添付資料 47

プロジェクト成果報告会

コンセプトノート

発表資料

As of 20th November 2017

Concept Note for PNGFA/JICA Project Debrief Meeting

Background and objectives:

Over three years have passed since current PNGFA/JICA Project was launched. Through this project, the PNGFA field officer's capacity to implement sustainable forest management has been strengthened in various aspects such as enhancement of FRIMS, ability to handle GPS, ability to apply basic GIS, ability to manage and monitor field operations and so on. Having achieved these knowledge and skills, the question now is how these knowledge and skills can be utilized in achieving the outcome of this project.

The debrief is basically presentations by JICA and KKC on interim accomplishments and inform PNGFA on the remaining activities and expected outcomes. Additionally, this debrief will introduce the use of Drone and possibility of being utilized by PNGFA in future.

Date: 22nd November 2017

Time: 10:00 – 12:40

Place: Board Room in PNGFA Headquarter

Participants: PNGFA officers

Expected Outcomes: The project achievements/outputs are shared and organized for;

- Discussion with JICA-HQ officer (Mr. Yuji SHIGEFUJI)
- Considering the potential actions in the project site
- Contributing to countries agenda (GFC proposal, etc)

Tentative agenda:

Time	Length	Topic	Presenter/Moderator
Opening:			
10:00	5	Introduction and Objectives	Mr. Constin Bigol
Report of Training in Japan: Introduction of New Technology for Forest Monitoring			
10:05	20	Report on the training and the possibility of utilization of Drone/UAV	Mr. Patrick Laa
10:25	10	Summary/Outline of the Project Achievements/Outputs	Mr. Masamichi HARAGUCHI
Output1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS)			
10:35	20	1.1 Progress & Output of Updating Forest Cover Maps	Ms. Ayako OCHI

		– Past Forest Cover Maps & Degradation Drivers Maps –	
10:55	20	1.2 Simulation of the location of future deforestation in West New Britain Province, Papua New Guinea	Dr. Takahiro KOIDE
11:15	20	1.3 Progress of updating/enhancing PNG-FRIMS: – Implemented Functions and Future Enhancement –	Mr. Yasuyuki OKADA
Output 2: Improved National/Provincial Forest Plans, Management Plan/Monitoring System			
11:35	10	2.1 Current progress and future prospects of activity2	Mr. Tsutomu KOYAMA
11:45	10	2.2 How to utilize the practical application for FRIMS.	Mr. Jehu Antiko
11:55	10	2.3 Digitizing of ALP's	Ms. Everlyn Paul Mel
Output 3: red/Identified Forest Information for addressing/contributing-to REDD+			
12:05	20	3. Consideration of the utilization of PNG-FRIMS for REDD+	Mr. Stephan Salim
Discussion			
12:25	15	Q & A	Mr. Constin Bigol Mr. Daisuke KADOWAKI Mr. Masamichi HARAGUCHI
Refreshment will be provided for every participant			

Report of the training in Japan and the utilization possibility for Drone

- New Technology for Forest Monitoring-

Patrick Laa
Forest Policy and Planning Directorate
Inventory and Mapping Branch,
PNG Forest Authority
22th November 2017

Training Outline

Part 1:

- ❖ Database & Remote Sensing Training

Part 2:

- ❖ Utilization Possibility for Drone in PNGFA

Part 1: Database & Remote Sensing Training

Contents:

1) To learn recent technologies on forest resource monitoring
2) To identify and/or discuss possibility and challenges in utilizing the technologies for future forest resource monitoring in forest plan and management in PNGFA.

Part 2: Utilization Possibility for Drone in PNGFA

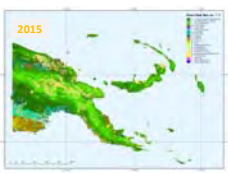
Contents:

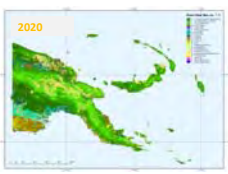
1) To acquire advanced skills relating to data collection, processing and management for forest monitoring
2) To identify and/or discuss possibility and challenges in utilizing the technologies for future forest resource monitoring in forest plan and management in PNGFA.

Part 1: Database & Remote Sensing Training

What we want to achieve:

- ❖ Detecting Forest Regrowth.
- ❖Upgrading of Current Forest cover Map
- ❖Continue producing Future Forest Cover Maps.





2020 and beyond

What we want to achieve:

Land use Classification:

- ❖Identification of degraded land- grassland and degraded forest area. (How much area,)
- ❖Recommendation for Rehabilitation of Identified area.

Land Cover Classification

- ❖Change in Land cover for the targeted time series.
- ❖Miss-match identification of forest Base Map Version 1.
- ❖Amount of land cover change (Area ha).
- ❖Identification of Drivers of Degradation.

Data Collection and monitoring tools

- Open Foris /Collect Earth
- Saiku Analysis
- Google Earth
- Google Earth Engine
- GLAD
- JJ-Fast
- Drone & Software

Data

- Hansen Gain/Loss Data
- Landsat Imagery series (30 m resolution)
- Annual Greenest Pixel Imagery
- Sentinel Imagery series (10m resolution)
- ALOS2- PALSAR2

Note: all the tools above are free expect for the last ones

Understanding of the techniques

JJ-FAST (JICA-JAXA Early Warning System in the Tropics)

New monitoring system by JICA and JAXA
Cloud free deforestation data.
Frequency 1.5 months (45 days)
PNG data released on October 2017!

GLAD (Global Land Analysis & Discovery): Forest Alert

Weekly deforestation data (tree cover loss)

Review of forest monitoring tools

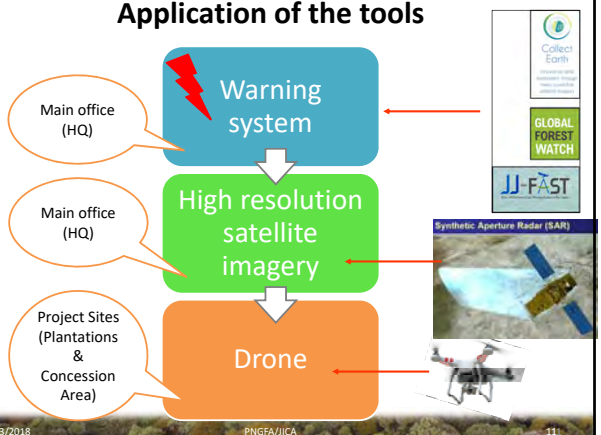
Tool	Smallest area detected	Scale	Frequency	Cost	How to obtain	Advantage	Disadvantage	Others
JJ-FAST	5 ha	National data	Every 45 days	Free	From the web site	Able to obtain data regardless of the cloud		
GLAD		National	Weekly	Free	From Google Earth Engine	Can be utilized for deforestation warning purposes.		
Hansen Tool	20 ha	National Data	Yearly	Free		Detection of areas >20 ha. Eg. Logging roads, FCA, Plantation	Unable to detect selective logging but good to use as a guide.	

Review of forest monitoring tools

- Data collection

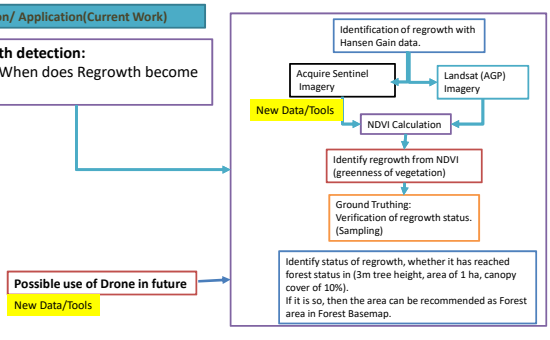
Tool	Area Size	Frequency	How to obtain	Advantage	Disadvantage
Collect Earth	Depends on the area of interest	Every 5 years	Open Foris	• Free and Open Source tool • User friendly interpretation tool using Google Earth interface • VHR multi-temporal images from Google Earth and Bing Maps • Landsat (8/7/5) datasets from Google Earth Engine • Data Analysis through Saiku	
Google Earth Engine	Depends on the area of interest	Every 5 years	Google Earth Engine	• Automated Landsat pre-processing steps (i) Image resampling (Landsat 7, 8) (ii) Conversion of raw digital values (DN) to top of atmosphere (TOA) reflectance (iii) Cloud/shadow/water screening and quality assessment (QA) (iv) Image normalization (MODIS imagery and SRTM-DEM are also used)	
Drone	• 150 ha (Setups) • 1 ha (Plantations)	• Timber operations – 3/ 5 years	• Through approval of PNGFA	• Field verification of all setups: FWPs & ALPs (PAD) • Encroachment (FSD) • Illegal Activities (PAD & FSD) • Plantation & Fire (FSD) • Good for Plantation Establishment and management	

Application of the tools



Integration/ Application(Current Work)

Regrowth detection:
Where/When does Regrowth become forest?



Possible use of Drone in future
New Data/Tools

Future Work

- ❖Monitoring of Regrowth Areas using ALOS2/PALSAR2 or Sentinel Imagery
- ❖Enhancement of Study Area. (Operation Painim Graun Planim Diwai)
- ❖Capacity Building (Training of Foresters and new Cartographers)
- ❖Continue improvements on Forest Cover Map.

Introduction – What's Drone?

UAVs (Unmanned Aerial Vehicles), commonly called as "Drones" are aircrafts without a human pilot on board

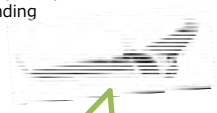
- Originally developed for military operations
- Most civilian drones are smaller and have shorter range and maximum flight time than military drones
- Operation are usually done by radio-control
- Powered by engine or battery

Introduction – What's Drone?

Mainly two types

- Rotary wing
  - Stable hover, enable adjusting camera angle
  - No space required for landing
  - Cannot fly long distance
- Fixed wing
  - Fast seed and long distance flight
  - Cannot hover
  - Require space for takeoff and landing

Suitable for capturing imagery in small area Multiple use



Suitable for obtaining data for wide range of area

Combination with various remote sensing technology

Landsat 7/8 【USGS/NASA】
- Spatial resolution : 30 m
- Return period : 16 days (monitoring is possible for8 days interval combining Landsat 7 and 8)

ALOS-2 【JAXA】

Spotlight mode
- Spatial resolution : 3 m
- Return period : 14~ days

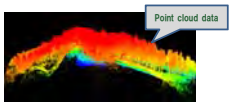
ScanSAR mode
- Spatial resolution : 50-100 m
- Return period : 1.5 months

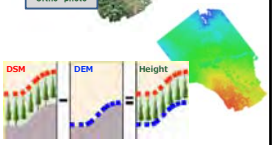
Stripmap mode
- Spatial resolution : 3-10 m
- Return period : 3 months

UAV/Drone・Lidar/Camera
- Spatial resolution : 1 cm
- Point density : Adjustable
- Return period : Adjustable

Application of the drone to forest monitoring

Major Item	Item	Use	Method
Shooting	Grasping General condition	◎	From imageries and movies
	Change detection	◎	By comparison of the images obtained from the same route
Photo Survey	Stem number	○	By point data from 3D model
	Tree height	○	From point cloud data
	Tree crown density	△	Maybe possible by DSM data
	DBH	×	
	Tree volume	△	Possible from the difference of DSM and DEM or estimation from tree height
	Stand structure	○	From point cloud data
	Understory	×	Maybe possible in sparse stands





Possibility for forest management in PNGFA

Confirming alerted site and creating evidence

Forest Loss Alerted site on GLAD, JJ-FAST need to be confirmed if there were actual forest loss.
Driver(s) of the loss might also be able to be identified by the imagery taken by drone.

GLAD (Global Land Analysis & Discovery) Forest Alert

JJ-FAST (JICA-JAXA Forest Early Warning System in the Tropics)

The evidence report can be created using the result of ground truth by drone

Confirming current condition (ground truth) of the alerted site from the sky

The evidence of the actual forest loss can be provided

Possibility for forest management in PNGFA

Obtaining latest information of the site before Forest Inventory Survey (FIPS)

Available satellite imagery could be out of date. UAV can obtain images/movies of the target site right before the survey, to confirm if the forest is at the planned site of the survey .

Monitoring Forest operation

Drone can fly the same route and obtain picture at the same point using programmed flight mode

Photo: Conservation Drones

Before logging / After logging

Monitoring logging operation "Repeatedly" and "Actively"

Confirmation if the operation was done within concession area is possible by overlaying orthophoto with concession boundary

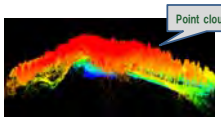
The latest imagery of the specific site can be obtained

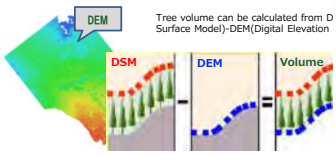
Possibility for forest management in PNGFA

Forest resource monitoring in Plantation site

3D model, Ortho-photo, DSM, DTM, Point cloud data can be obtained from the aerial image taken by the drone, using 3D production software.

