch	Live tree (mortality < 100%)	**Not considered under this method**
			Snapped trees — Below the first branch	Standing deadwood	Height (H), DBH
	Area damaged due to log extraction	Skid tracks		Standing deadwood	Height (H), DBH
				Lying deadwood	Length (L), Diameters of lying deadwood (D1–D2)
				Forested area removed	Skid track width and length, or area
		Log landings		Forested area removed	Log landing width and length, or area
		Hauling roads		Forested area removed	Hauling road width and length or area
		Others (e.g., logging camps)		Forested area removed	**Not considered under this method**

Activity 3-3: Identify and develop methodology for monitoring, recording, reporting or reducing emission level from logging operations through trials and validations in the pilot site(s).

Prior to the development of the field logging carbon monitoring methods, discussions were held with the PNGFA to confirm the objectives and direction, as well as level of expected outcomes of the

methodology development, ensuring a shared understanding among stakeholders. The key points agreed upon are as follows.

<u>\<Objectives of Field Carbon Monitoring Method Development\></u>

- Access to climate finance (as an alternative foreign revenue source beyond commercial logging).
- Contribution to targets for PNG's Nationally Determined Contributions (NDCs) and Sustainable Development Goals (SDGs).

<u>\<Direction of Methodology Development\></u>

- Establish a methodology to measure emissions from RIL-C through LCoP compliance.
- Align with internationally-recognized methodologies to facilitate future certification.
- Put primary focus on developing a method to quantify carbon emissions at the smallest operational unit within commercial logging concessions (setup unit level).

<u>\<Level of Expected Outcome\></u>

- Recognize that collecting extensive amount of field data required for full-scale development of a solid methodology like VM0035 would require a significant amount of time and effort (including financial investment). Instead, the expected outcome of methodological development should be to craft a method to conduct a trial of field carbon monitoring of logging operations.

Based on this understanding, data collection methods were explored for parameters identified that are related to the impact of logging operations on carbon stocks change. In March 2023, a field survey test was conducted at one of the pilot sites, the Marshall Lagoon & Unu Amau FMA in Kupiano District, Central Province. Details on this test are documented in the LCoP Impact Assessment & Carbon Monitoring Methodology Review Report (Annexure 26). Building on the test results, a concept proposal for a field carbon monitoring method for commercial logging operations was developed. After consultations with the PNGFA, a framework for the method and the parameters to be measured were finalized. Subsequently, a draft method was compiled in June 2024 and the first trial carbon monitoring survey was conducted again at Marshall Lagoon & UNU Amau FMA in early July (see Annexure 14 for survey results). Additionally, in November 2024, another field trial survey was conducted at the natural forest logging site operated by OBT, which is another pilot site of the Project (see Annexure 15 for survey results). Based on the findings and insights gained from the surveys at both locations, the method was revised and finalized. In addition, supporting materials were also prepared, such as field record sheets, the "Project Manual for Field Logging Emission Measurements" and "Project Manual for Logging Carbon Emission Calculation", and Excel spreadsheets for carbon calculations.
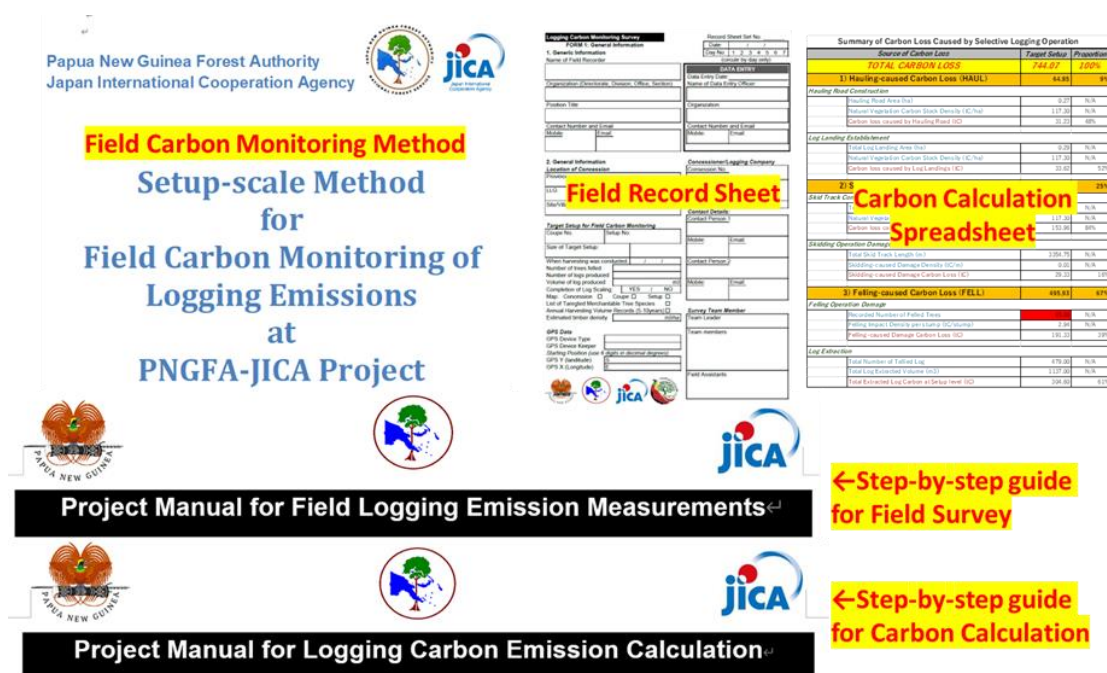
Figure 2.3-5 Set of Documents Prepared for Logging Carbon Monitoring

Reflecting the results of two field surveys, the field carbon monitoring method was finalized and is included as Annexure 16. Additionally, for detailed information on the specific field survey process and the carbon calculation procedures, please refer to the Project Manuals (Annexure 17 and 18). The values required for the measurement of logging emissions, along with the corresponding survey items necessary for their calculation, are listed in Table 2.3-8 and Table 2.3-9.

Table 2.3-8 Required Values for Logging Emission Calculations

Emission Factor		Required Values
Logging infrastructure emission	Forest clearance for hauling road	Total hauling road area (ha)
		Natural vegetation carbon stock density (tC/ha)
	Forest clearance for log landing	Total log landing area (ha)
		Natural vegetation carbon stock density (tC/ha)
	Forest clearance for skid track	Total skid track area (ha)
		Natural vegetation carbon stock density (tC/ha)
Logging damage emission	Skidding-caused collateral damage	Total skid track length (m)
		Average deadwood carbon density per skid track meter (tC/m)
	Felling-caused collateral damage	Recorded number of felled trees (stump)
		Average deadwood carbon density per felled tree (tC/stump)
	Log wastes/residues	Recorded number of felled trees (stump)
		Average log waste carbon density per felled tree (tC/stump)
Log extraction emission	Log extraction	Recorded removed log carbon volume (tC) (from log scaling data)

