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

(Summary)

May 2025

Japan International Cooperation Agency (JICA)

Kokusai Kogyo Co., Ltd.

GE
JR
25-049

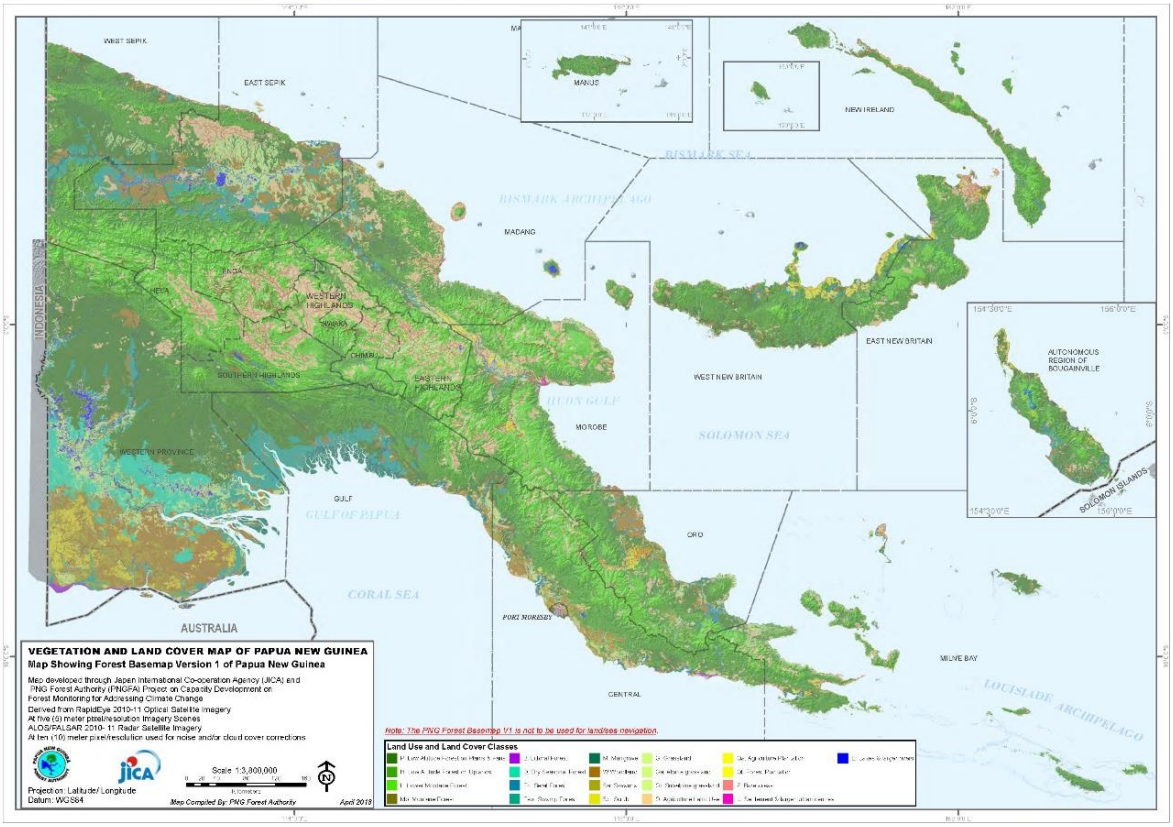
Project Target Area Location Map

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)



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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
MD	Managing Director
MOU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
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
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
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. Background and Purpose 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, various donors, including the Japan International Cooperation Agency (JICA), have been cooperating in the forestry sector, but 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. 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+[1].

The overall goal, Project purpose, and outputs of the Project are listed as follows.

- **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**

[1] 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

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.

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

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)

The following are examples of target issues for improvement identified by a field condition survey at a concession site in Central Province (Marshall Lagoon Forest Management Area (FMA)).

- In the log landing, 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.
- 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.
- The buffer zone is not properly set up, a logging road extends into the river, 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 compiled into the Activity 1-1 Report (Annexure 21).

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

① A logging company submits 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.

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. 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.

（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.