Drone survey can be carried out with less cost, manpower, and the better accuracy compared to the ground survey





Tree volume can be calculated from D Surface Model)-DEM(Digital Elevation

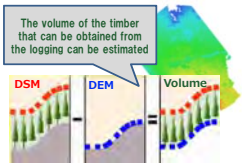
Drone survey can be an alternative option for ground survey

Possibility for forest management in PNGFA

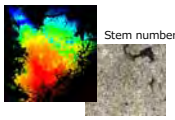
Logging Plan

Tree volume can be calculated from DSM (Digital Surface Model)-DEM(Digital Elevation Model)

The volume of the timber that can be obtained from the logging can be estimated



Planning Logging area by the imagery



Stem number

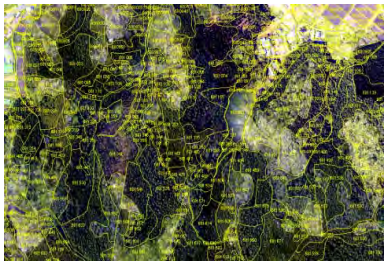
Planning where and when to cut

Appropriate and efficient logging can be planned by drone survey

Possibility for forest management in PNGFA

Visualizing Property Boundary

Knowing the boundary of forest property is important for planning new plantation site and conducting forestry operation. Drone imagery can be used as an clear evidence of the boundary.



Planning the area for new plantation and forestry operation (e.g. clear cutting) within the site

Confirming clear boundary for the plantation

Possibility for forest management in PNGFA

Monitoring operation

Photo: Conservation Drones

Before logging

After logging

Confirmation if the operation was done according to the planed area is possible by overlaying orthophoto with planning boundary

Drone can fly the same route and obtain picture at the same point using programmed flight mode

Monitoring logging operation "Repeatedly" and "Actively"

Monitoring Forest Resource

Current Challenges

Inventory & Mapping:

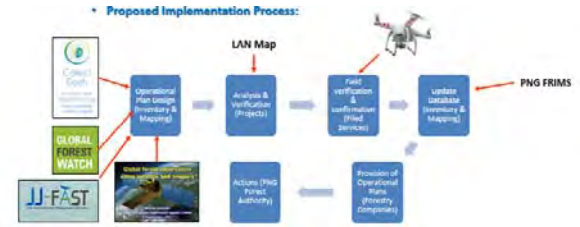
- ❖Maintaining FRIMS updates
- ❖Analogue Data (Operational Plans) – Designed by Companies
- ❖Lack of Human Resource
- ❖Poor Internet Connections
- ❖Internet Restrictions
- ❖Timely Maintenance of Equipment
- ❖Funding

Projects

- ❖Isolation and Remoteness – Accessibility difficult
- ❖Poor Communication Modem – No reliable communication service
- ❖Logistic Support – Costly
- ❖Lack of Human Resource – Ratio for increased in Forestry operations such FMAs, FCAs for economic benefit is not equivalent to the capacity rate for monitoring.

Recommendations

- Allow access to GIS/Remote Sensing Lab. (FRI)
- Arrangement to have access to JJ-Fast, GLAD etc.
- Consideration of Drone for monitoring purposes
- Include these procedures as part of our duty statement.
- Incorporate the usage of these tools and information into the Planning Monitoring Control Procedures (PMCP) and the Logging Code of Practice (LCOP). This becomes a law for PNGFA for implementation.
- Utilizing the tools to design Operational Plans that the Organisation can manage in-terms of monitoring. Finally, the coordination of these plans should be designed by M&I, PAD & FSD using appropriate current available data.



Acknowledgment

We would like to convey our sincere gratitude to the following Organizations and persons:
1. JICA & Government of Japan
2. PNG Forest Authority
3. KKC
4. JAXA
5. Drone and Pictures Creators Association
6. Tokyo International Center
7. Kansai Electric Power Company

Special Mention to the following people:
Nozaki san,
Toda san,
Yoshinaga san

THANK YOU

Summary/Outline of JICA Project Achievements/Outputs

22 November 2017
Masamichi HARAGUCHI

Table of Contents

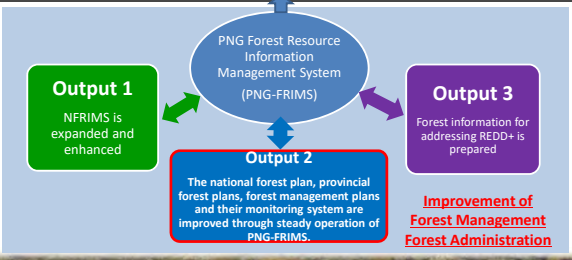
Brief Outputs

JICA Project (Phase2) Overview

Project Period: 5 years (from 2014 to 2019)

Overall Goal
Forests in PNG are conserved and managed in a sustainable manner, while at the same time, mitigation and adaptation measures against climate change are promoted.

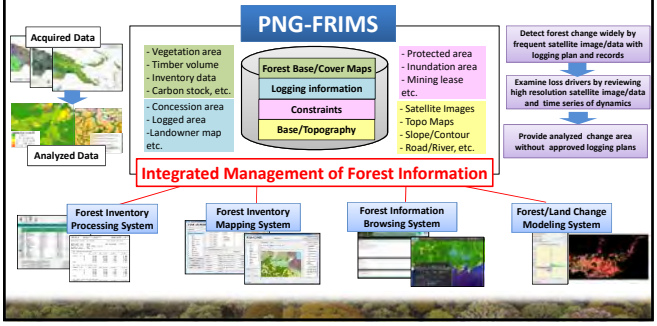
Project Purpose
Capacity of the PNGFA to continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.



Output1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS)

Progress :

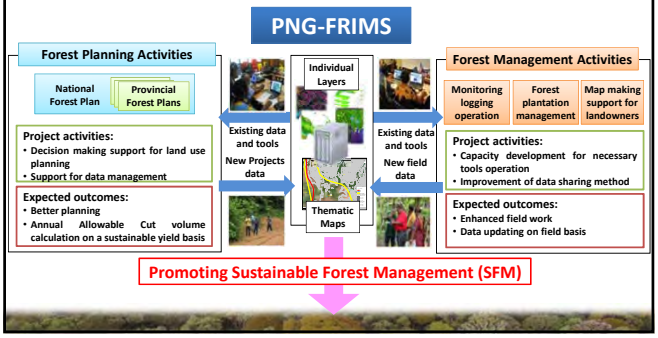
- Revised/Enhanced Forest Base Map (National)
- Developed Past Forest cover Maps (2 provinces)
- Deforestation/Degradation Driver Map (National)
- Developed Logging Road (National every 5 years)
- Demonstrated Forest Land Change Modeling



Output2: Improved National/Provincial Forest Plans, Management Plan/Monitoring System

Progress :

Considered utilization of PNG-FRIMS for forest planning/management, monitoring activities through trainings

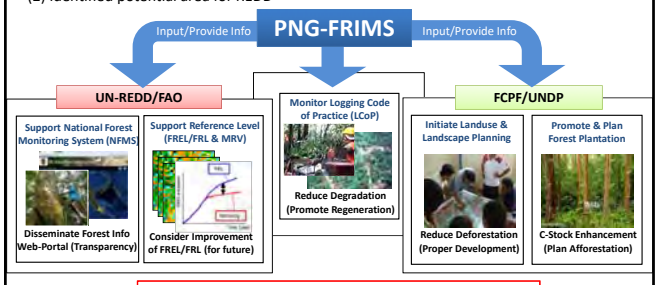


Output3: Prepared/Identified Forest Information for addressing/contributing-to REDD+

Progress :

(1) Contributed to National Forest Monitoring System & Reference Level

(2) Identified potential area for REDD+



Exploring Potential Utilization of FRIMS for REDD+

Achievements/Outputs List (Maps/Layers)

PNG-FRIMS

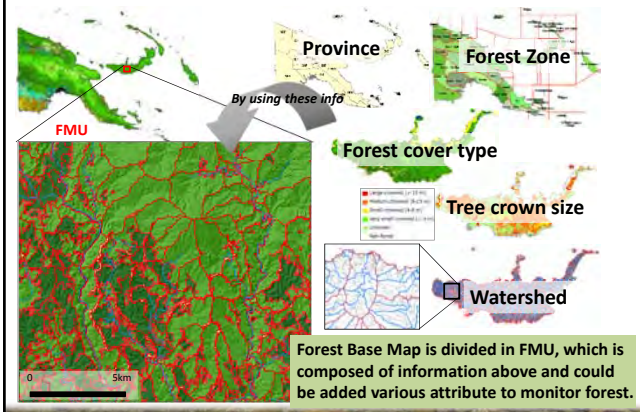
#	Maps/Layers	Target Area	Status
1-1	Revised/Enhanced Forest Base Map 2012	National	Completed
1-2	Past Forest Cover Maps 2000/2005/2011	WNB, WSP	Completed
1-3	Updated Forest Cover Map 2015	National	On-going (1/3)
1-4	Developed Forest Degradation Driver Map	National	Completed
1-5	Updated Constrains Information (Map)	National	Completed
1-6	Watershed(Catchment): Large/Middle/Small	National	Completed
1-7	Updated Timber Volume Information (Map)	National	Completed
1-8	Digitized Logging Road 2000-2005-2010-2015	National	Completed
1-9	Future Forest/Land Change Simulation Map	WNB	Demonstrated
2-1	Satellite Images (RapidEye 2011, Landsat AGPs)	National	Completed
2-2	Topographic Data (DEM, Contour, Slope, Hillshade)	National	Completed
3-1	Logging Concession, Logged-Over Area	WNB, WSP	On-going
3-2	Forest Clearance Authority (FCA)	National	Planning
3-3	Forest Plantation Area (PNGFA/Private)	National	Planning

FIPS | FIMS | FLCM

LAN Map Browser

Output1 | Output2 | Output3

Review of Forest Base Map: Not only Vegetation Type!



Forest Base Map is divided in FMU, which is composed of information above and could be added various attribute to monitor forest.

Review of LAN Map: Available Spatial Data in PNGFA Browsable!

Goal	Function	Objectives	Examples of outcome
To improve the planning, monitoring and control procedures for forest logging operations	Shares forest information stored in PNG-FRIMS with relevant officers	[Portal site functions] - Manage the user access privileges - Manage the map availability - Annoucement postings on PNG-FRIMS [Web GIS functions] - Overlay several forest information - Search location, Measure distance and extent - Edit and update forest information - Estimate forest volume etc.	To carry out more accurate assessment of logging plans submitted by logging companies To find encroachment logging and overlapping of project boundaries

Deliverable Documents (for PNGFA operation)

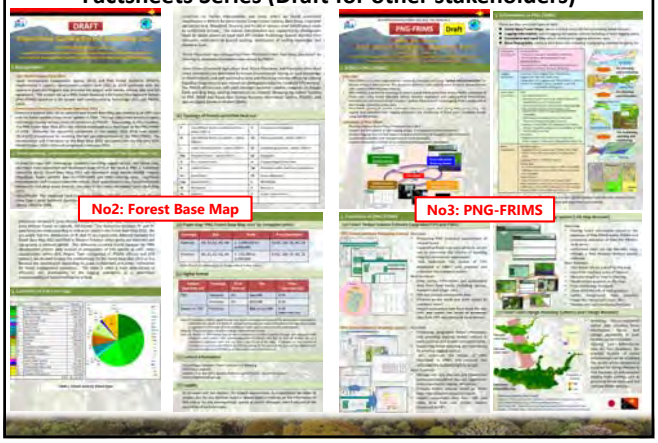
Defined in PDM

	Document Name	Status
1-1	Manual on updating forest base map	
1-3	Design document of DB	
1-8	Manual of PNG-FRIMS	
2-1	Methods/procedures for solving the issues of the current forest planning system	
2-2	The document on the usage of PNG-FRIMS→[PNG-FRIMS & GPS User Guide Book for the Forest Planning]	
2-4	Guidelines of the forest planning	
3-1	Document on the draft of the technical procedures for estimation of forest carbon emissions and removals	
3-2	The document on the results of consideration on the usage of PNG-FRIMS	
3-3	Guidelines on the method of access and provision of the information	

Others than PDM

	Document Name	Status
	Manual for Land Change Modeler Analysis	Completed
	Digitizing road network utilizing LANDSAT imagery	Completed
	PNG-FRIMS (from JICA-PNGFA project) support to forest plantations development in Papua New Guinea and considerations for REDD+	Completed (Draft)
	An overview of institutional conditions conducive to Sustainable Forest Management to input supports from the JICA-PNGFA project and REDD+ in Papua New Guinea	Completed (Draft)

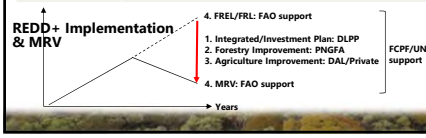
Factsheets Series (Draft for other stakeholders)