Table 2.3-9 Survey Items for Field Logging Carbon Monitoring

Emission Category	Survey Items
SKID	**Skid Track Area** at target setup (total length of both main and spur roads and average width)
	Skidding-caused Collateral Damage Impact at target setup (deadwood density per meter and total length)
	Natural Vegetation Carbon Stock Density (average carbon volume of natural vegetation per hectare)
FELL	**Felling-caused Damage Impact Density (Collateral Damage + Waste)** at target setup (deadwood and residue density per stump/tree and total number of trees felled)
	Log Extraction Impact of target setup (log extraction volume)
HAUL	**Hauling Road Area** at target setup (average width and length allocated for target setup)
	Total Log Landing Area at target setup (length and width of respective log landings)
	Natural Vegetation Carbon Stock Density (average carbon volume of natural vegetation per hectare)

Similar to the VM0035 methodology, this method is specifically designed to calculate emissions derived from logging activities. Therefore, deadwood that existed before logging operations is excluded from the survey items, as is non-tree vegetation such as ferns, lianas, palms, pandanus, bamboo, and seedlings. Additionally, the carbon pools considered in this method exclude soil carbon and are limited to aboveground and belowground biomass of trees and newly-generated deadwood resulting from logging operations, as summarized in Table 2.3-10.

Table 2.3-10 Target Carbon Pools

Carbon Pools	Included/Excluded	Remarks
Above-ground tree biomass carbon	Included	Significant pool affected by logging operation
Below-ground tree biomass carbon	Included	Significant pool affected by logging operation
Above-ground non-tree biomass carbon	Excluded	Non-trees like ferns, liana, palm, pandanus, bamboo, seedlings are conservatively excluded
Deadwood biomass carbon	Included	Standing and lying deadwood produced by harvesting are included. Changes in stock of pre-existing deadwood are conservatively excluded.
Litter	Excluded	No significant change is expected.
Soil	Excluded	No significant change is expected.

Activity 3-4: Develop training program and provide necessary trainings to adopt carbon monitoring for PNGFA field officers.

In the process of planning Activity 3-2, a consultation meeting was held with PNGFA officers in November 2023 to discuss the training content and training implementation plan. It was mutually confirmed that the training would be conducted after completion of the development of the field carbon monitoring method conducted under Activity 3.3, in order to design the training program based on that method. Additionally, it was also agreed that the training would be conducted on-site at the Project pilot sites, together with actual field surveys, in order to provide both theoretical lectures for the acquisition of knowledge and practical field training for hands-on experience. As a tentative training framework, the following key components were planned:

1. Introduction to global trends in carbon monitoring and related plans in PNG, including an overview of Indonesia's FCPF Carbon Fund subnational program and applied VCS methodologies for RIL-C.

2. Explanation of the field logging carbon monitoring method in PNG, covering aspects such as survey processes, data collection methods for different parameters, and the theoretical and procedural aspects of carbon calculations.

Based on this plan, a total of five training sessions were conducted during the Project period. The first and second training sessions were conducted in July 2024, coinciding with the first trial carbon monitoring survey. The third and fourth training sessions were held together with the second trial carbon monitoring survey at OBT in East New Britain Province. The content of the training was continuously updated based on findings from each training session and field survey, and based on participant feedback. A forest carbon monitoring workshop, which also served as part of Activity 3-7 and incorporated training sessions, was conducted from February 18 to 20, 2025. The number of participants are given in Table 2.3-11.

Table 2.3-11 Summary of Trainings (with the Number of Participants)

Training Program	Participating PNGFA Officers	Location
Discussions on training plan development	(6)	Port Moresby
First Training Session (July 8–9, 2024)	21	Port Moresby
Second Training Session (July 14–18, 2024)	6	Marshall Lagoon
Third Training Session (November 25–27, 2024)	4	Open Bay
Fourth Training Session (December 5, 2024)	25	Port Moresby
Fifth Training Session and workshop (February 18–21, 2025)	20	Port Moresby
Total Number of Training Participants	**76**	

In particular, during the Carbon Monitoring Workshop/Fifth Training Session, a comprehensive training was conducted based on the developed method and procedures. This training covered the

entire cycle, from field survey design and data collection methods to data entry and the estimation of logging-caused carbon stock changes for emission calculations. To assess the outcomes of the training, a pre- and post-training assessment surveys were conducted using three evaluation indicators: (1) theoretical understanding of field carbon monitoring of logging operations (Indicator 1: Theory); (2) practical understanding of field measurement during logging carbon monitoring surveys (Indicator 2: Field Measurement); and (3) practical understanding of carbon loss calculation based on field data (Indicator 3: Carbon Calculation). The evaluation method focused on participants' self-assessment of changes in their level of understanding and knowledge before and after the training, using on a five-point scale (Excellent, Very Good, Good, Fair, and Poor).

As shown in the graphs below, significant improvements in understanding were observed across all three indicators, something confirmed by an increased in the number of participants rating their understanding as Excellent or Very Good. While there was some variation in the degree to which individual knowledge improved, overall a marked increase was confirmed. (It should be noted that among participants who reported "no improvement", one individual had already been regularly involved in carbon monitoring activities and was therefore assessed as having sufficient knowledge of the methodologies and procedures prior to the training. In this case, no change in knowledge level was observed in the post-training assessment).

The results of these assessments explicitly indicated that PNGFA technical staff involved in carbon monitoring activities have attained at least the minimum necessary level of knowledge and understanding required to sustain this output. Among these technical staff members, several C/P officers who actively participated in field carbon monitoring surveys at the pilot sites can be considered to have reached a level where they could play a leading role in the future expansion of carbon monitoring initiatives.
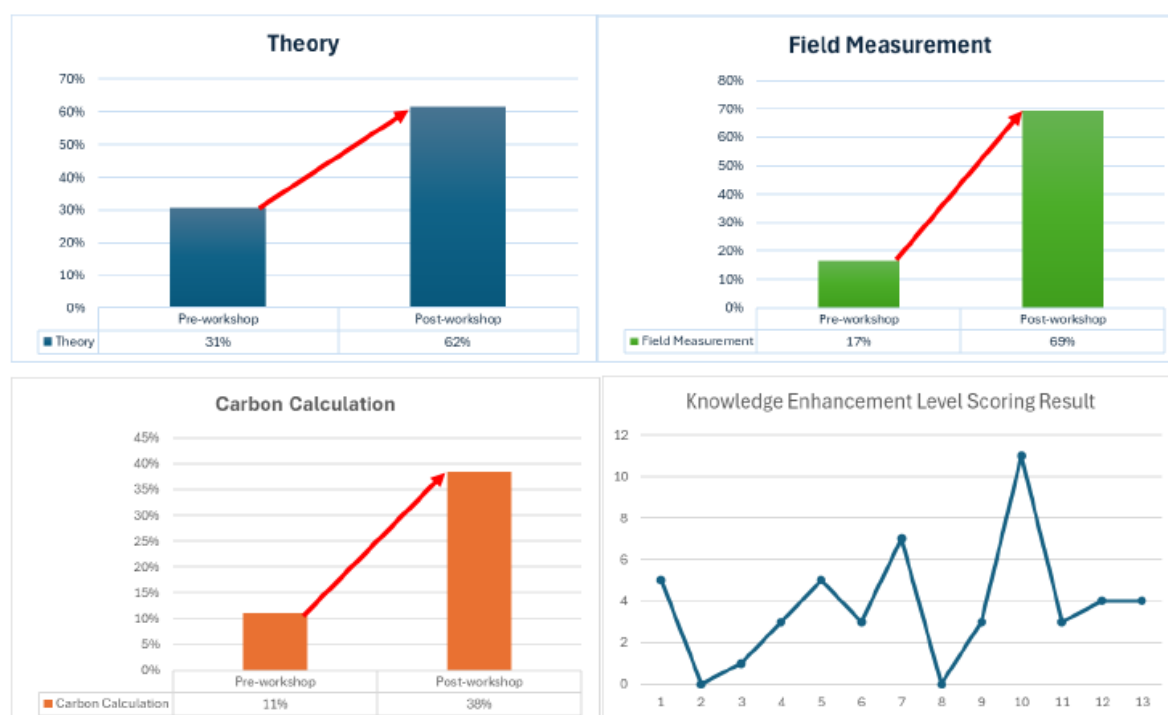
Figure 2.3-6 Changes in Understanding and Knowledge Level Before and After the Carbon Monitoring Workshop/Training