Activity 1-2: Examine and identify ways to strengthen PNG-FRIMS and utilize technologies related to GIS and remote sensing to effectively promote sustainable forest management complying with PMCP and LCoP

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

Through interviews with PNGFA officers, the following issues were identified with regard to field monitoring using the PMCP: (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 2.1-1 Conceptual Image of Mobile Device Utilization

The web map for the intranet (LAN Map) developed in previous technical cooperation projects would no longer be available due to support ending for Adobe Flash Player. As a result of interviews with relevant officers (Annexure 22), 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. The LAN Map2 prototype was developed and finalized after reflecting feedback from PNGFA officers (Annexure 1 - Appendix 3).

（2）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, afforestation and reforestation activities are required and on-site monitoring activities are essential. On the other hand, PNGFA officers are faced with an overwhelming amount of work 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.

（3）Presentation and trial implementation of LCoP and PMCP monitoring techniques

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.

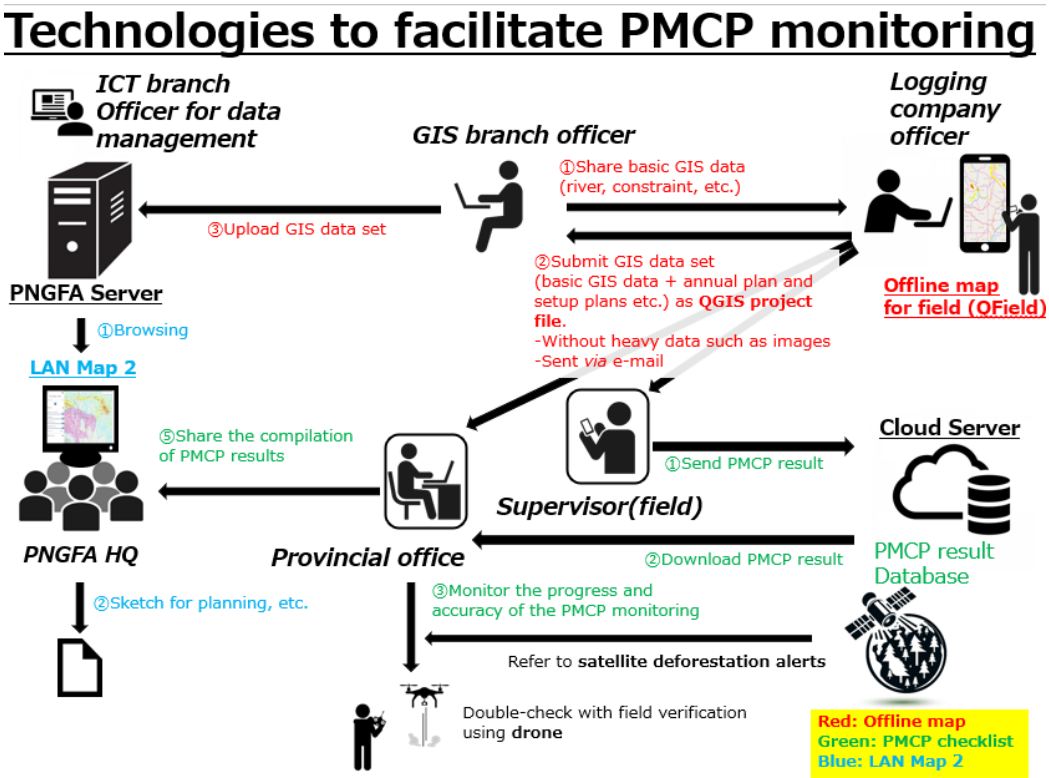


Figure 2.1-2 Proposed Scope of Methodology to Be Developed for in the Project Related to Output 1

Activity 1-3: Determine pilot site(s) to undertake trials of the effective forest management complying with PMCP and LCoP

Five candidate pilot sites were selected from forestry concessions under the jurisdiction of PNGFA regional offices in different provinces, taking into account regional characteristics and the status of project implementation. The pilot sites were selected based on the following selection criteria.

- 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.

A total of three pilot sites were selected: Kupiano District, Central Province; Amanab District, West Sepik Province; and Open Bay District, East New Britain Province.