For Discussion

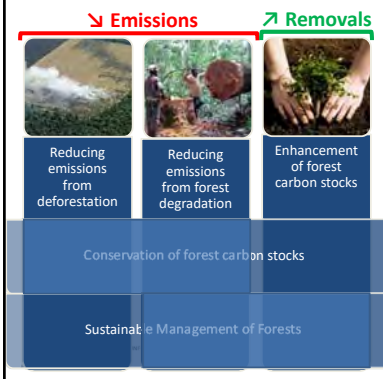
Countries Agenda: Green Climate Fund

Item	Contents	Remarks
Preparation	**2017-18:** Feb: Submit to UNDP, Mar: Evaluation, Apr: Submit to GCF	**Working Material: Internal Only**
Implementation	**5 years: July 2018 start - June 2023 end** (Note: Plan of Proposal)	
Proposed Budget	**36M USD** (Note: Total Budget of implementation by the country)	
Activity	**1. Investment in enabling policies to reduce emissions from deforestation and forest degradation** (1) Strengthen capacities for land use planning at national, provincial, local levels (2) Strengthen environmental management, enforcement and protection (3) Strengthen access to information and recourse mechanisms.	**Integrated policy among multi-sectors** ・Land use Planning (DLPP) ・Conservation (CEPA) ・Challenges: Data Sharing
	2. Improved management of production forests (1) Strengthen capacities for sustainable forest management at national, provincial and local levels. (2) Strengthen alternative approaches to timber production and processing	**Potential to utilize JICA outputs/enlargement?** ・FLEGT(EU), DSS (Australia)
	3. Strengthened capacities for sustainable agricultural production (1) Improve productivity of smallholder agricultural systems. (2) Pilot multiple approaches to incentivize sustainable production. (3) Support to certification, traceability and access to premium markets.	**Collaboration with Private Sector and NGO?** ・Palm Oil, Cacao, Vanila? ・Agro-Forestry
	4. Management and coordination of REDD+ (1) NFMS operational and institutionalized, and reporting to the UNFCCC supported, including on FRL. (2) SIS operational and institutionalized. (3) Overall project coordination and management including human and financial resources, monitoring, reporting and evaluation.	**Support by FAO?** ・MRV of Activity 1/2/3 against FREL
CO2 Emissions		



Readiness to Implementation (Role of PNGFA is important)

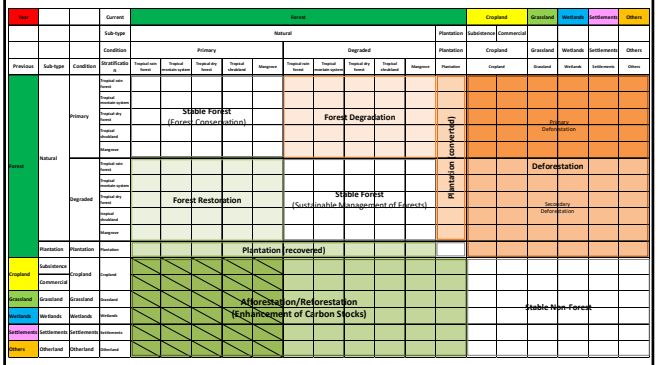
REDD+ Activities/Scope and Policies and Measures (PaMs)



- **The Five REDD+ Activities: Scope**
- **Just a different way to present the same PaMs**

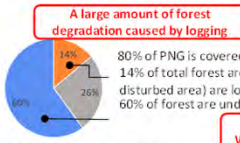
Reference: South-South Learning: "The FRL Assessment Process in Asia and the Pacific"Pokhara, Nepal, April 2017

REDD+ Activities/Scope and Land Change Matrix



Forest Degradation and Commercial Logging in PNG

A large amount of forest degradation caused by logging



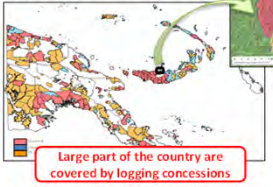
80% of PNG is covered by forest
14% of total forest area (35% of disturbed area) are logged over
60% of forest are undisturbed

The proportion of un-disturbed and disturbed forest

Management Issues
Where? When? How much?

Increasing tendency in both timber yield and export volume

Trend of log export volume in PNG



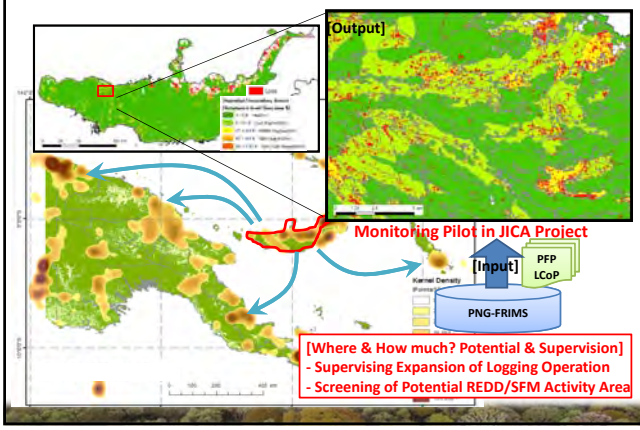
Large part of the country are covered by logging concessions

Concession Area implemented and proposed

Presence of logging in an inappropriate way

Example of after In-appropriate logging area

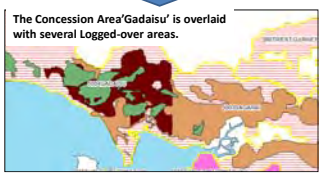
Potential Future Effect (Supervision & Potential Area)



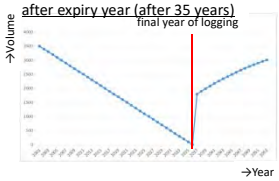
[Where & How much? Potential & Supervision]
- Supervising Expansion of Logging Operation
- Screening of Potential REDD/SFM Activity Area

Sustainable Management of Forests and Restoration

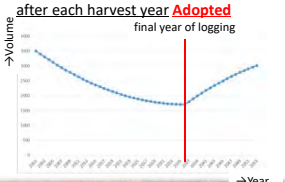
The Concession Area'Gadaisu' is overlaid with several Logged-over areas.



Idea 1: Forest volume recovery starts after expiry year (after 35 years)



Idea 2: Forest volume recovery starts after each harvest year **Adopted**



Summary

- Brief Outputs
  - Overview of Project/Overview of Output1/2/3
  - Achievements/Outputs List (Maps/Layers)
  - Deliverable Documents (for PNGFA operation)
  - Factsheets Series (Draft for other stakeholders)
- For Discussion
  - Countries Agenda: Green Climate Fund
  - REDD+ Activities/Scope & Land Change Matrix
  - Forest Degradation and Commercial Logging
  - Potential Future Effect (Supervision & Potential Area)
  - Sustainable Management of Forests and Restoration

Progress and Output of Updating Forest Cover Maps

– Past Forest Cover Maps & Degradation Drivers Maps -

Ayako OCHI
22th November 2017

Contents

Design of Updating Forest Cover Map

Task	Target area	Output	Impact
(1) Revision of the Forest Base Map 2012	Whole of PNG	Revised Forest Base Map 2012 (ver. 1.1)	• Improve accuracy of the Map, which is used the following map work • Enhance attributes to estimate forest resources such as timber volume
(2) Creation of past Forest Cover Maps	Pilot Province (WNB, WSK)	Forest Cover Maps in 2000 and 2005, Revised Forest Cover Map in 2011	• Knowledge clarified in this process is useful for examining the method of detecting forest area change for the future as well. • Contribute to simulation of forest area change and development of reference emission level
(3) Construction of Forest Degradation Driver Info into the Forest Cover Maps	All Forest Cover Maps	Forest Base/Cover Maps with DD Driver info	• Contribute to better estimation of forest resources amount
(4) Creation of Forest Cover Map in 2015	Whole of PNG	Forest Cover Map in 2015 with DD Driver info	• Could be a benchmark map for monitoring impacts of REDD+ activities • Develop basic capacities of updating future forest cover map in PNGFA

(1) Revision of the Forest Base Map 2012

Target area: Whole of PNG

Output: The revised Forest Base Map 2012 (ver. 1.1)

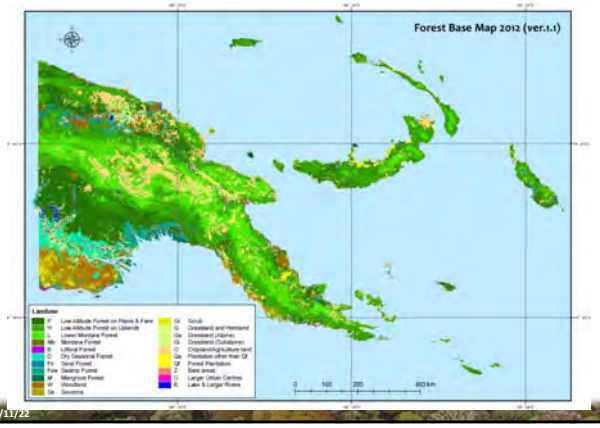
Main works:

- Examine the approach of distinguishing W, S, and Sc, detecting wetland forest, and dividing P and H in WES
- Assess quality and accuracy of vegetation type classification
- Subdivide land cover codes examining FIMS
- Add timber volume studying PNGRIS, FIPS, and PSP
- Add some other attributes such as tree crown size, Forest Zone, watershed, Tree cover loss, etc.
- Redefine a new set of the Forest Monitoring Unit

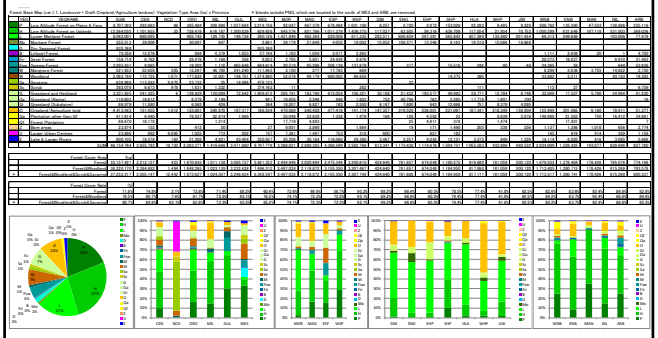
Impact:

- Improve accuracy of the Map, which is used the following map work
- Enhance attributes to estimate forest resources such as timber volume

(1) FBM: Revised Forest Base Map 2012



(1) FBM: Vegetation Type Area x Province



(2) Development of Past Forest Cover Maps

Objectives:

- To figure out where and how much forest resources are for SFM
- To get handle on the behavior and situation of the forest for a better forest planning, monitoring and management
- To contribute to simulation of forest area change and development of reference emission level
- Through this process, to get useful knowledge for the method of detecting forest area change for the future as well

Method:

- **Target year**:
  2011 (revised), 2005, 2000
- **Target site:**
  2 pilots: WNB and WSP
- **Available data referred and used for analysis**:
  - The Forest Base Map 2012
  - Hansen gain/loss/lossyear data 2001-2012
  - LANDSAT (AGP): 1990, 2000, 2005, 2010, 2011, 2014 for whole PNG
  - Old FIMS vegetation
  - Logged over area
  - Mining
  - Google Earth, etc.

(2) Development of Past Forest Cover Maps

Difficulties / challenges clarified in the examination:

- **LANDSAT 2005** imagery has scanning line **errors** -> difficult to interpret
- **Absence** of **Hansen data before 2000**
  -> difficult to know changed area before 2000
- **Hansen lossyear** data, which shows loss year in mesh, can only show one loss year in each mesh; data shows **first change year only**
  -> disable to detect repeated changed area
- **Hansen gain** data does **not** have **year** information
  -> disable to know gain year
- **LANDSAT** image resolution is **30m**
  -> difficult to find small change and forest degradation such as selective logging and sustainable agriculture, and vegetation type
- The **Forest Base Map** has some **misclassifications**
  -> need to revise land use/cover class in 2011

(2) Development of Past Forest Cover Maps

Procedure:

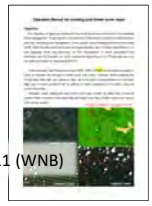
Forest Base Map
↓
Revise misclassifications
↓
Revised Forest Cover Map 2011
↓
Detect changed areas
Cut the changed area (about Larger than 1ha)
Identify land use/cover class
↓
Forest Cover Map 2005
↓
Detect changed areas
Cut the changed area (about Larger than 1ha)
Identify land use/cover class
↓
Forest Cover Map 2000

- Check over land use of the Forest Cover Map and **Hansen loss/gain**
- Compare **satellite imagery (LANDSAT)** in the corresponding year
- Refer the **surrounding land use/cover pattern** and **slope**

(2) Development of Past Forest Cover Maps

Outcomes:

- Forest Cover Map in 2011 (WNB)
- Forest Cover Map in 2005 (WNB)
- Forest Cover Map in 2000 (WNB)
- Changed Area Map 2000 – 2011 (WNB)
- Vegetation Type Area (ha) x Year (WNB)
- Changed Area (ha) from 2000 to 2005 and 2005 to 2011 (WNB)
- Changed Vegetation Type Area (ha) x Year (WNB)

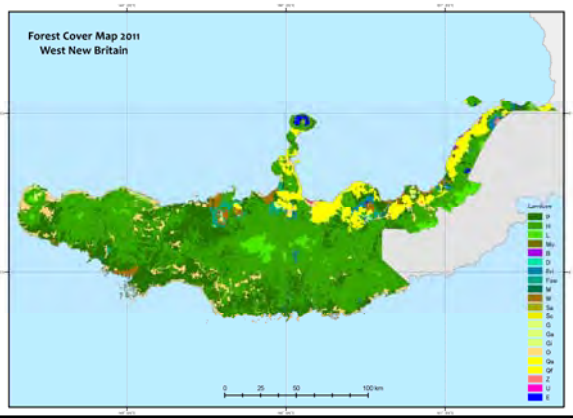


Manual

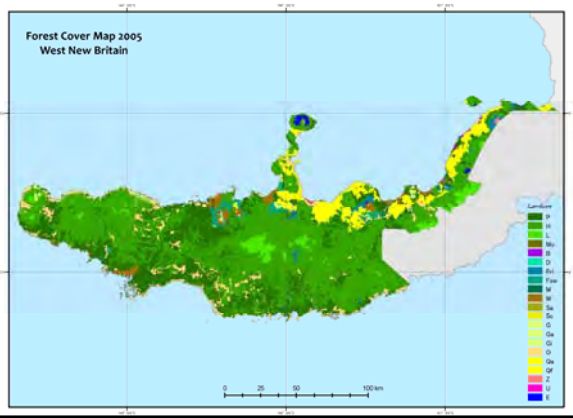
- Forest Cover Map in 2011 (WSP)
- Forest Cover Map in 2005 (WSP)
- Forest Cover Map in 2000 (WSP)
- Changed Area Map 2000 – 2011 (WSP)
- Vegetation Type Area (ha) x Year (WSP)
- Changed Area (ha) from 2000 to 2005 and 2005 to 2011 (WSP)
- Changed Vegetation Type Area (ha) x Year (WSP)