Activity 3-5: Compile proposals to promote the implementation of low emission logging.

The development of a method for field logging carbon monitoring under Activity 3-3 will enable the future disaggregation of emissions specifically from commercial logging from the overall emissions of forest degradation. Furthermore, as shown in Table 2.3-12, this method will allow for a comparative analysis by distinguishing between the impact of conventional commercial logging and the impact of RIL-C, the latter of which is expected to be promoted in future initiatives. This suggests the potential for establishing carbon projects in a new area of REDD+, "Sustainable Management of Forests", similar to the FCPF project in East Kalimantan, Indonesia (in the context of VCS projects, this would be categorized under "Improved Forest Management").

Table 2.3-12 Overview of Emission Calculations and Benefits Associated with Commercial Logging

More transitions in LU matrix	Land use transitions (matrix)		
	Deforestation (DEF)	Primary DEF	I (primary forest) -> 0 (deforested area)
		Secondary DEF	II (secondary forest) -> 0
	Degradation (DEG)	DEG by all drivers	I -> II
	Logging	DEG by Logging	I -> logged area
Gain-Loss approach Field method [FM]		DEG by Conventional logging	I -> CL logged area
		DEG by RIL logging	I -> LEL logged area
		Secondary DEG by Conventional logging	RIL-> CL logged area

Possible right now

Possible in the future

More carbon standards methodologies to apply	Emission Factors	BASELINE scenario	PROJECT scenario	AFOLU carbon methodologies applicable	Projects in PNG
	EF (def)	0	I	Avoiding Ecosystem Conversion **VM0009**	Yes
		0	I	Avoiding unplanned DEF **VM0015**	Yes
		0	I	Mixed REDD methodo **VM0006, 07, 37**	Yes
	EF (deg)	Logging	Forest protection	- Logged to Protected **VM0010** - Preventing logging **VM0011**	Yes
Gain-Loss approach Field method [FM]	EF(log)	Conventional logging	Improved logging (RIL)	- IFM through RIL **VM0035** - East Kalimantan **WBFCPF-CF**	Intentions

Possible right now

Possible in the future

Additionally, at the request of the PNGFA, a rough estimation was undertaken in order to assess the potential financial support at the concession level that could be obtained from carbon funds, if emissions reductions were achieved through the promotion of RIL-C. As shown in Table 2.3-13, a baseline was established using the average annual logging volume over the past 10 years at the Marshall Lagoon & UNU Amau FMA pilot site. Further, as shown in Table 2.3-14, the potential emission-reduction effects achievable through RIL-C initiatives were estimated based on other countries' cases.

- 12%: Actual reduction achieved at the results-based payment stage of the East Kalimantan FCPF project

- 25%: The value used by USAID in the formation of an RIL-C project in Peru

- 37%: Projected reduction at the planning stage of the East Kalimantan FCPF project

Assuming a carbon price of USD 8 per tCO_2e, and that emission reductions achieved in the Project are comparable to those of the East Kalimantan FCPF project — which includes RIL-C within its scope — the total value over a 10-year project period would amount to approximately USD 2.16 million (around JPY 320 million), excluding deductions such as buffer allocations. Based on this estimate, it was confirmed that if the formation of a carbon project is pursued as an exit strategy, it will be necessary to consider project scale at the sub-national level (covering one or two provinces), targeting multiple concessions within provincial jurisdictional boundaries. In light of these estimation results, it was proposed that field carbon monitoring of logging operations be continued and the

development of carbon projects be pursued at the provincial level through the promotion of RIL-C in the future.

Table 2.3-13 Baseline of Marshall Lagoon & UNU Amau FMA

Year	Timber production (m3)	Emission Factor (MgC/m3)	Historical emissions (MgCO2e/year)
2010	6,227	2.5	57,133
2011	5,173	2.5	47,459
2012	2,752	2.5	25,253
2013	46,307	2.5	424,863
2014	16,529	2.5	151,656
2015	27,497	2.5	252,282
2016	7,372	2.5	67,638
2017	32,450	2.5	297,732
2018	0	2.5	0
2019	0	2.5	0
2020	0	2.5	0
2021	25,603	2.5	234,908
2022	44,789	2.5	410,939
2023	54,989	2.5	504,524
Mean emissions (2018-20 not considered)			**224,944**

Table 2.3-14 Rough Estimation of Carbon Finance Scale through Emissions Reduction by RIL-C

Year	Baseline Emission (tCO2e/year)	Emission Reduction (10%)	Emission Reduction (12%: East Kalimanthan/RBP)	Emission Reduction (25%: Peru/Planning)	Emission Reduction (37%: East Kalimanthan/Planning)
2025	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2026	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2027	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2028	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2029	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2030	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2031	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2032	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2033	224,944	22,494.40	26,993.28	56,236.00	83,229.28
2034	224,944	22,494.40	26,993.28	56,236.00	83,229.28
TOTAL	2,249,440	224,944.00	269,932.80	562,360.00	832,292.80
1tCO2e/year = 8USD	*1,799,552.00*	*2,159,462.40*	*4,498,880.00*	*6,658,342.40*