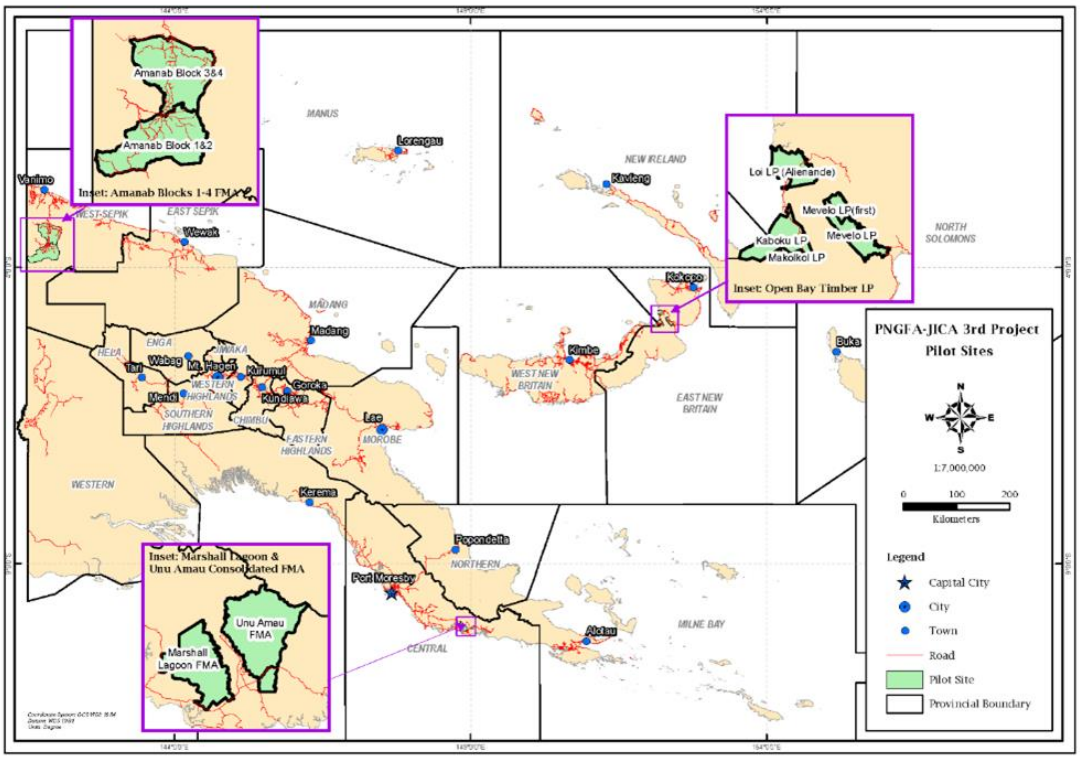


Figure 2.1-3 Pilot Site Location Map (Forestry Concession)

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). 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.

Following determination of the pilot sites, the tree species targeted by the Project were determined as per Table 2.1-1, based on inventory information and field survey results.

Table 2.1-1 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

（1）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 (for the manual, see Annexure 1 - Appendix 1). The results showed 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.”

（2）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.

（3）PMCP Check app trial

At one of the pilot sites, Kupiano in Central Province, a PMCP Check app trial using mobile devices was conducted from the Central Province office (for the manual, see Annexure 5 and Annexure 1 - Appendix 2). 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. Further, both entered or unentered data could be checked on a list, which was seen as useful for state forest office officers to check how well monitoring of the setup was progressing. The field survey results obtained using the PMCP Check app received high evaluations from the trial participants.

（4）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).