Refer to documents distributed

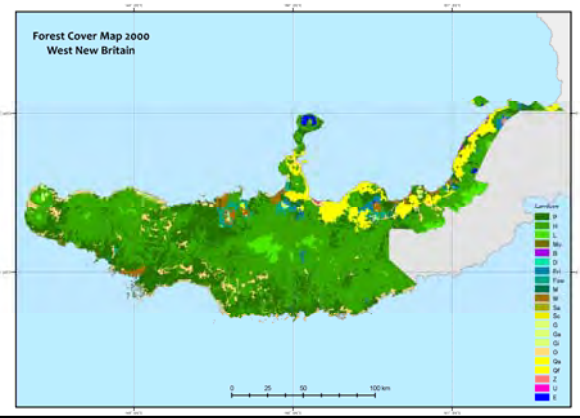
(2) Past FCM: Forest Cover Map 2011 (WNB)



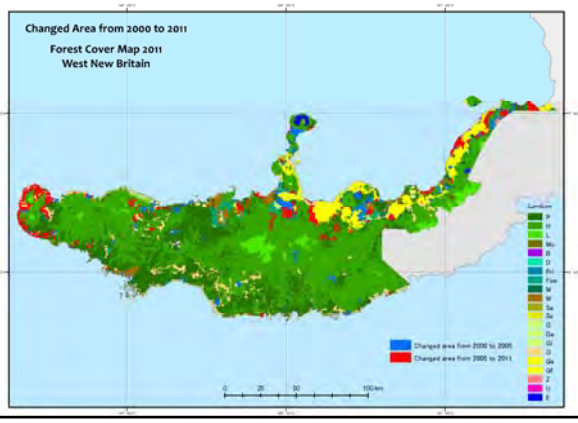
Past FCM: Forest Cover Map 2005 (WNB)



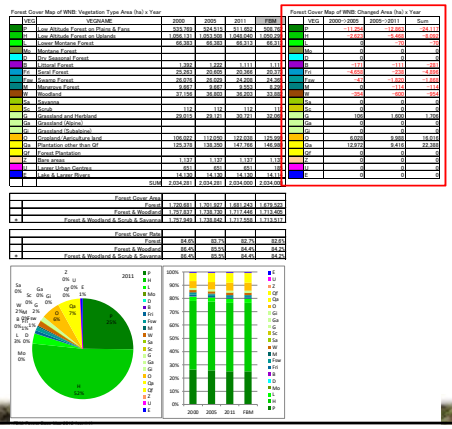
(2) Past FCM: Forest Cover Map 2000 (WNB)



Past FCM: Changed Area 2000-2011 (WNB)



(2) Past FCM: Vegetation Type Area x Year (WNB)



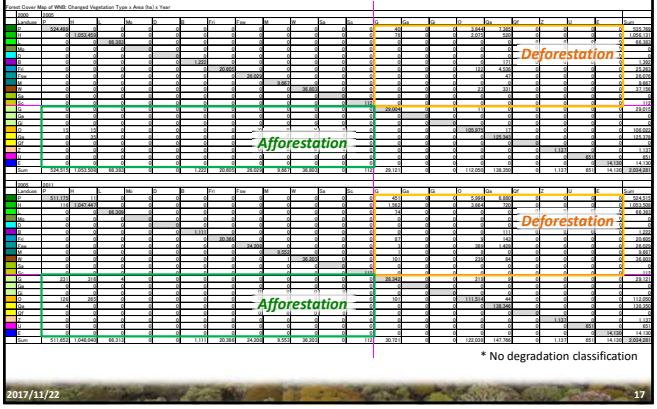
(2) Past FCM: Vegetation Type Area x Year (WNB)

Forest Cover Map of WNB: Changed Area (ha) x Year

	VEG	2000->2005	2005->2011	Sum
	P	−11,254	−12,863	−24,117
	H	−2,623	−5,468	−8,092
	L	0	−70	−70
	B	−171	−111	−281
	Fri	−4,658	−238	−4,896
	Fsw	−47	−1,820	−1,868
	M	0	−114	−114
	W	−354	−600	−954
	G	106	1,600	1,706
	O	6,028	9,988	16,016
	Qa	12,972	9,416	22,388

: Decreasing tendency
: Increasing tendency

(2) Past FCM: Changed Vegetation Type Area x Year (WNB)



* No degradation classification

(2) Past FCM: Changed Vegetation Type Area x Year (WNB)

Forest Cover Map of WNB: Changed Vegetation Type x Area (ha) x Year

2000	2005											
Landuse	P	H	L	B	Fri	Fsw	M	W	G	O	Qa	Sum
P	524,490	0	0	0	0	0	0	0	40	3,844	7,385	535,769
H	0	1,053,459	0	0	0	0	0	0	78	2,075	520	1,056,131
L	0	0	66,383	0	0	0	0	0	0	0	0	66,383
B	0	0	0	1,222	0	0	0	0	0	0	171	1,392
Fri	0	0	0	0	20,605	0	0	0	0	122	4,538	25,265
Fsw	0	0	0	0	0	26,029	0	0	0	0	47	26,076
M	0	0	0	0	0	0	9,667	0	0	0	0	9,667
W	0	0	0	0	0	0	0	36,803	0	23	331	37,156
G	0	0	0	0	0	0	0	0	29,004	11	0	29,015
O	15	15	0	0	0	0	0	0	0	105,975	17	106,022
Qa	0	35	0	0	0	0	0	0	0	0	125,343	125,378
Sum	524,515	1,053,508	66,383	1,222	20,605	26,029	9,667	36,803	29,121	112,050	138,350	2,018,252

Deforestation
Afforestation

2005	2011											
Landuse	P	H	L	B	Fri	Fsw	M	W	G	O	Qa	Sum
P	511,175	11	0	0	0	0	0	0	451	5,996	6,886	524,515
H	116	1,047,447	0	0	0	0	0	0	1,562	3,664	724	1,053,508
L	0	0	66,309	0	0	0	0	0	74	0	0	66,383
B	0	0	0	1,111	0	0	0	0	0	0	111	1,222
Fri	0	0	0	0	20,366	0	0	0	87	9	143	20,605
Fsw	0	0	0	0	0	24,208	0	0	3	388	1,429	26,029
M	0	0	0	0	0	0	9,552	0	1	8	6	9,667
W	0	0	0	0	0	0	1	36,203	101	239	84	36,803
G	231	316	4	0	0	0	0	0	28,342	219	9	29,121
O	126	265	0	0	0	0	0	0	101	111,514	44	112,050
Qa	4	0	0	0	0	0	0	0	0	0	138,346	138,350
Sum	511,652	1,048,040	66,313	1,111	20,366	24,208	9,553	36,203	30,721	122,038	147,766	2,018,252

Deforestation
Afforestation

: Changed area > 100 ha
: Changed area > 1,000 ha
: Decreasing tendency (changed area > 100 ha)
: Decreasing tendency (changed area > 1,000 ha)
: Increasing tendency (changed area > 100 ha)
: Increasing tendency (changed area > 1,000 ha)

* No degradation classification

(3) Construction of Forest Degradation Driver Info into Forest Cover Maps

Background/ Objectives:

- Main forest resource changes in PNG are **forest degradation**.
- **Decision/agreement on elements that will be the basis for the future work of analysis of deforestation and degradation processes** were discussed among the Project Team.
- Study of **available data and satellite imagery** was implemented to **identify and quantify DDs and their drivers**.
- Based on the results of DD assessment, DD driver information was constructed into the Forest Base/Cover Maps.
- This work will be a help to examine the method to develop Forest Cover Map 2015 and to monitor forest resources for the future.

(3) DD Driver: Decision/Agreement on Elements Related

Decision/agreement on elements that will be the basis for the future work of analysis of deforestation and degradation processes:

Track 1: Definitional issues

- Land Use Use (LU) classes
- Forest Strata (temporal sub-classes)
- FMU definition and selection criteria
- Land transition types
- Deforestation / Forest Degradation drivers

Track 2: Data availability and sources

- Disturbance types in the logging concessions
- Regeneration types
- Information on Plantations, SABLs, and Settlements

Track 3: Human activities on focus and their characteristics

- Illegal logging characteristics
- Hansen-loss analysis scale
- Subsistence agriculture characteristics

As for details, refer to the DD discussion report

Following work are processed on the basis of this decision/agreement

(3) DD Driver: Method

Procedure:

Overview

1. Data preparation
2. Driver identification with **large Hansen lossyear polygons (> 20 ha)**
3. Driver identification with **small Hansen lossyear polygons (<= 20 ha)**
4. Driver input into each **FMU** using large/small Hansen lossyear
5. Driver identification for each **FMU without Hansen lossyear polygons**

(3) DD Driver: Method (Cont.)

Procedure:

1. Prepare data
   - Forest Base Map
   - Hansen lossyear
   - Satellite imagery: LAMDSAT AGP, RapidEye (2011), Google Earth
   - Reference data necessary for identifying drivers
     - Mining
     - Forest plantation (Qf) polygon in the Forest Base Map
     - Plantation other than forest plantation (Qa) polygon in the Forest Base Map
     - FCA and SABL polygon
     - Subsistence agriculture (O) in the Forest Base Map
     - 500 m buffer from logging road (2000, 2000-2005, 2005-2011)
     - Concession (Current and Expired, purchase before 2010)
     - 5 km buffer from CU
     - Hansen Gain
     - FireWatch PNG

* For the Past Forest Cover Maps, use data for targeted year

Forest cover map 2005:

- Hansen loss (2001-2004)
- logging road (-2005)
- concession (purchase before 2004)
- Qf, Qa and O (in the FC Map 2005)

Forest cover map 2000:

* without Hansen Lossyear data

- logging road (-2000)
- concession (purchase before 1999)

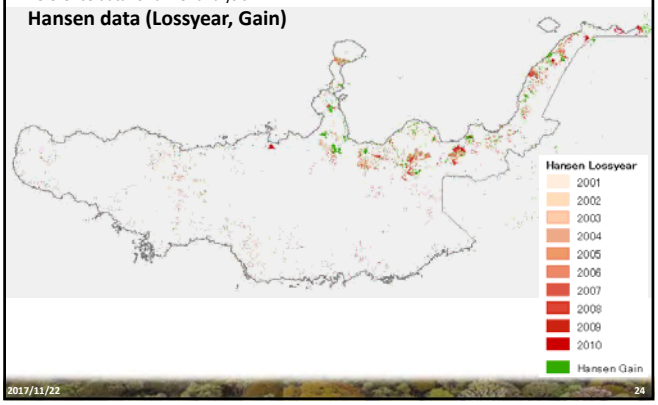
(3) DD Driver: Method (Cont.)

Forest Base Map (WNB)

(3) DD Driver: Method (Cont.)

Reference data for driver analysis:

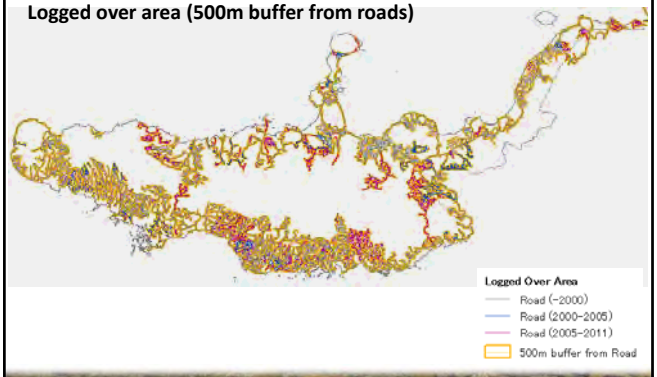
Hansen data (Lossyear, Gain)



(3) DD Driver: Method (Cont.)

Reference data for driver analysis:

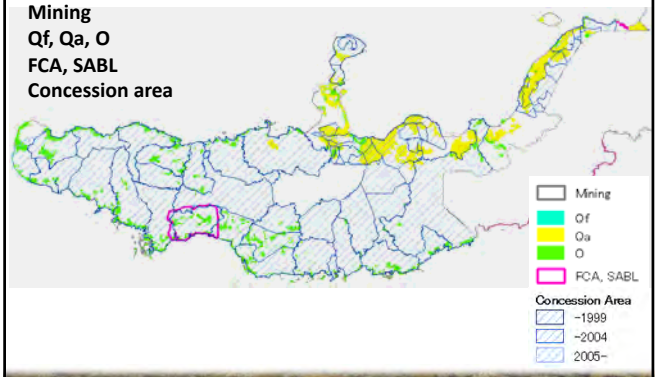
Logged over area (500m buffer from roads)



(3) DD Driver: Method (Cont.)