Regarding field logging carbon monitoring, trial field surveys at two pilot sites of the Project were utilized as samples for developing and scrutinizing the method used. In the formation of future carbon projects, it will be essential to further refine this method to make it practical and solidify it. Therefore, increasing the number of samples and accumulating carbon monitoring field data will be indispensable. To achieve this, the following strategy was proposed, as illustrated in Figure 2.3-7 and Table 2.3-15, for the phased expansion of this field logging carbon monitoring initiative, considering

cases in Central Province, as it is relatively accessible from Port Moresby and, moreover, the project pilot site of Marshall Lagoon Concession (two setups already surveyed) is also located in Central Province (see the August 2024 version of the proposal in Annexure 32 for more details).
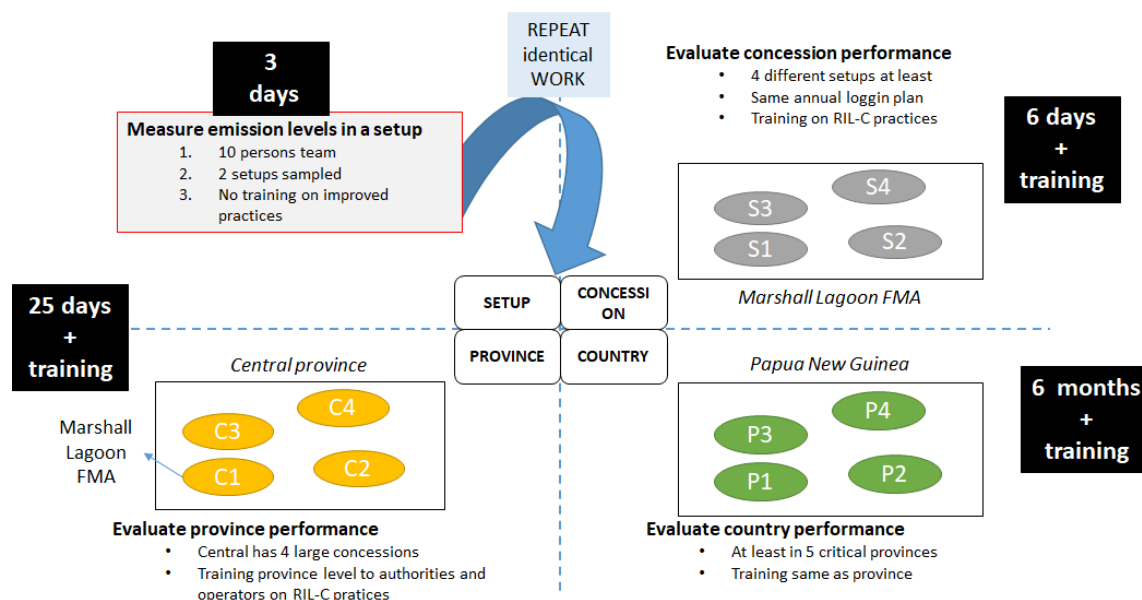

Figure 2.3-7 Phase-wise Approach for Expansion of Field Logging Carbon Monitoring

Table 2.3-15 Proposed Activities for Expansion of Field Logging Carbon Monitoring

Expected Outputs	Activities	Pre-phase (JICA Project, 2024)	Phase I: Setup (2024)	Phase II: Concession (2024)	Phase III: Province (2026)
Output 1: Draft methodology	*Methodology*	Setup-scale methodology (first)	Setup-scale methodology (country validation)	Setup-scale methodology (application)	Full-scale methodology (standards validation)
	Test	2 setups	Additional setups	Setups in other concessions	Setups from all voluntary concessions of 1 province
Output 2: Select priority practices to support and provide training	*Improvement practices and targets*	Training sessions	Expert workshop	Expert workshop	Expert workshop
	Training and implementation support	No	No	Training and support	Training and support
Output 3: Field trial monitoring	*Emission levels*	Measured biomass loss	Measured biomass loss	Add biomass gains (regeneration, etc.)	Add biomass gains (regeneration, etc.)
	Baseline emissions	Extrapolated (because of no setup-scale activity data)	Extrapolated (same reason)	Calculated	Calculated
	Project emissions estimation	Default targets e.g. 10%	Targets (expert workshop)	Targets (expert workshop)	Targets (expert workshop)

	Project emissions measurement	No	No	Monitoring parameters (expert workshop)	Monitoring parameters (expert workshop)

In addition, as part of efforts for low-emission logging through compliance with the LCoP and PMCP, it is necessary to examine feasible and specific RIL-C practices. In Activity 2-2, it became clear that optimizing the skidding road network (including width restrictions), minimizing the area and number of log landings, and improving felling and skidding processes to reduce unnecessary incidental damage are particularly important for emissions reduction. However, an analysis and evaluation of the potential emission-reduction effects of each RIL-C practice, as well as their cost-effectiveness, have not been conducted, as these fall outside the scope of the Project. Therefore, as illustrated in Table 2.3-16, based on the results of a review of the LCoP and PMCP, possible RIL-C practices in compliance with these regulations were organized and proposed. Furthermore, it was strongly recommended that specific RIL-C practices be identified that the PNGFA would like to prioritize for promotion, as well as future demonstration trials and potential evaluations to be carried out.