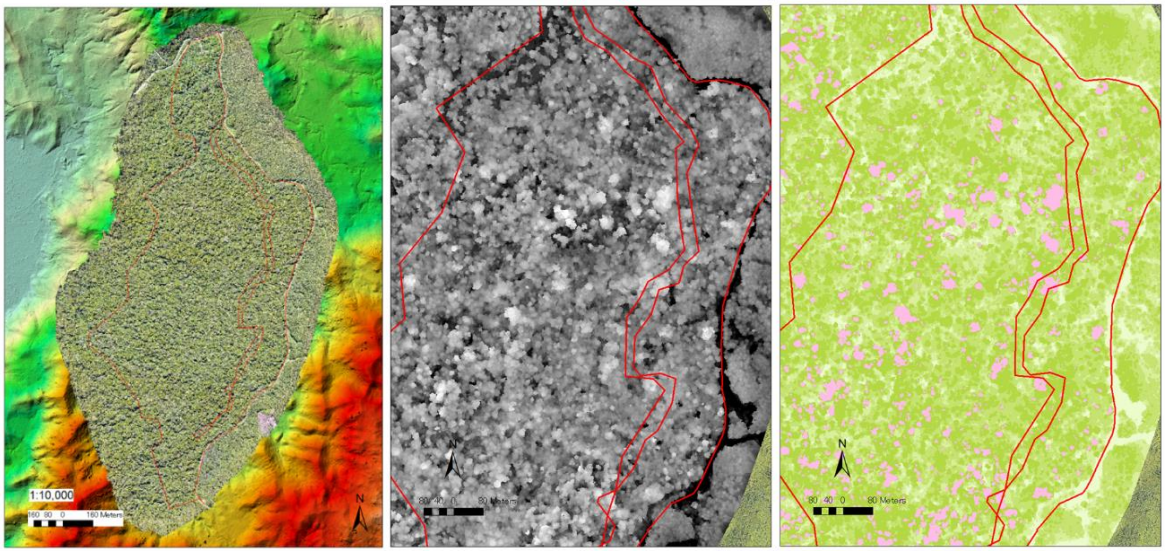


Figure 2.1-4 Orthoimage of the Planned Activity Site Created for Activity Planning, and Forest Canopy and Tree Top Analysis

(Left: orthoimage created from images taken by drone. The red line indicates the planned activity area. Image resolution is 20 cm. Middle: 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.)

A sampling survey of trees to be harvested was conducted 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 page), 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).

(5) 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 (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).

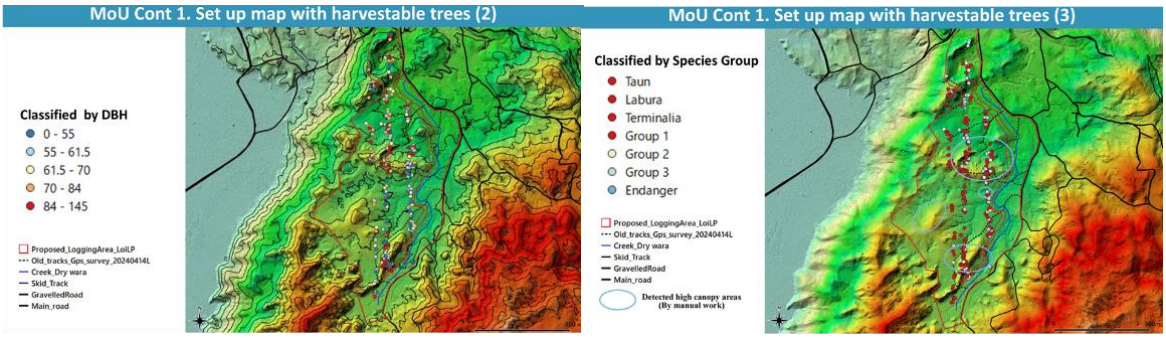
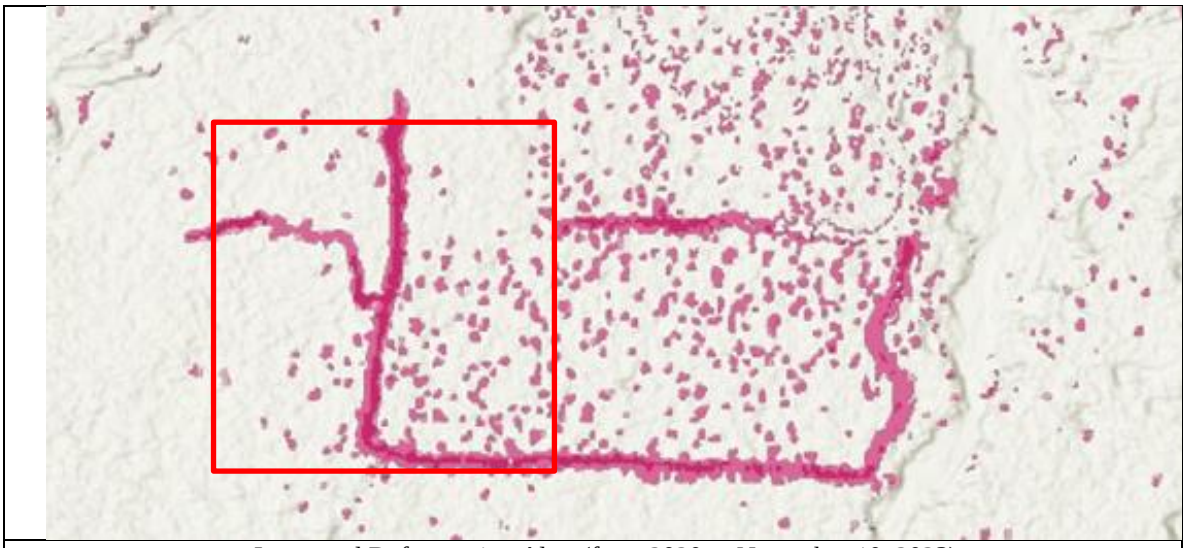
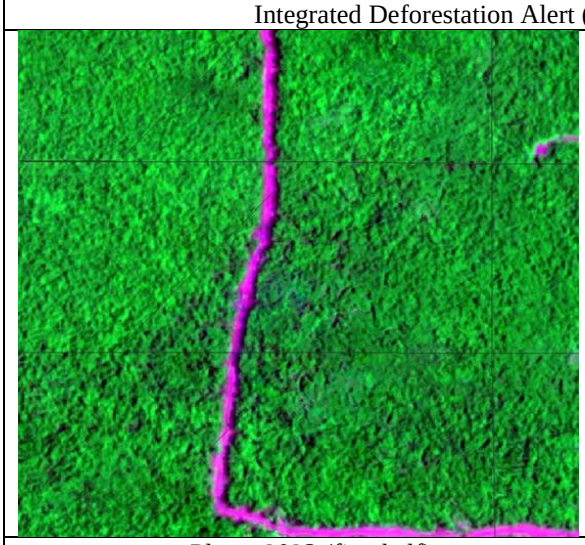