Reference data for driver analysis:

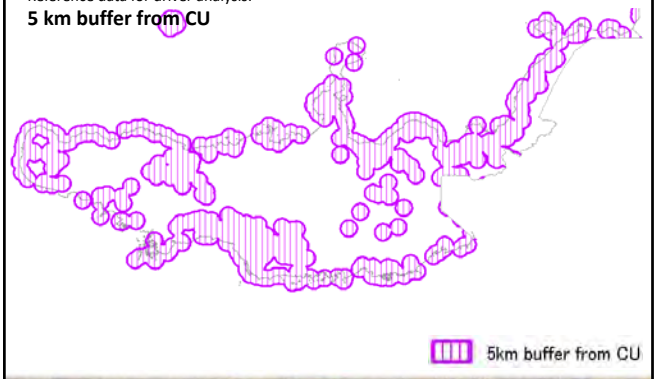
Mining
Qf, Qa, O
FCA, SABL
Concession area



(3) DD Driver: Method (Cont.)

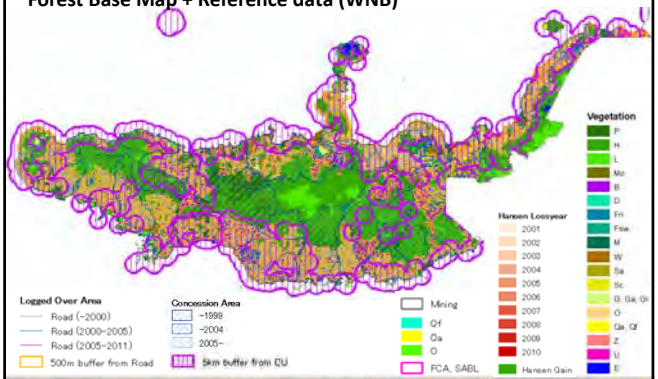
Reference data for driver analysis:

5 km buffer from CU



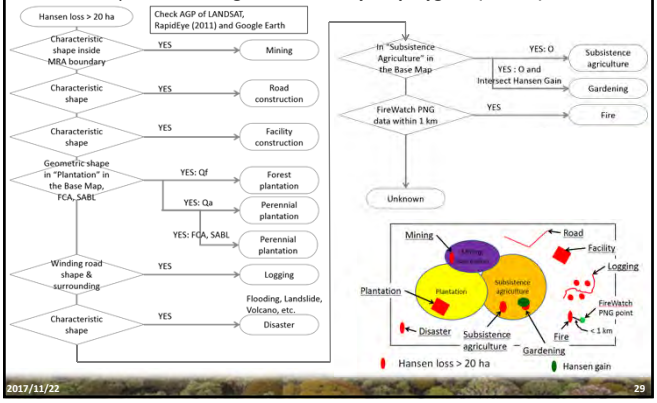
(3) Method (Cont.)

Forest Base Map + Reference data (WNB)



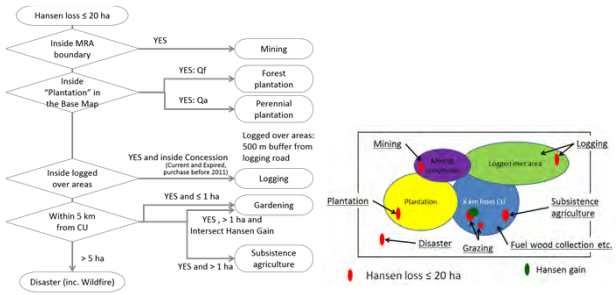
(3) DD Driver: Method (Cont.)

2. Identify drivers of **large Hansen Lossyear polygons (>20 ha)**



(3) DD Driver: Method (Cont.)

3. Identify drivers of **small Hansen Lossyear polygons (<=20 ha)**

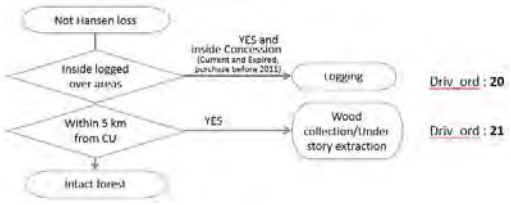


4. Input driver information for each FMU of the Forest Base Map by overlaying Lossyear polygons prepared in step 2 and 3

* Apply upper driver (high priority) if FMU intersects more than two Lossyear polygons

(3) DD Driver: Method (Cont.)

5. Input driver information for each FMU **without Hansen Lossyear**



* FMU with no driver information are considered as intact forest.

(3) Construction of Forest Degradation Driver Info into Forest Cover Maps

Outcomes:

- DD Driver info of Forest Cover Map in 2011 (WNB)
- DD Driver info of Forest Cover Map in 2005 (WNB)
- DD Driver info of Forest Cover Map in 2000 (WNB)
- DD Driver info of Forest Cover Map in 2011 (WSP)
- DD Driver info of Forest Cover Map in 2005 (WSP)
- DD Driver info of Forest Cover Map in 2000 (WSP)

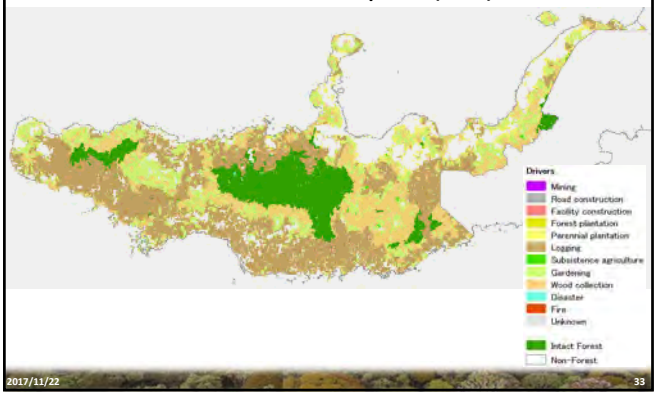
Refer to documents distributed

- DD Driver info of Forest Base Map (PNG)
- DD Driver Area (ha) x Province
- DD Driver Area (ha) x Year (WNB)
- DD Driver Area (ha) x Year (WSP)

Manual

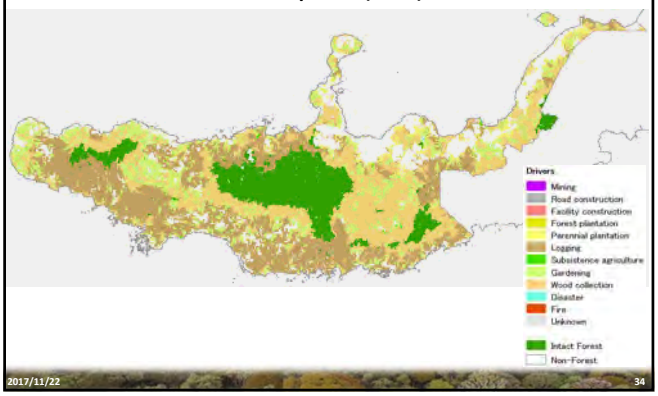
(3) DD Driver: DD Driver Info of Forest Cover Map 2011 (WNB)

Driver info of revised Forest Cover Map 2011 (WNB)



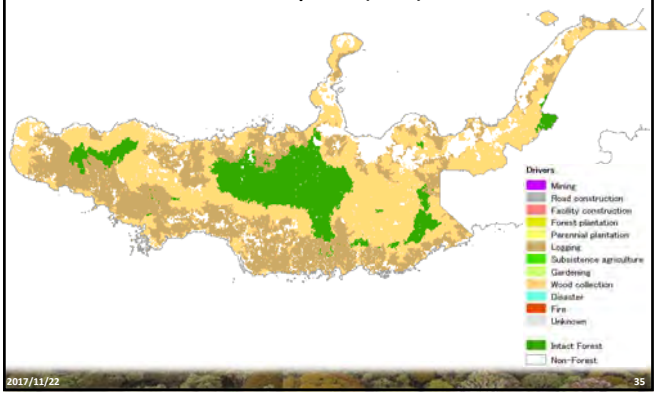
(3) DD Driver: DD Driver Info of Forest Cover Map 2005 (WNB)

Driver info of Forest Cover Map 2005 (WNB)

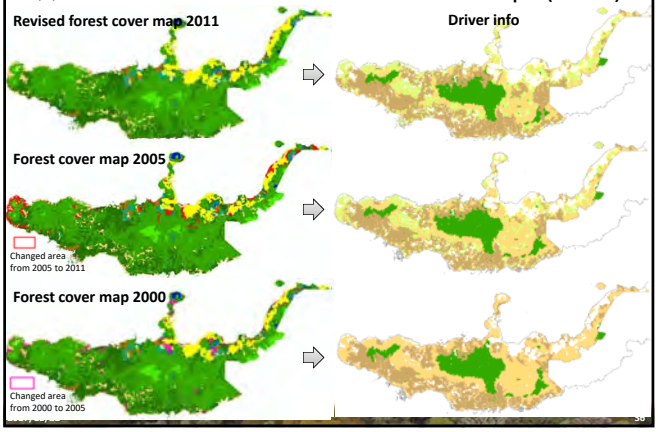


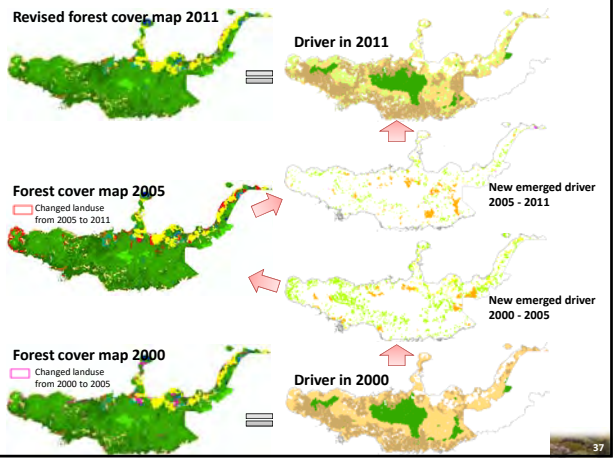
(3) DD Driver: DD Driver Info of Forest Cover Map 2000 (WNB)

Driver info of Forest Cover Map 2000 (WNB)

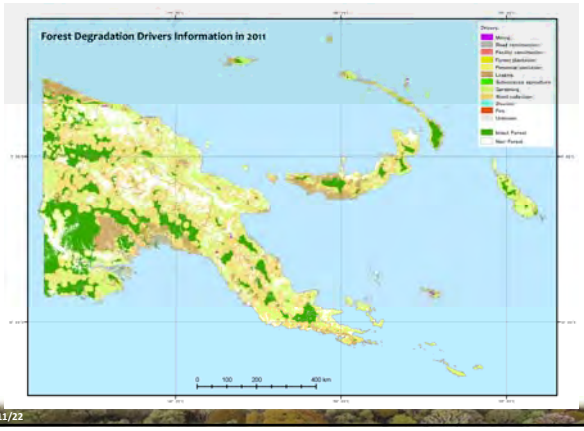


(3) DD Driver: Driver info of Forest Cover Maps (WNB)

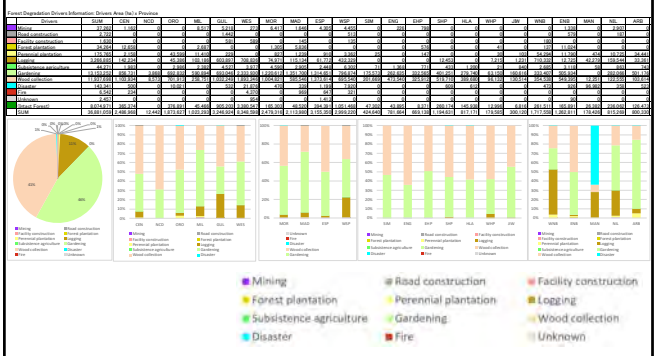




(3) DD Driver: Drivers Caused Forest Degradation (PNG, 2011)



(3) DD Driver: DD Driver Area x Province



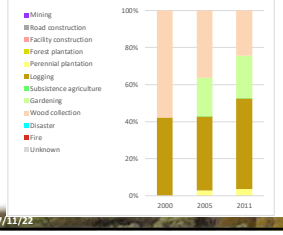
(3) DD Driver: DD Driver Area x Year (WNB and WSP)

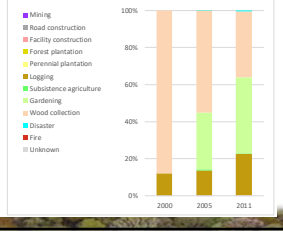
Forest Degradation Drivers Information of WNB: Drivers Area (ha) x Year

Drivers	2000	2005	2011
Mining	0	0	0
Road construction	0	0	0
Facility construction	0	0	180
Forest plantation	0	0	137
Perennial plantation	0	39,818	54,294
Logging	614,830	581,988	710,332
Subsistence agriculture	0	2,281	2,685
Gardening	0	300,010	333,407
Wood collection	837,377	527,197	354,538
Disaster	0	236	473
Fire	0	0	0
Unknown	0	0	0
(Intact Forest)	305,742	287,054	261,511
SUM	1,757,949	1,738,561	1,717,558