Table 2.3-16 Summary of RIL-C Practices with Mitigation Potential

LCOP/PMCP Compliance	Future Potential RIL-C Practices based on LCOP/PMCP compliance	Emission Source Category
PLANNING		
1) Five-year Plan: - Term: 5 years - Map scale: 1/50,000 - Concession boundary - Location of permanent hauling roads, bridges, log ponds, camp, conservation area, steep slope (>30 degree), swamp area - Forest inventory data	* Prepare a 1/ 25,000 scale map for the Mid-term plan like Five-year Plan to accurately delineate concession boundaries and optimal hauling road planning * Identify High Conservation Value (HCV) Areas at the concession level (for safeguarding purposes). * In addition to the Five-year Plan, 20- or 30-year Long-term Plan can be prepared with 1/50,000 scale map	Logging Infrastructure Emission (Hauling Road)
2) Annual Logging Plan: - Term: 1 year - Map scale: 1/25,000 - Setup boundary (each setup<150 ha) - Detailed location of log ponds and camps, as well as exclusion areas like buffer zones, reserves/tambu sites, water supply zones	* Prepare a 1/5,000 or 1/10,000 scale map for the Annual Plan for effective timber harvesting and accurate identification of exclusion areas (like buffers)	Logging Infrastructure Emission (Log Pond/Camp)
3) Setup Plan: - Term: No specification but shorter than 1 year - Map scale: 1/10,000 (map) or 1/5,000 (sketch) - Boundaries of excluded areas (watercourse buffer zones, cultural/historic sites or tambu sites) - Detailed location of skid tracks, log landings, and hauling roads which provides access to the setup	* Prepare a map of 1/5,000 scale (not a sketch), with 5-10 m contour lines for the Setup Plan, which enables accurate and cost-effective skid track network plannings	Logging Infrastructure Emission (Skid Track)
HAULING		
1) Hauling Road Width: Not exceeding 40 m between cleared edges: (including pavement and drainages of 15 m + cleared zone of about 12.5 m either side, in order to allow for drying of the road surface and to provide safe sight lines)	* **Optimize total hauling road networks** at concession level in the Five-year Plan, through accurate planning based on topography and forest stocks, in order to minimize forest clearance areas * **Strictly control road widths** at any part of the concession area, in order to minimize forest clearance areas	Logging Infrastructure Emission (Hauling Road)
2) Log Landing: - Size: Not exceeding 0.25 ha - Number: No more than 3 log landings per setup	* Optimize and **minimize the number of log landings** through accurate planning for the Annual Logging Plan, based on estimated harvesting volumes, in order to minimize forest clearance areas * **Strictly control the size of log landings less than 0.25ha or even smaller** through proper bucking/trimming, in order to minimize forest clearance areas as well as log wastes/residues	Logging Infrastructure Emission (Log Landing)
SKIDDING		
1) Skid Track Network Area: - Not exceeding 10% of setup area (less than 15 ha, as maximum setup size is 150 ha)	* **Optimize total skid track networks** at setup level through detailed planning based on a detailed topography map (5-10 m contour lines) for the Setup Plan, as well as the field inventory survey and tree prescriptions, in order to minimize forest clearance areas	Logging Infrastructure Emission (Skid Track)
2) Skid Track Width: - Not exceeding 6 m between edges	* **Strictly control skid track widths** during construction at any part of the skid track networks, in order to minimize forest clearance areas as well as collateral damage to surrounding trees	Logging Infrastructure Emission (Skid Track)
3) Skidding Machines: - All skidding machines must be fitted with a winch carrying not less than 40 m of good wire rope	* **Promote the utilization of winches** for skidding operations instead of excavator's booms or dozers, in order to minimize collateral damage caused by skidding operation * Monitor collateral damage around skid tracks (both main track and spur roads)	Logging Damage (Skidding-caused Collateral Damage)
FELLING		
Tree Felling 1) Retain certain basal area (i.e., 9-10 m² per hectare in a setup of 150ha) 2) Tree Size: Must be above 50 cm DBH 3) Prescription of all harvesting trees in advance 4) Low-height cutting (below 50 cm height of stump remaining) through backcut above scarf-cutting 5) Apply directional felling 6) Apply vine cutting prior to harvesting (6 months before) 7) No felling on the steep slope above 30 degrees, (above 20 degrees in case of sandy and silty soil)	* **Monitor basal areas, utilizing remote-sensing technologies** * **Mark only bigger trees above 55 cm or 60 cm DBH**, instead of 50 cm, at the stage of prescription, in order to reduce the number of felled trees * Prepare a detailed setup-level harvesting plan (Setup Plan) based on location data of prescribed trees (GPS applied) together with the skid track network construction plan, prepared based on a 1/5000 scale map with 5-10 m contour lines * **Monitor heights of stumps while encouraging application of low height cutting and improved bucking/trimming**, in order to minimize log wastes * **Monitor collateral damage around felled tress (lying and standing deadwoods) while encouraging application of directional felling and sound-testing/plunge-cutting to identify hollow or defective trees**, in order to minimize log wastes * **Develop an accurate Setup Plan based on a topography map of 5-10 m contour lines** to avoid steep slope areas, in order to minimize felling caused damages	Logging Damage (Felling-caused Collateral Damage)

Activity 3-6: Compile proposals for forest carbon monitoring and reducing emissions from logging operations on the basis of the Activity 3-1 to the Activity 3-5.

Based on the outputs, as well as insights and lessons learned through the implementation of Activities 3-1 to 3-5 described above, specific proposals for expanding forest carbon monitoring and promoting

emissions reduction from logging operations were compiled jointly with the long-term expert team, as outlined below. Furthermore, after conducting consultations with PNGFA officers who have been involved in previous activities, project proposals in terms of forest carbon monitoring were finalized.

Recommendations on Carbon Monitoring

1. **Accumulate field carbon monitoring data**: Using the Project's outputs of carbon monitoring methods to accumulate carbon emissions data at set-up level.

2. **Institutional arrangement**: As this is a new initiative for the PNGFA, a project team needs to be established to ensure its continuation. This team should be composed of relevant technical directorates.

3. **Expand field carbon monitoring**: Expand carbon monitoring from the setup level to the concession and provincial levels to assess carbon emissions from logging operations on a broader scale.

4. **Working with Expertise France (EF):** Key actions for carbon monitoring in 2025: (1) identify target province; (2) plan carbon monitoring (number and types of projects and setups, and forest classification (primary or secondary)); (3) technical sessions (identification of operational practices to reduce carbon emissions (e.g., bulldozer and chainsaw operators, data exchange), capacity building, and refinement of method).

5. **Assess emissions reduction through LCoP compliance**: (1) Identify operational practices in the LCoP that contribute to emissions reduction; (2) compare emissions levels between compliant and non-compliant operations; and (3) assess the effect of carbon emissions reduction from compliance with the LCoP.

6. **Pursue an opportunity for forest carbon project**: Accumulate sufficient emissions data from logging operations through the actions above, and pursue opportunities to develop a forest carbon project.

7. **Assess logging emissions and explore measures for their reduction**: Conduct a comprehensive assessment of logging emissions and explore measures for emissions reduction. By utilizing the results, contribute to the achievement of PNG's Nationally Determined Contribution and global climate change mitigation efforts.

Based on the above proposals, particularly those related to number 4, field carbon monitoring activities were already incorporated into EU-FCCB Programme FY2025 Annual Action Plan, which the PNGFA will be implementing this year with EF's support. During the workshop in February 2025,

Table 2.3-17 Detailed Activity Plan of Field Logging Carbon Monitoring in 2025 under EU-FCCB Programme

the formulation of a detailed implementation plan was facilitated by the JICA expert team. As outlined below, three carbon monitoring surveys will be conducted in the two target provinces of the EU-FCCB Programme (West Sepik Province and New Ireland Province), targeting a total of three concessions and aiming to collect data from 12 setups. It was also confirmed among PNGFA officers that this initiative will continue to expand in 2026 and 2027 as well. With this output, it is evident that even after the completion of the Project, the field logging carbon monitoring initiated under Output 3 will continue and further expand with support from the EU-FCCB, which explicitly indicated that a clear pathway has been created for promoting RIL-C and establishing the formation of future forest carbon projects.

Target Province	West Sepik	New Ireland
Target project	Amanab Block 1-4 (3h from Vanimo) Amanab Block 5-6 (3h from Vanimo)	Komdaru Lamasa Siaman TRP (2h from Vanimo)
Participating officers	7 x PNGFA officials from technical directorates (1-2 each, including field level officers stationed at provincial level) 2 x FRI officials 1 x International expert assigned by EF/EU-FCCB	
Number of trips in 2025	2 times (preferably 11 days per trip)	1 time (7 days per trip)
Target number of setups	10 setups (1st trip: 4 setups, 2nd trip: 6 setups)	2 setups
Required logistics and arrangement	Flights, excess charge for survey tools, car hire, accommodations, printing and stationary, rations (food and water), allowances, petty cash, etc.	

Activity 3-7: Organize Workshop to disseminate the results of project activities.