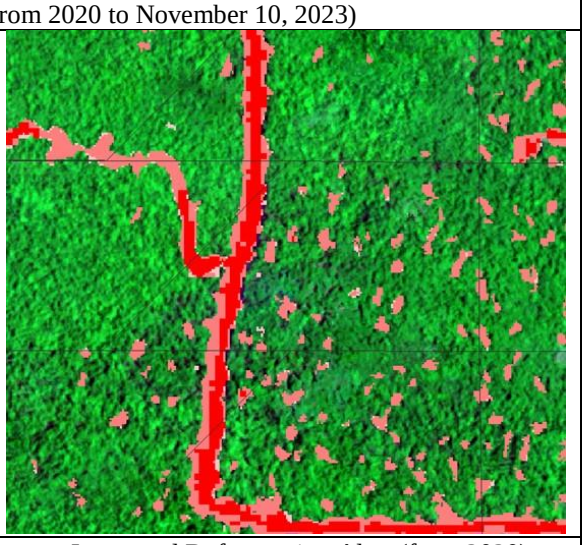
Figure 2.1-5 Resource Distribution and Topographic Analysis Map Created from Field Survey, DCHM and DTM



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



Planet 2023 (first half)



Integrated Deforestation Alert (from 2020)

Figure 2.1-6 Status of Deforestation Alerts in the Pilot Site Setup

（6）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, including related various manuals, materials, and documents, was developed. This document consolidates the key technical elements introduced in the Project to facilitate the efficient implementation of the PMCP and LCoP (Annexure 1).

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

（1）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; Momase Region; New Guinea Islands

(NGI) Region). 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.

（2）Intensive capacity building for Mapping Branch officers

Training materials and video manuals were prepared and intensive capacity building was conducted for the GIS officers of the Mapping Branch to ensure the continued dissemination of the methodologies developed in the Project after the Project is completed.

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 2.1-2. 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 third training in Madang Province was accomplished with lectures and practical training on GPS and GIS conducted by Mapping Branch GIS officers only, utilizing prepared manuals (Annexure 6, 7, 19, 30, and Annexure 1 - Appendix 6 and 8).