Forest Degradation Drivers Information of WSP: Drivers Area (ha) x Year

Drivers	2000	2005	2011
Mining	0	3,350	4,455
Road construction	0	0	513
Facility construction	0	0	135
Forest plantation	0	0	0
Perennial plantation	0	444	3,362
Logging	232,422	263,344	432,329
Subsistence agriculture	0	5,720	6,302
Gardening	0	594,472	796,874
Wood collection	1,690,076	1,058,340	695,540
Disaster	0	549	7,920
Fire	0	0	321
Unknown	0	0	0
(Intact Forest)	1,132,495	1,111,720	1,051,468
SUM	3,054,992	3,037,939	2,999,220

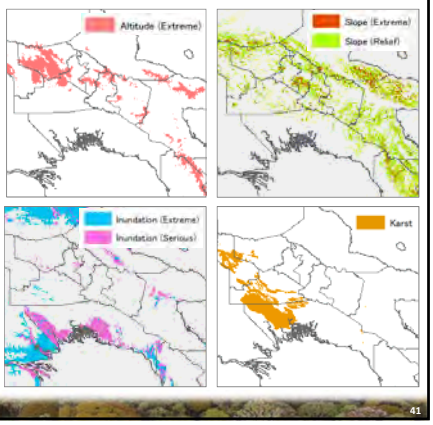




Other PNG-FRIMS Database Arranged

Constraints:

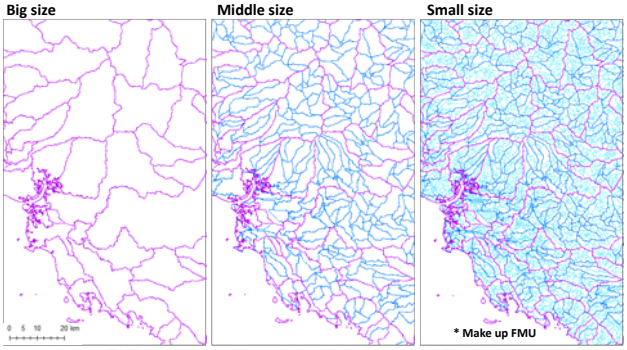
- Altitude
- Slope (Extreme)
- Slope/Relief
- Mangroves
- Inundation (Extreme)
- Inundation (Serious)
- Karst



Other PNG-FRIMS Database Arranged

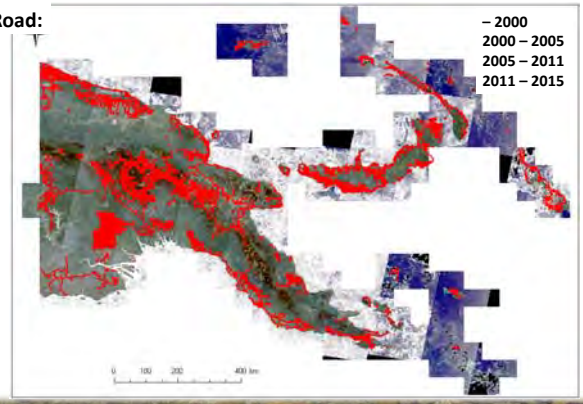
Watershed (Catchment):

Big size | **Middle size** | **Small size**



Other PNG-FRIMS Database Arranged

Road:



Overview of Work Progress / Plan for Future

1. **Revision of the Forest Base Map 2012** → **Done**
2. **Creation of past Forest Cover Maps** → **Done**
3. **Construction of Forest Degradation Driver Information into the Forest Cover Maps** → **Done**
4. **Creation of Forest Cover Map in 2015**
   → **WES, CEN, MIL, WSP, MOR, NIP, ENB, WNB: Tentatively done**
   14 Provinces: Not yet

Other works

- Develop the **manual** on updating forest cover map → **ongoing**
- Update **timber volume** attribute examining NFI (?)
- **Design maps** for provision as the Factsheet 2 shows → **ongoing**
- Arrange maps using attribute information
- Organize data in PNG-FRIMS Database
- Calculate **Biomass**, **Carbon stock**, and **Emission/Removals** → **ongoing**
- Calculate **REL/FREL** using time-series maps on a trial basis

Challenges for the Future

- **Forest Cover Map 2015 with DD driver** information will be developed using the same approach.
- These forest maps can be used for **forest plan**, **forest monitoring**, and **analyses** such as simulation of the location of future deforestation.
- Data/products should be **utilized** for **PNGFA activities** etc.
- Updating of forest cover map and other data such as road should be **positioned** in PNGFA task.
- It is required to make **data quality** (ex. Qf) better for effective work.
- Forest Cover Maps is useful for **broad-based** and **longtime** forest monitoring in **national/regional level**.
- The Maps (Satellite analysis) have a **limitation** in **rapid** monitoring and detecting **small** forest area change.

Thank you for your attention

Appendix

Output and Activity 1.3

1.3 Examine the approach of updating the forest base map.

1.3.1 Lay out a **basic design** for the **method of detecting forest area changes** with remote sensing technology.

1.3.2 Process and analyze the remote sensing data **combining with ground truth** (ex. Permanent Sample Plots of Forest Research Institute, Resource Inventory of PNGA) on a trial basis.

1.3.3 **Identify necessary additional information** from other sources (ex. From agriculture, mining and wildlife management).

1.3.4 Develop the **manual** on updating forest base map.

1.3.5 **Update forest base map** for the forest area change detected in the pilot area(s) identified in activity 2.2.1.

⇨ **Method / Manual / Updated Forest Base Map**

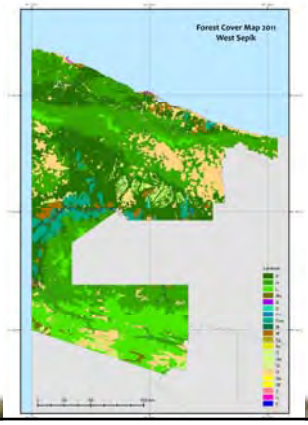
Design of Updating Forest Cover Map

1. **Revision of the Forest Base Map 2012**
   - Target area: Whole of PNG
   - Output: Revised Forest Base Map 2012 (ver. 1.1)
   - Impact:
     - Improve accuracy of the Map, which is used the following map work
     - Enhance attributes to estimate forest resources such as timber volume
2. **Creation of past Forest Cover Maps**
   - Target area: Pilot Province (West New Britain, and West Sepik)
   - Output: Forest Cover Maps in 2000 and 2005, and Revised Forest Cover Map in 2011
   - Impact:
     - Contribute to simulation of forest area change and development of reference emission level
     - Knowledge clarified in this process is useful for examining the method of detecting forest area change for the future as well.

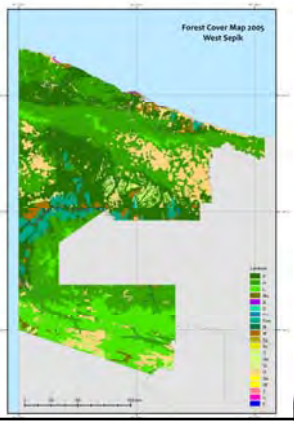
Design of Updating Forest Cover Map

3. **Construction of Forest Degradation Driver Information into the Forest Cover Maps**
   - Target: Forest Base Map, Past Forest Cover Maps (2000, 2005, 2011)
   - Output: Forest Base/Cover Maps with DD Driver info
   - Impact:
     - Contribute to better estimation of forest resources amount
4. **Creation of Forest Cover Map in 2015**
   - Target area: Whole of PNG
   - Output: Forest Cover Map in 2015 with DD Driver info
   - Impact:
     - Could be a benchmark map for monitoring impacts of REDD+ activities
     - Develop basic capacities of updating future forest cover map in PNGFA

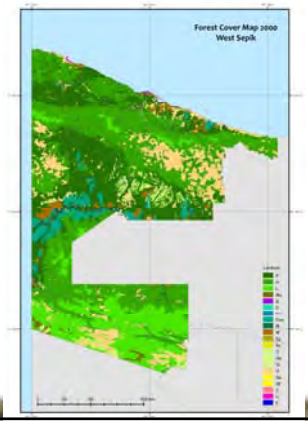
(2) Past FCM: Forest Cover Map 2011 (WSP)



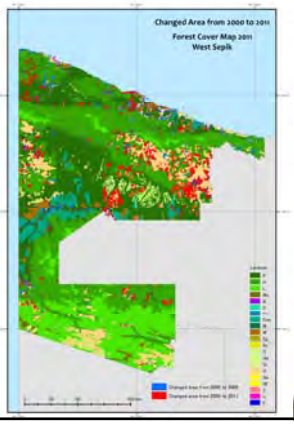
(2) Past FCM: Forest Cover Map 2005 (WSP)



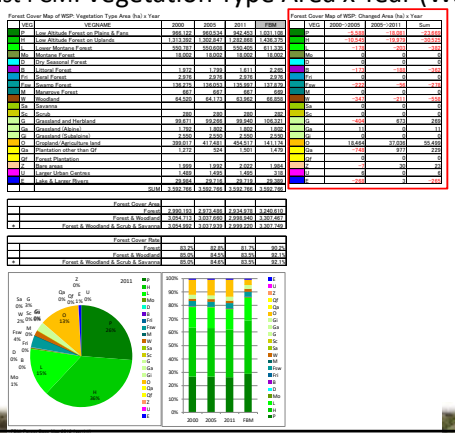
(2) Past FCM: Forest Cover Map 2000 (WSP)



(2) Past FCM: Changed Area 2000-2011 (WSP)



(2) Past FCM: Vegetation Type Area x Year (WSP)



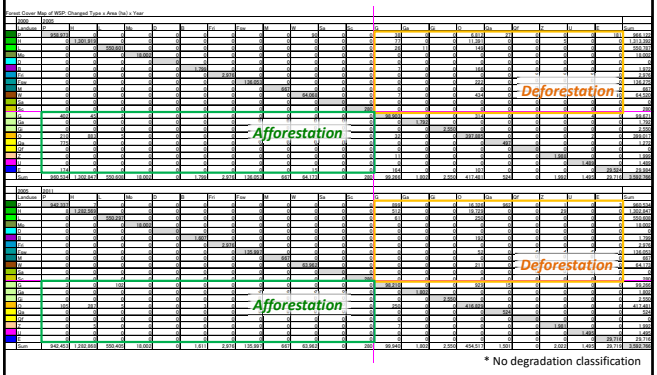
(2) Past FCM: Vegetation Type Area x Year (WSP)

Forest Cover Map of WSP: Changed Area (ha) x Year

	VEG	2000–>2005	2005–>2011	Sum
	P	−5,588	−18,081	−23,669
	H	−10,545	−19,979	−30,525
	L	−178	−203	−382
	B	−173	−188	−362
	Fsw	−222	−56	−278
	W	−347	−211	−558
	G	−404	673	269
	Ga	11	0	11
	O	18,464	37,036	55,499
	Qa	−748	977	229
	Z	−7	30	23
	U	6	0	6
	E	−268	3	−265

: Decreasing tendency
: Increasing tendency

(2) Past FCM: Changed Vegetation Type Area x Year (WSP)



* No degradation classification

(2) Past FCM: Changed Vegetation Type Area x Year (WSP)

Forest Cover Map of WSP: Changed Type x Area (ha) x Year

2000 \ 2005	P	H	L	B	Fsw	W	G	Ga	O	Qa	Z	U	E	Sum
P	958,973	0	0	0	0	90	38	0	6,812	27	0	0	181	966,122
H	0	1,301,919	0	0	0	0	77	0	11,391	0	5	0	0	1,313,392
L	0	0	550,601	0	0	0	26	11	149	0	0	0	0	550,787
B	0	0	0	1,799	0	0	7	0	166	0	0	0	0	1,972
Fsw	0	0	0	0	136,053	0	0	0	222	0	0	0	0	136,275
W	0	0	0	0	0	64,068	7	0	434	0	0	0	10	64,520
G	402	45	2	0	0	0	98,903	0	314	0	0	4	0	99,671
Ga	0	0	0	0	0	0	0	1,792	0	0	0	0	0	1,792
O	210	883	5	0	0	0	32	0	397,885	0	2	0	0	399,017
Qa	775	0	0	0	0	0	0	0	0	497	0	0	0	1,272
Z	0	0	0	0	0	0	11	0	0	0	1,988	0	0	1,999
U	0	0	0	0	0	0	0	0	0	0	0	1,489	0	1,489
E	174	0	0	0	0	15	164	0	107	0	0	0	29,524	29,984
Sum	960,534	1,302,847	550,608	1,799	136,053	64,173	99,266	1,802	417,481	524	1,992	1,495	29,716	3,568,291

Deforestation
Afforestation

2005 \ 2011	P	H	L	B	Fsw	W	G	Ga	O	Qa	Z	U	E	Sum
P	942,337	7	0	0	0	0	899	0	16,326	962	1	0	3	960,534
H	8	1,282,569	0	0	0	0	512	0	19,729	0	29	0	0	1,302,847
L	0	0	550,297	0	0	0	61	0	250	0	0	0	0	550,608
B	0	0	0	1,607	0	0	0	0	192	0	0	0	0	1,799
Fsw	0	0	0	0	135,997	0	0	0	52	0	4	0	0	136,053
W	0	0	0	0	0	63,962	0	0	211	0	0	0	0	64,173
G	2	0	102	0	0	0	98,210	0	929	15	8	0	0	99,266
Ga	0	0	0	0	0	0	0	1,802	0	0	0	0	0	1,802
O	105	287	5	3	0	0	250	0	416,829	0	0	0	0	417,481
Qa	0	0	0	0	0	0	0	0	0	524	0	0	0	524
Z	0	5	0	0	0	0	0	0	0	0	1,981	0	0	1,992
U	0	0	0	0	0	0	0	0	0	0	0	1,495	0	1,495
E	0	0	0	0	0	0	0	0	0	0	0	0	29,716	29,716
Sum	942,453	1,282,868	550,405	1,611	135,997	63,962	99,940	1,802	454,517	1,501	2,022	1,495	29,719	3,592,766

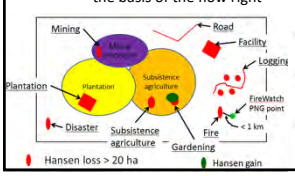
Deforestation
Afforestation

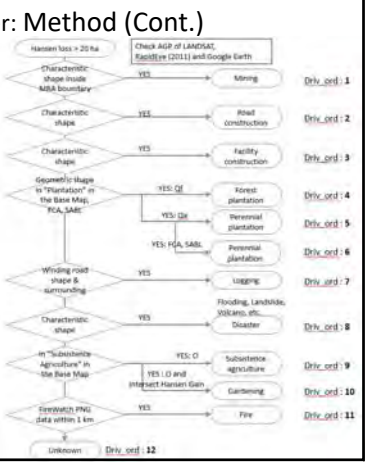
: Changed area > 100 ha
: Changed area > 1,000 ha
: Decreasing tendency (changed area > 100 ha)
: Decreasing tendency (changed area > 1,000 ha)
: Increasing tendency (changed area > 100 ha)
: Increasing tendency (changed area > 1,000 ha)

* No degradation classification

(3) DD Driver: Method (Cont.)