As indicated in Table 2.1-7 under Activity 1-7, dissemination of the outputs of carbon monitoring-related activities was carried out primarily through three events: the mid-term Project workshop, carbon monitoring workshop, and final Project workshop. In particular, the carbon monitoring workshop, which also served as a training program, was attended not only by staff from the three key divisions who had participated in previous field carbon monitoring surveys — (1) the Forest Policy and Planning Directorate, (2) Reforestation & Afforestation Directorate, and (3) Field Operation Directorate — but also by representatives from the FRI and the Trade & Investment Directorate and the Forest Acquisition & Allocations Directorate, which are involved with logging companies. As a result, this workshop significantly contributed to the dissemination and promotion of the output of field carbon monitoring within the PNGFA.
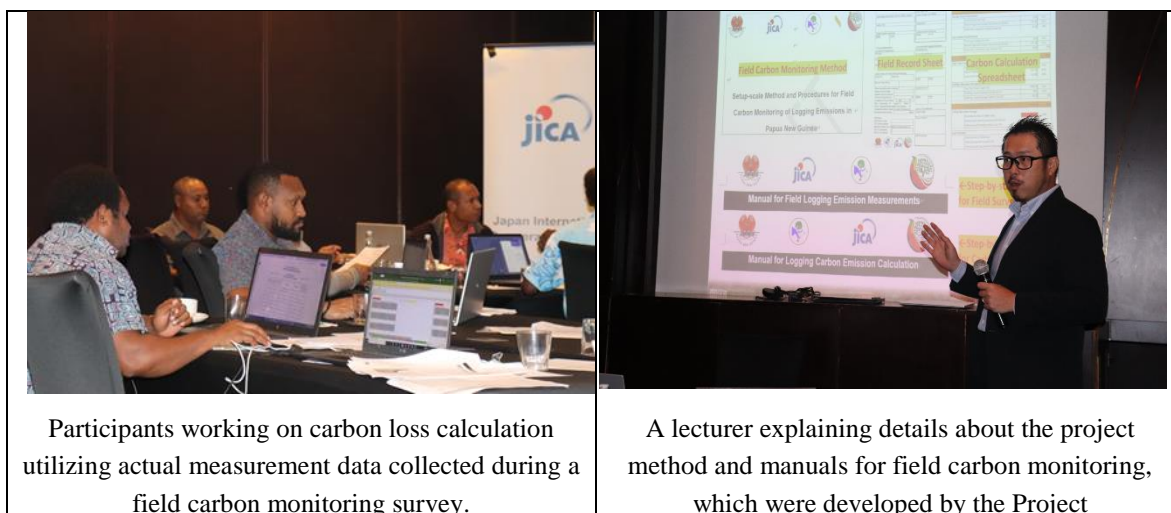
Participants working on carbon loss calculation utilizing actual measurement data collected during a field carbon monitoring survey.	A lecturer explaining details about the project method and manuals for field carbon monitoring, which were developed by the Project

Figure 2.3-8 Photos of Carbon Monitoring Workshop

2-60

Chapter 3.   Lessons Learned and Recommendations

3.1   Lessons Learned in Project Management

Utilization of Digital Technology and Ensuring Sustainability

The Project promoted the introduction of digital technology to enhance the transparency and efficiency of forest management by monitoring compliance with the PMCP and LCoP and digitizing data. In particular, to ensure sustainability beyond the Project's completion, the adoption of cost-effective free software was recommended over commercial software.

However, free software posed a challenge in that the information required for its operation was scattered, making it more time-consuming to master compared to commercial software. To address this issue, the Project identified essential functions, developed simplified manuals for practitioners, and provided training. Additionally, not all stakeholders involved in monitoring and forestry operations were proficient in digital technology, making its application at the field level particularly challenging. Therefore, it is crucial that even after completion of the Project, PNGFA headquarters continues capacity-building efforts to ensure the sustained adoption of digital technology. As part of the Project, training was provided for GIS officers at the PNGFA, aiming to ensure the dissemination of technical knowledge beyond the Project period.

In addition to these challenges, infrastructure is essential for the effective introduction of digital technology. Initially, the Project considered installing PCs and other digital data management equipment in the offices of officers monitoring logging projects. However, due to difficulties in ensuring a stable power supply, internet access, and security at these offices, the decision was made to install PCs and drones in regional offices, which also serve as supervisory units for monitoring officers. This arrangement helped streamline the data flow and enhance overall monitoring efficiency.

Capacity Building

Alongside the introduction of digital technology, the Project placed strong emphasis on capacity building for stakeholders. From the early stages of digital technology development, capacity-building efforts were carried out through pilot site trials involving monitoring officers and logging companies, while simultaneously developing training materials.

These materials were utilized effectively in collaboration with the long-term experts to conduct PMCP and LCoP training, incorporating digital technology as a key component. A notable achievement was the expansion of training coverage through collaboration with international projects under EU-FCCB and USAID. This enhanced the Project's impact, ensuring that its outcomes were not just isolated activities but part of a broader, long-term initiative. Collaboration with such organizations represents an innovative approach in forest management projects, one that is rarely seen in other countries and has the potential to serve as a model for future projects.

Furthermore, to ensure the continuity of training beyond the Project's completion, PNGFA officers were encouraged to take on the role of trainers, enabling the PNGFA to independently sustain training programs in the future.

Impact of the COVID-19 Pandemic

The outbreak of the COVID-19 pandemic had a significant impact on the Project's implementation schedule. In particular, travel restrictions at the outset of the Project prevented on-site visits, leading to an initial plan that divided the Project into two phases: the Detailed Design Survey Phase (Phase 1) for the first year and the Full Operation Phase (Phase 2) for the remaining two years. However, because the duration of the Project was limited to three years, the Detailed Design Survey Phase was concluded within the first six months and the Project transitioned to the Full Operation Phase earlier than initially scheduled. As a result, the Full Operation period was extended to 2.5 years, maximizing the Project's outcomes through swift adaptation.

Until May 2023, when COVID-19 was reclassified to a lower risk category in Japan, strict infection prevention measures were implemented to ensure the health and safety of all stakeholders. Consequently, there were no reported infections among Project personnel during official travels. Nevertheless, flight reductions and travel restrictions caused by the pandemic led to adjustments in travel schedules.

Moving forward, it is crucial to set flexible project schedules that allow for adaptability to unforeseen circumstances, ensuring sufficient contingency planning in future projects.

Virus Infection of the PNG-FRIMS Server and Strengthening Information Security

At the start of the Project, it was discovered that the server storing PNG-FRIMS data had been infected with a virus, an unexpected issue that required extensive recovery efforts. It is believed that this was caused by a PNGFA employee opening an email received from an external source, which resulted in the server being infected with ransomware, and also because the PNGFA server's OS was out of support. This problem had not been identified before the Project began, but fortunately the Detailed Design Survey Phase allowed for adjustments to address this situation. Moving forward, it is essential to ensure project flexibility to accommodate unforeseen circumstances.

Alongside these recovery efforts, the Project facilitated discussions with PNGFA officers on information literacy and collaborated with ICT personnel to establish the following preventive measures:

- ✓ Regular updates of antivirus software

- ✓ Prohibition of outdated operating systems

- ✓ Implementation of cybersecurity training for personnel

To ensure sustainable and secure data management, the PNGFA must establish clear operational rules for server maintenance and develop a system where all relevant stakeholders can properly manage and protect data.