Table 2.1-2 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

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 2.1-3 to disseminate the Project outputs.

Table 2.1-3 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 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).

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

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, with the target range of commercial tree species classified as Group 1 and Group 2 in “Procedures for Exporting Logs”.

(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 2.2-1 Enrichment Initiatives

Activity 2-2: Identify key stakeholders, and examine implementation structure and technical improvement measures for managing natural regeneration

In PNG, a concession named Amanab 1-4 FMA is an advanced case site for enrichment planting. When planning activities to promote natural regeneration, the Project positioned the concession's efforts as the Amanab model, reviewed the status of the post-logging, and identified some issues with respect to understanding the current situation and implementing activities in order to establish this as a model for the dissemination of enrichment planning. These are as follows.

（1）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 City, 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.

（2）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, it was observed that the production of seedlings was not being carried out in line with appropriate planting plans.

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

With regard to advanced NFM activities, the need to expand the size of the PNGFA's 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. 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.

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 2.2-2 Comparison of Growth Status by Tree Age

For the implementation of pilot activities at each pilot site, a demonstration site was identified and a detailed plan prepared for each activity (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 (Annexure 12 - Appendix 2).

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

（4）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.

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

Plot Name	Activity
Amanab 1-4 UT123	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.
Amanab 1-4 UT51	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.
Amanab 1-4 FW15	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.

Enrichment planting in UT123 and tree removal in FW15 were conducted in October 2023. In November of the same year, an enrichment planting activity was conducted with PNGFA officers who were participants in the PMCP/Revised LCoP training in UT51. 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. The results of the surveys with regard to survival rate showed that 80% or more of the seedlings survived in April and 75% or more survived in September (Annexure 31). 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 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 2.2-2. 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.

Table 2.2-2 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											

[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.

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] suggests 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.

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.

(5) 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.

Table 2.2-3 Activities at the Open Bay Site

Plot Name	Activity
Open Bay Loi Compartment	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. 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 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.

(6) 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

[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.

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.

Table 2.2-4 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 2.2-5 Activities at the Marshall Lagoon Site

Plot Name	Activity
UNU & Amau Setup 2, 12, 13	Enrichment Planting Line planting was conducted in the forest stand in setups where selective logging operations had been conducted in the past. 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.

（7）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.

Table 2.2-6 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

The draft user manual developed in Activity 2-4 was modified in accordance with the status of activities at the pilot sites as well as with the actual work conditions of the C/P, and was re-edited and finalized through discussions with the C/P officers, public disclosure at the mid-term Project workshop, and the workshop on finalizing User Manual for Assisted Natural Regeneration at Natural Forest Logging Sites (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 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. The analytical investigation of the report documented in one of the two prior technical cooperation projects revealed that there is a significant level of alignment 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. 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. 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, 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. 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 — remain unmeasured under current regulations.

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)

Activities were implemented at the pilot sites to digitize logging monitoring data and develop survey methods for unmeasured parameters. 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 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. To assess the feasibility and applicability of existing RIL-C methodologies in PNG, the VCS0035: Methodology for Improved Forest Management through Reduced Impact Logging,[4] 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, provisional field indicators, monitoring parameters and necessary data for logging-associated carbon monitoring, and provisional impact parameters to assess emissions reduction, were identified.

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. 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 (Annexure 26).