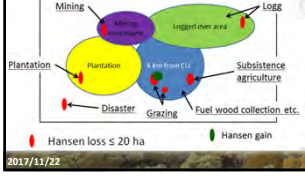
2. Identify drivers of **large Hansen Lossyear pologons (>20 ha)**
   - Pick out Hansen Lossyear polygons larger than 20 ha for targeted year of 2001-2010
   - Referring satellite imagery and data prepared in step 1, identify driver for each Hansen lossyear polygon on the basis of the flow right

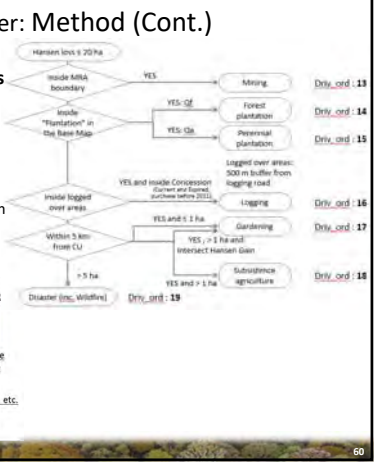




(3) DD Driver: Method (Cont.)

3. Identify drivers of **small Hansen Lossyear polygons (<=20 ha)**
   - Pick out Hansen Lossyear polygons smaller than and equal 20 ha for targeted year of 2001-2010
   - Identify driver for each Hansen lossyear polygon on the basis of the flow right by overlay analysis with reference data





(3) DD Driver: Method (Cont.)

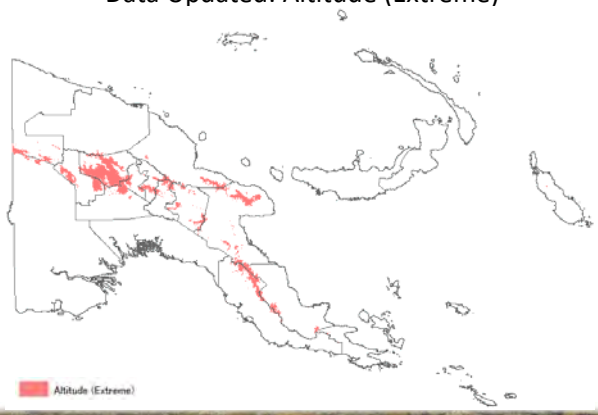
4. Marge Lossyear polygons prepared in step 1 and step 2
5. Input driver information for each FMU of the Forest Base Map by overlaying Lossyear polygons prepared in step 4

   * Apply upper driver (high priority) if FMU intersects more than two Lossyear polygons

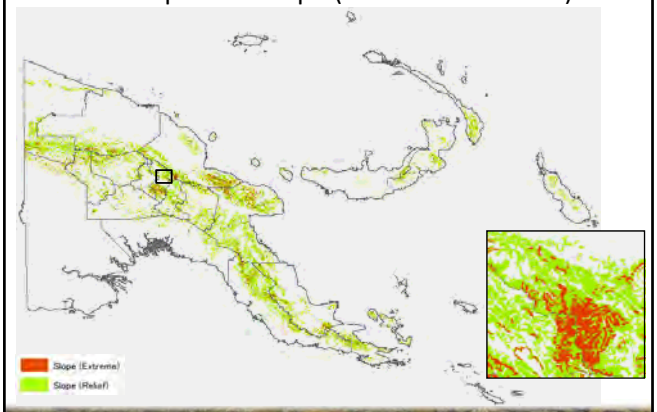
6. Input driver information for each FMU **without Hansen Lossyear**
   - Identify driver for each FMU on the basis of flow right by overlay analysis with reference data

* FMU with no driver information are considered as intact forest.

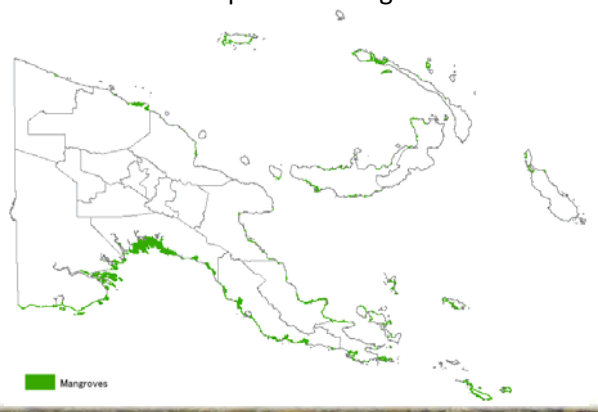
Data Updated: Altitude (Extreme)



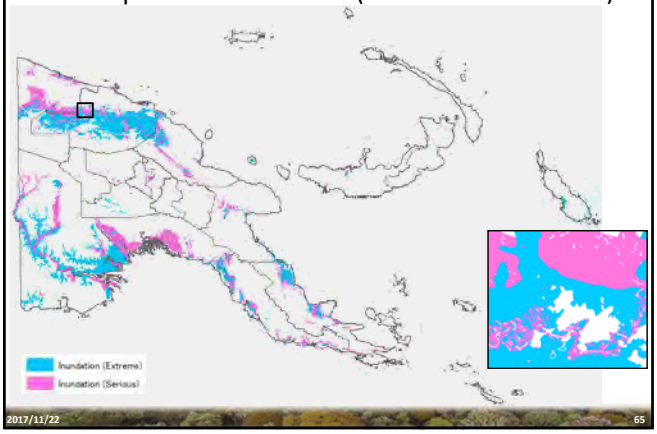
Data Updated: Slope (Extreme and Relief)



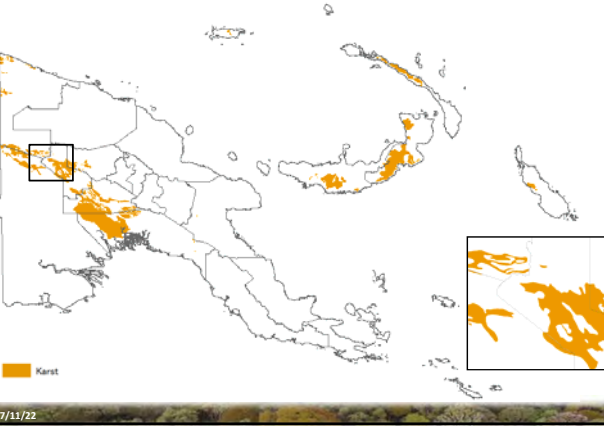
Data Updated: Mangroves



Data Updated: Inundation (Extreme and Serious)



Data Updated: Karst



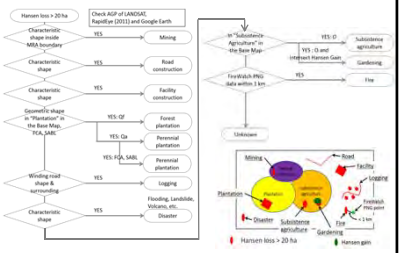
Simulation of the location of future deforestation in West New Britain Province, Papua New Guinea

November 2017

Introduction

PNG Forest Authority (PNGFA) developed forest cover map in 2000, 2005, 2011 and 2015 utilizing archives of LANDSAT imageries and time series of deforestation data published by Maryland University.

For the development of the maps, PNGFA analyzed drivers of deforestation / forest degradation, so that deforested area can be clarified with its driver.



It is possible to simulate deforestation probability refined by driver information analyzing the time series of maps.

Methods

Target area:
West New Britain Province, Papua New Guinea

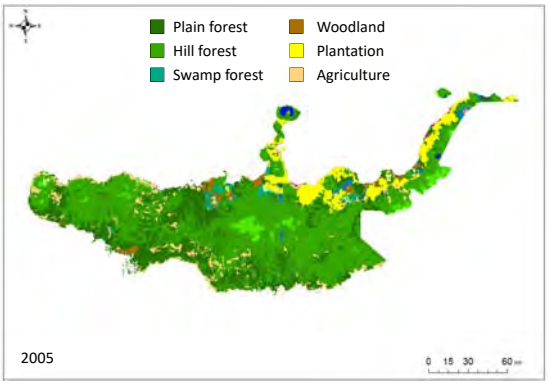
Area size: 2,034,000 ha

Population: 210,000 (2008)

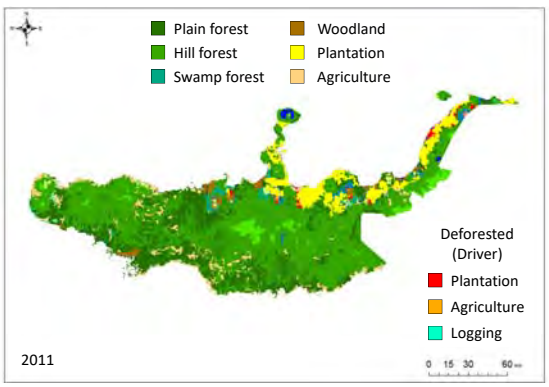
Applied maps:
forest cover map 2005, 2011, 2015 developed by PNGFA

Tool:
Land Change Modeler for ArcGIS 2.0 (Clark University)

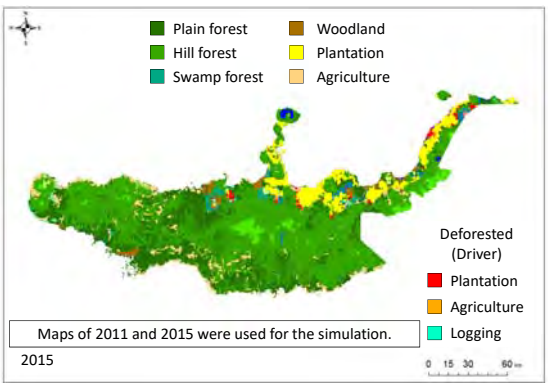
Applied maps



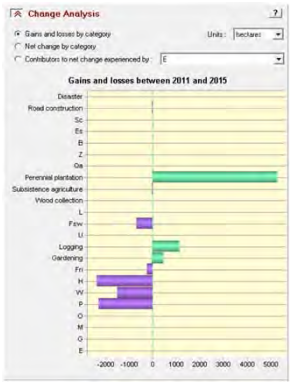
Applied maps



Applied maps



Change Analysis



Maps of 2011 and 2015 were compared.

3 major drivers of deforestation:

1. Perennial plantation
2. Logging
3. Gardening (Shifting agriculture)

4 major types of forest deforested:

1. Hill forest
2. Plain forest
3. Woodland
4. Swamp forest

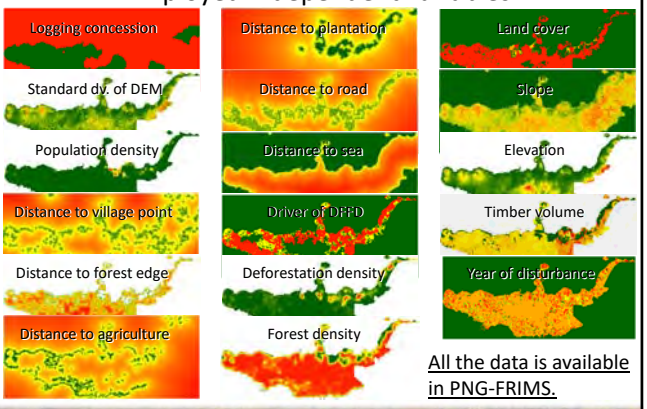
Only transitions sized more than 200 ha in whole WNB province were simulated.