Budget Flexibility and Logistical Challenges

In the Project, the ability to use Project vehicles to commute helped reduce rental car expenses in Port Moresby. However, for regional business trips, the need to hire security vehicles led to unexpected costs. Additionally, due to a policy change made by the Managing Director of the PNGFA, midway through the Project travel expenses for C/P personnel were no longer covered by the PNGFA, requiring the Project to assume these costs.

Furthermore, frequent flight cancellations within PNG impacted the Project schedule. In situations where on-site assignments were time-sensitive, adjusting to these cancellations posed significant challenges.

In light of these experiences, the following measures should be considered for future projects.

✓ Ensuring budget flexibility: Allocate contingency funds during budget planning to accommodate unforeseen expenses.

✓ Optimizing logistics: Reduce travel risks by selecting pilot sites accessible by land from Port Moresby rather than relying on air travel.

Lessons Learned Regarding Project Design and Implementation Structure

Due to the travel restrictions caused by the COVID-19 pandemic, the first six months of the Project were used for detailed planning, and the remaining two and a half years for full-scale implementation. However, in the forestry sector, activities often require extended periods for execution. In this Project, there was a particular challenge with natural regeneration activities—such as seedling growth, planting on logged-over areas, post-planting care, and monitoring survival rates—since there was insufficient time to fully verify and refine the methodology. While PNG presents difficulties in balancing budget and implementation period due to high stay costs, it is considered crucial to secure a sufficient implementation period to maximize project effectiveness.

One of the project's activity indicators (Indicator 4) stated that "In PNGFA headquarters and pilot sites provincial offices, total 5 PNGFA staff are trained as technical experts of forest carbon monitoring." However, the evaluation concluded that " PNGFA technical experts of forest carbon monitoring increased from 0 to 3 officers as the result of the involvement of field carbon monitoring," which fell short of the target and was therefore assessed as "Partially Achieved" (see Attachment 35). At PNGFA headquarters, only two technical staff members were assigned to the branch responsible for forest carbon monitoring, and the number of staff in the provincial offices was also limited. This raises questions about whether setting the target at five was appropriate in the first place, and whether the goal of developing "technical experts" was overly ambitious. Alternatively, the appropriate

technical content and level of the targeted "technical experts" should have been established at an earlier stage.

Activities 1-7 ("Prepare programs and materials introducing outputs of the Project and help PNGFA to disseminate the outputs to the stakeholders in workshop(s).") and 3-7 ("Organize Workshop to disseminate the results of project activities.") overlapped in content. Meanwhile, no workshop-related activities were included for Output 2. While information sharing and gathering through workshops, including mid-term and final ones, was necessary for all outputs, it would have been more effective either to consolidate the workshop-related activities into a single component or to clarify the objectives of workshops for each output. This would have made the purpose of each activity more explicit.

3.2 Recommendations for Sustainable Natural Forest Management and Climate Change Measures in PNG

Continuation of Capacity Building for Sustainable Forest Management

The Project conducted three training sessions for logging companies on the PMCP and LCoP, aiming to enhance transparency in forest management and promote compliance with proper logging procedures. However, to extend the training to all logging companies nationwide, an additional four sessions are required.

Currently, the EU-FCCB project is preparing to secure a budget for these additional training sessions, but the PNGFA must take the lead in planning, implementing, and evaluating the training programs. The necessary training materials have already been developed through the Project and a system is in place where PNGFA officers and external consultants can serve as trainers.

Moreover, although during the Project period training sessions were conducted for almost all relevant PNGFA officers, it is crucial to continue providing training opportunities for newly-hired staff and regular refresher courses for existing personnel to enhance their skills. Therefore, the PNGFA must secure sustainable funding for training and further develop its training programs to ensure the long-term effectiveness of sustainable forest management.

PNG-FRIMS Upgrade and Sustainable Operation

The base software of PNG-FRIMS, ArcMap 10.2, has already reached the end of its support period, leading to increasing system obsolescence. Additionally, the computers used for PNG-FRIMS operation were primarily installed in 2012 and run Windows 7, which is also no longer supported. This has resulted in difficulties in connecting to the internet and to the PNGFA's servers. Furthermore, various PNG-FRIMS software applications can only be accessed from the LAN environment of PNGFA headquarters, limiting the effective utilization of data.

To address these issues, the PNGFA should consider the following measures:

1. Migration to the latest OS and GIS software

- ✓ Introduce the latest ArcGIS products and secure a sustainable budget for license fees.
- ✓ Alternatively, consider transitioning to free GIS software such as QGIS while establishing an effective management system.
- ✓ Upgrade the computers used for PNG-FRIMS operations to ensure compatibility with modern software.

2. Strengthening data security

- ✓ Since past virus infections have led to data loss, consider migrating PNG-FRIMS to a cloud-based system.
- ✓ In alignment with the PNGFA's information security policy, evaluate the possibility of allowing access to PNG-FRIMS software from locations outside PNGFA headquarters.

3. Ensuring the sustainable operation of PNG-FRIMS

- ✓ Assign system administrators within the PNGFA to establish a framework for the maintenance and management of GIS technology.
- ✓ Develop a long-term operational strategy and establish a financial and technical support system for sustained operation.

Strengthening Provincial Offices

The Project proposed an information flow system for forest monitoring using digital technology, in which provincial offices play a crucial role. These offices are responsible for monitoring results, overseeing forestry concessions using satellite imagery, and conducting on-site inspections using drones.

However, many provincial offices face the following challenges.

1. Lack of skilled personnel

- ✓ There is a limited number of staff members with expertise in digital technology and remote sensing technology.

2. Insufficient equipment and infrastructure

- ✓ While PCs and drones were provided to pilot provincial offices through the Project, other provinces still lack the necessary equipment, making data management and utilization difficult.

To establish a forest management system centered on provincial offices, the following measures are necessary.

1. Capacity-building programs for provincial officers

- ✓ Regular training on remote sensing technology, GIS applications, and drone operations.

2. Provision of equipment and infrastructure development

✓ Further deployment of PCs, drones, and other necessary tools to enhance the use of digital technology in provincial offices.

3. Establishment of a data management and information-sharing system

✓ Consideration of a cloud-based system that allows real-time data sharing between provincial offices and PNGFA headquarters.

Current Status of Sustainable Natural Forest Management at the PNGFA

It is recognized, and was confirmed in the Project, that commercial target species do not grow in some logged-over setups as they originally had grown. Assisted natural regeneration in the form of enrichment planting or silvicultural treatment are necessary to improve forest conditions or increase the percentage of commercial species after areas have been logged over.

On the other hand, to this point the PNGFA has conducted some projects to tackle these challenges in the provinces of West Sepik, Madang, West New Britain, and Manus. In particular, in the Amanab region in West Sepik, one of the Project pilot sites, a number of assisted natural regeneration activities and reforestation as NFM have previously been implemented.