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

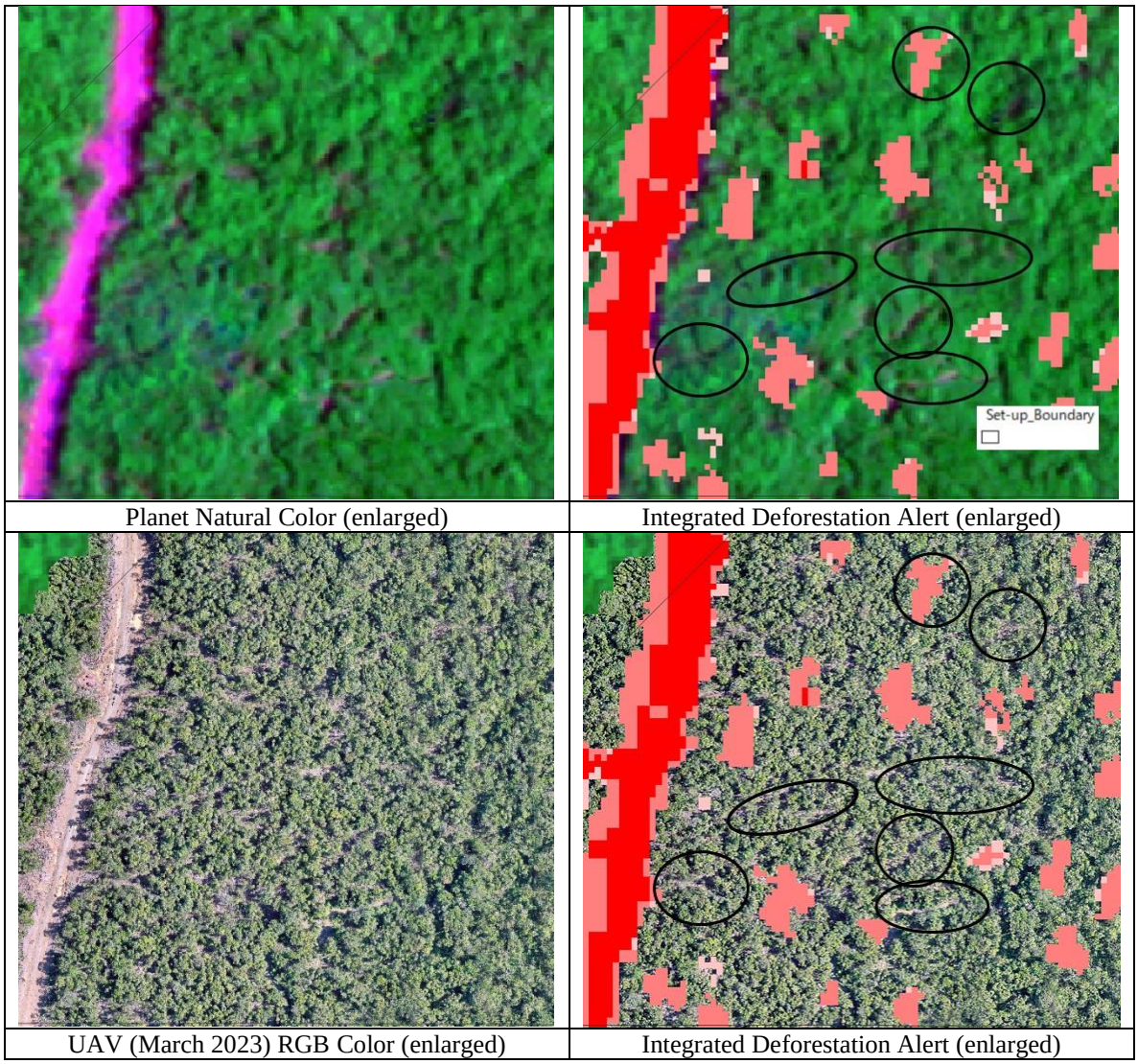


Figure 2.3-1 Comparison of High-frequency Observation Satellite Images, High-resolution Drone Images, and Integrated Deforestation Alert

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. 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.