Under the National Forest Development Program for 2023 to 2027, a Government of PNG policy that takes a medium-term perspective, the PNGFA conducts reforestation for 2,000 ha in areas of insufficient natural regeneration under the FMA concessions financed by the Reforestation Levy and the logging companies' own funding. At the same time, this will also raise awareness among landowners and provide them with technical training. In addition, the revised LCoP contains a new section on natural regeneration, although it does not mention any specific approach to such projects at the ground level. For this reason, the Project prepared a manual on assisted natural regeneration that arranged items that should be considered when undertaking projects to promote assisted natural regeneration.

G. NATURAL REFORESTATION

(i) Soil displaced in windrows at the edge of skid tracks should be carefully re-spread over the skid track, preferably using an excavator, to assist natural regeneration once the skid track is no longer required.

(ii) Cuttings, seeds or seedlings used for enrichment planting should be sourced from material collected from within the setup or from the adjoining forest area.

(iii) Vines and competing vegetation should be cut from the young regeneration within the canopy gaps created by tree felling and extraction to ensure that regeneration is not smothered or suppressed.

Figure 3.2-1 The Revised Logging Code of Practice (Extract)

Implementation Policy of the PNGFA/JICA Project for Assisted Natural Regeneration at Natural Forest Logging Sites

The purpose of the Project pilot activities in the Amanab region was to establish the activities studied from the region's history as a model to be expanded to other pilot sites as well as to disseminate and develop the experience and knowledge of assisted natural regeneration activities in PNG in the future. A summary of the activities is as follows.

- Establish model areas in each concession and implement enrichment planting in post-logging setups.

- Implement enrichment planting in post-logging setups where target tree species are not in good condition to improve forest conditions.

- Implement silvicultural treatment such as weeding, clearing, and vine cutting at the enrichment sites to eliminate competitive vegetation that may be an obstacle to the natural regeneration of target tree species.

- Clarify procedures for monitoring enrichment activities at post-logging set-ups.

- Conduct other ancillary activities, such as dealing with animal damage if necessary.

- Develop an implementation manual on matters to be addressed at the field level and methods for planning, implementing, and monitoring to promote assisted natural regeneration (enrichment) activities. This manual will be utilized in other regions to achieve national policy goals.
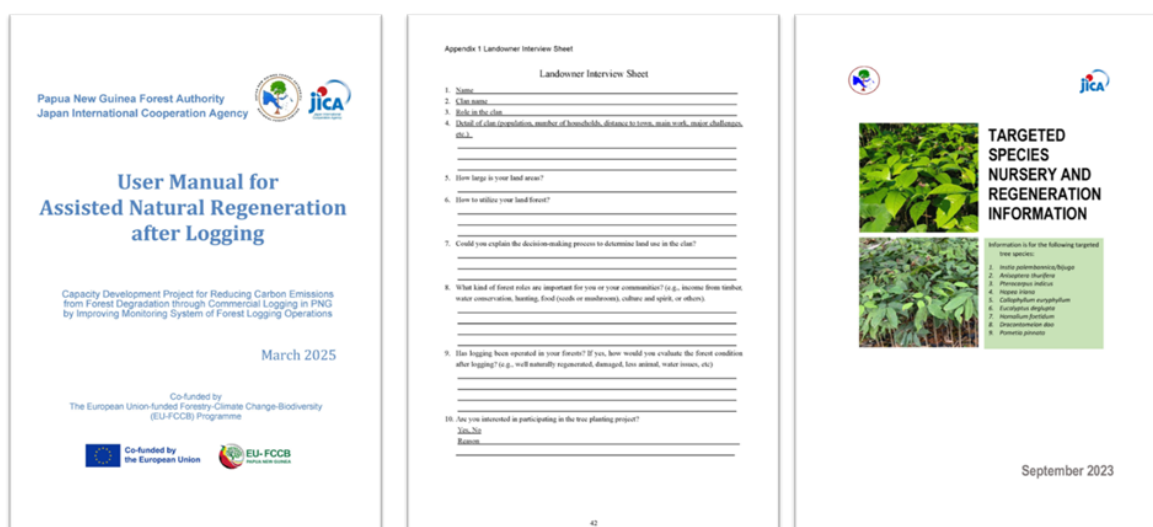

Figure 3.2-2 The Manual for Assisted Natural Regeneration Prepared by the Project

Recommendation for Future Activities on Sustainable Natural Forest Management

It is important to set detailed targets to meet mid-term targets and clarify the following items:

✓ Who (implementation by the PNGFA through a reforestation levy or by a logging company through an agreement);

✓ Where (provincial-level target based on the project area in each province).

It is necessary to identify a method to meet mid-term targets. This is to be accomplished by enrichment, reforestation, or other methods. Further, it is necessary to sort out how to calculate the area (the setup area or planted area).

Assuming that skid tails will be re-used with a view of carrying out normal re-entry, planting along the skid is discouraged. Plans that encourage the formation of commercial tree species through line planting in gaps and forest stands are currently considered to be the best option.

For the selection of species to plant, there are a number of species for which scientific knowledge or experience are not clear at this time, so planted species require monitoring of their growth, possibly in collaboration with the FRI, to identify lessons learned.

Continuous monitoring of the enrichment sites that have been in operation so far will help to optimize future activities by accumulating best practices. In addition, GIS database management is required at PNGFA headquarters and at local offices to record continuous monitoring of assisted natural regeneration enrichment and reforestation sites. It is considered important to create a system to record the results of monitoring assisted natural regeneration activities by linking setup plans to be prepared in the future to GIS data.

Expansion of Carbon Monitoring and Access to International Funding

The Project developed a carbon monitoring methodology at the setup level, but the sample size remains insufficient for application at the concession, provincial, and national levels (only three samples were measured in the Project).

Moving forward, the PNGFA must take the lead in implementing the following actions.

1. Accumulation of carbon monitoring data

✓ Continue on-site monitoring to increase the sample size and improve data accuracy.
✓ Adjust and refine methodologies as needed.

2. Establishment of internationally-recognized methodologies

✓ Expand the sample size and refine the methodologies developed in the Project to align with international standards, strengthening the justification for securing international funding.

3. Integration with the National Forest Inventory (NFI)

✓ Incorporate NFI data into the carbon monitoring methodology to improve operational efficiency and ensure data consistency.

Promotion of Low-Emission Logging and Introduction of Appropriate Incentives

With the establishment of carbon monitoring methodologies and an increase in measurement samples, it will become clearer which aspects of forestry activities contribute the most to carbon emissions. This will enable the development of specific strategies to promote low-emission logging/RIL-C.

The following key issues must be addressed:

1. Adoption and dissemination of low-emission logging/RIL-C techniques

   ✓ Improve logging practices to reduce carbon emissions (e.g., optimal tree felling direction, efficient skid trail planning).
   ✓ Conduct technical training for logging companies to encourage the adoption of low-emission logging/RIL-C methods.

2. Introduction of economic incentives

   ✓ Develop financial support mechanisms for companies implementing low-emission logging/RIL-C.
   ✓ Utilize the carbon market to allow emissions reductions from low-emission logging/RIL-C to be traded as carbon credits.

By implementing these initiatives, forest logging in PNG can become more sustainable, enhancing its role as a climate change mitigation strategy.