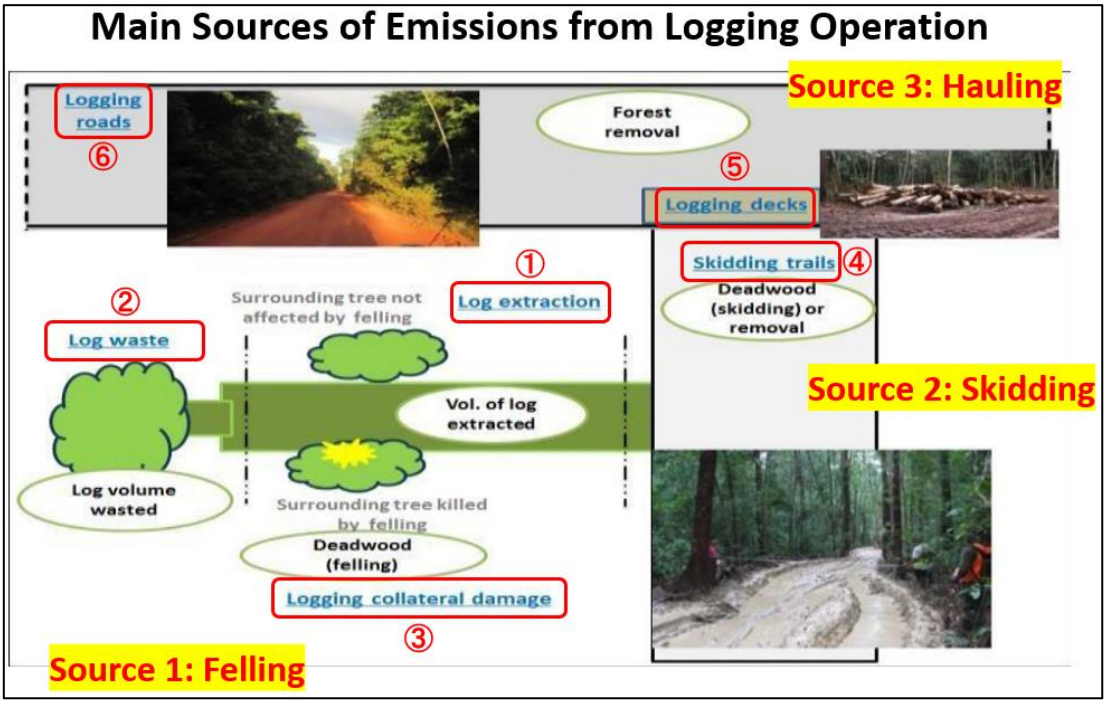


Figure 2.3-2 Sources of Emissions from Logging Operations

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 ensure a shared understanding among stakeholders.

<Objectives of Field Carbon Monitoring Method Development>

- 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).

<Direction of Methodology Development>

- 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).

<Level of Expected Outcome>

- 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 the Marshall Lagoon & Unu Amau FMA in Kupiano District (Annexure 26). A framework for the field carbon monitoring method for commercial logging operations and the parameters to be measured were developed. Subsequently, the first trial carbon monitoring survey was conducted again at Marshall Lagoon & UNU Amau FMA (Annexure 14) and the natural forest logging site operated by OBT (Annexure 15). 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. Reflecting the results of two field surveys, the field carbon monitoring method was finalized (Annexure 16 - 18). The values required for the measurement of logging emissions, along with the corresponding survey items necessary for their calculation, are listed in Table 2.3-1 and Table 2.3-2.

Table 2.3-1 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 2.3-2 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.

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

In consulting about this activity, a meeting was held with PNGFA officers to discuss the training content and training implementation plan. It was confirmed that the training would be based on the carbon monitoring survey method developed in Activity 3-3. 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.

Table 2.3-3 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**	

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, this method will allow for a comparative analysis by distinguishing between the impact of conventional commercial logging and the impact of RIL-C. 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").

Additionally, the scale of potential financial support at the concession level was estimated, if emissions reductions were achieved through the promotion of RIL-C practices based on the LCoP/PMCP. Assuming a carbon price of USD 8 per tCO_2e, and that the emission reductions achieved in the Project are comparable to those of the East Kalimantan FCPF project, 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.

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, for the phased expansion of this field logging carbon monitoring initiative, considering cases in Central Province, as it is relatively accessible from Port Moresby (Annexure 32).

Table 2.3-4 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 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 evaluation of the potential emission-reduction effects of each RIL-C practice, as well as their cost-effectiveness, has not been conducted. Therefore, 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.

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 as outlined below.

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.

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

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.

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". 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.

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 computers and base software used for PNG-FRIMS operation are heading toward increased system obsolescence. 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

- ✓ 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

In the information flow system for forest monitoring using digital technology, provincial offices are responsible for monitoring results, overseeing forestry concessions using satellite imagery, and conducting on-site inspections using drones. However, many provincial offices face challenges such as a lack of personnel with knowledge and skills in digital and remote sensing technologies, as well as insufficient equipment and infrastructure such as PCs and drones. 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.

Recommendations for Sustainable Natural Forest Management

（1）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.

(2) 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.

(3) 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 to 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.