Hill forest -> Gardening

Plain forest, Hill forest, Swamp forest -> Logging

Plain forest, Hill forest, Woodland -> Perennial plantation

Employed Independent variables

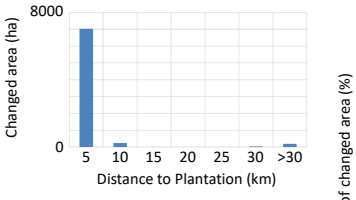


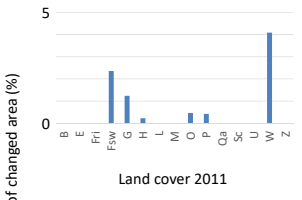
All the data is available in PNG-FRIMS.

Sensitivity of Model to Forcing a Single Independent Variable to be Constant

	Accuracy (%)	Skill measure	Influence order
(With all variables)	76.04	0.7365	N/A
Distance to Plantation	51.41	0.4655	1 (most influential)
Land cover in 2011	56.34	0.5197	2
Timber Volume	64.85	0.6133	3
Active Concession	68.03	0.6484	4
Distance to village point	69.89	0.6688	5
Distance to Sea	73.71	0.7108	6
Driver of Deforestation	74.69	0.7216	7
Slope	75.54	0.731	8
Distance to Road	75.81	0.7339	9
Year of disturbance	76.02	0.7362	10
Distance to Forest edge	76.02	0.7363	11
Elevation	76.04	0.7365	12
Forest density	76.04	0.7365	13
Deforestation density	76.04	0.7365	14
STD of elevation	76.04	0.7365	15
Population density	76.04	0.7365	16
Distance to Agriculture	76.14	0.7375	17 (least influential)

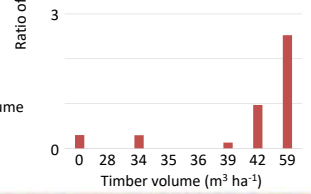
Land change between 2011 – 2015 and variables



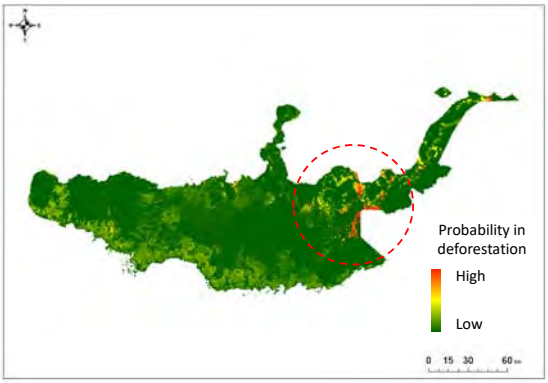


Land cover change:

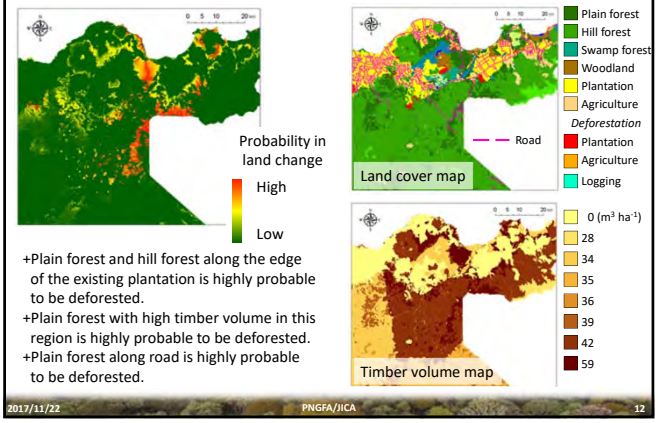
+High in area close to plantation
+High ratio in woodland and swamp forest
+Higher ratio in forest with higher timber volume



Deforestation probability in West New Britain



Deforestation probability and variables



+Plain forest and hill forest along the edge of the existing plantation is highly probable to be deforested.
+Plain forest with high timber volume in this region is highly probable to be deforested.
+Plain forest along road is highly probable to be deforested.

Use of spatial models

FREL/REL construction

Spatial models simulate the expected location of future land change (deforestation).

Their use for FREL/REL construction may provide a more accurate estimate of the carbon contents of forest expected to be lost in the future.

Note: since spatial models is not good at simulating the quantity of future deforestation, therefore their use in calculating may be limited.

REDD+ context

The use of spatial modeling to predict the location of future change may serve the following purposes:

- Inform policy making and the national REDD+ strategy;
- Provide information on where the greatest deforestation pressures may be;
- Help choose the location of REDD+ activities;
- Help in the design of monitoring efforts and additional (intensified) data collection in anticipated deforestation hotspots.

Limitation

+Spatial models has a limited ability to evaluate conditions not observed in the past (Brown et al. 2013).

+Some variables may be highly dynamic, and can significantly change the land change probability.

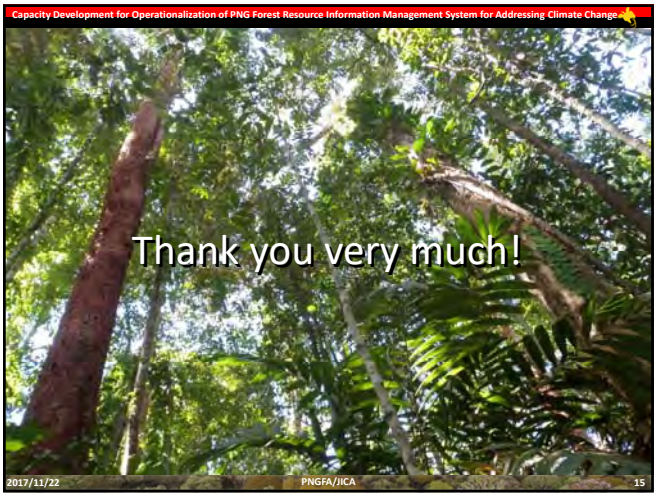
ex. New roads, new mining concessions, significant population migration, etc.

Future actions

+Simulation in other Provinces implementing capacity buildings of the staffs in PNGFA.

+Examining the other use of the Land Change Modeler other than deforestation simulation, such as plantation, logging etc.

+Comparing with results of the other modelling activities such as FCPF's deforestation modelling.



Progress of updating/enhancing PNG-FRIMS

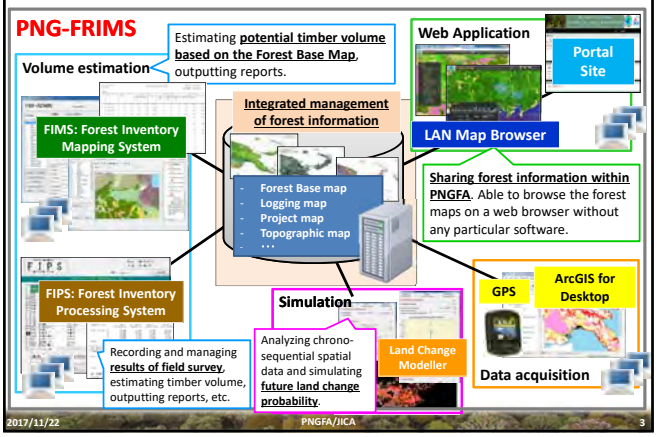
– Implemented Functions and Future Enhancement –

Yasuyuki OKADA

22th November 2017

Contents

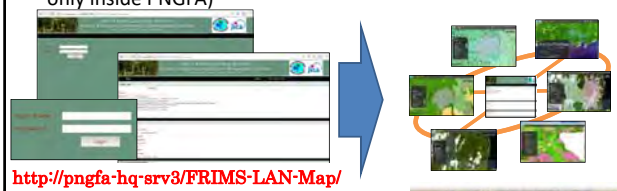
1. Overview of PNG-FRIMS



2. Implemented principal items

2.1 Forest Information Browsing System (LAN Map)

- LAN Map makes it possible to share forest information stored in the database of PNG-FRIMS within PNGFA and to promote utilization of them for PNGFA's daily works.
- Authorized users can see thematic maps through a Web Browser without special software.
- No access to the map through Internet from outside. (Access from only inside PNGFA)

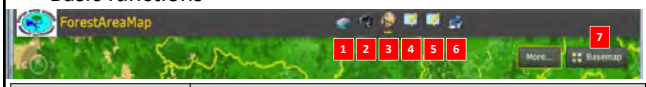


http://pngfa-hq-srv3/FRIMS-LAN-Map/

2. Implemented principal items

2.1 Forest Information Browsing System (LAN Map)

- Basic functions



	Functions	Note
1	Layer List	Turn layers (forest info) on and off.
2	Search	Search for location/ point of interest
3	Measure	Measure length or area on the map.
4	Sketch	Sketch simple graphics (point, line, polygon) on the map
5	Feedback	Send feedbacks to Administrator (e.g. the data error that you found etc.)
6	Print	Print a visible map displayed.
7	Switch background maps	Satellite imageries, topographic maps, etc (RapidEye2011, Landsat Annual Greenest Pixel 2000/ 2013/ 2014, Topomap, Hillshade)

It is possible to develop and add processing functions to LAN Map that are provided by ArcGIS.

2. Implemented principal items

2.2 Enhancement of data specification on harvesting history

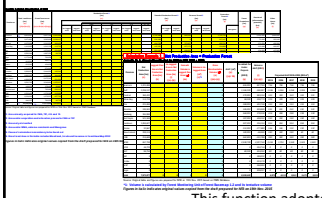
- PNG-FRIMS started storing set-ups boundaries with distinction between planned area and actual logged area
- Furthermore, harvested year and additional features (bridge, campsite, gravel pit, log landing, road , river/stream) are being captured from ALPs.

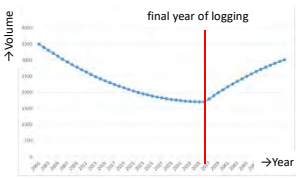
Issue to be considered

- There are a lot of workloads to digitize ALPs.
- Acquiring softcopies of ALPs from developers is highly recommended to reduce the time for updating harvesting history.

2. Implemented principal items
2.3 AAC calculation taking forest re-growth into account

- AAC calculation function based on Forest Base Map 2012 has been developed on a trial basis. The draft results of the calculation are being verified for now.
  - Current FIMS only subtracts the harvested area from forest area for a rough estimate of timber volume. Not taking account of re-growth.

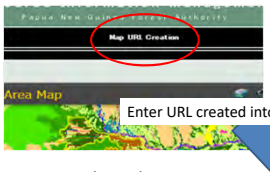




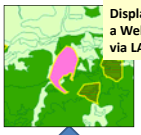
This function adopted the idea that timber volume will recover over the next 35 years linearly, although we examined PINFORM.

3. Future enhancement
3.1 Cooperation with DSS (Decision support system)

- LAN-Map has the function to create a URL link which shows the map with focus on the point of interest by magnifying or scaling down the map.



Enter URL created into DSS



Display a map on a Web Browser via LAN Map

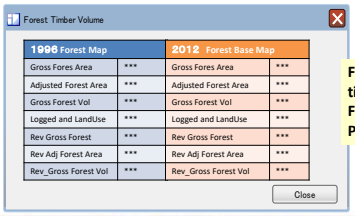
Table in the DSS (image)

Project name	Setup name	***	LAN Map URL
EastFurgasson	S13-14 10A	***	http://pngfa-hq-srv3/flexviewers/123
EastFurgasson	S13-14 11A		
EastFurgasson	S13-14 12A		

If DSS can add a new column for recording a URL link, LAN Map provides a URL to the map

3. Future enhancement
3.2 Upgrading FIMS

- Working on upgrade of FIMS to import Forest Base Map 2012 for calculation of timber volume and outputting reports
  - The number of polygons of Forest Base Map 2012 is 100 times as many as the number of polygons of FMU (previous vegetation map).



Function to compare timber volumes using Forest base map 2102 and Previous base map (FMU).

Summary

- LAN-Map has been ready to provide forest information stored in the database of PNG-FRIMS for PNGFA's daily works.
  - If you have any requests for using forest information, please consult with cartographer team. It became easier to access forest map information than before.
- Upgrading PNG-FRIMS functions based on Forest Base Map 2012 currently.

Thank you

Current Progress and Future Prospect in Activity2

PNGFA/JICA Project
Tsutomu KOYAMA
22nd Nov, 2017

Contents

1. A brief review of the objective of activity2
2. Current progress
3. Future prospects

Contents

1. **A brief review of the objective of activity2**
2. Current progress
3. Future prospects

1. A review of the objective of activity2

Expected outcome of PNGFA/JICA project

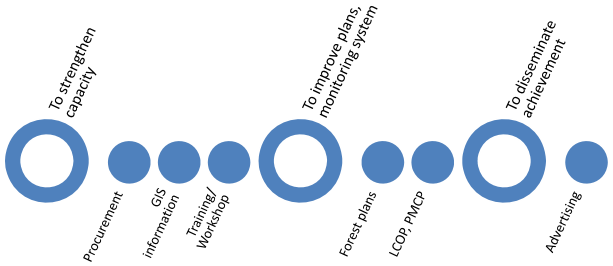
Capacity of the PNGFA continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.

To achieve above purpose	Output1: PNG-FRIMS is expanded and enhanced.
	Output2: The national forest plan, provincial forest plan forest management plans and their monitoring system are improved through steady operation of PNG-FRIMS.
	Output3: Forest information for addressing REDD+ is prepared.

Key point: PNG-FRIMS, Remote sensing, Sustainable forest management, Climate change

1. A review of the objective of activity2

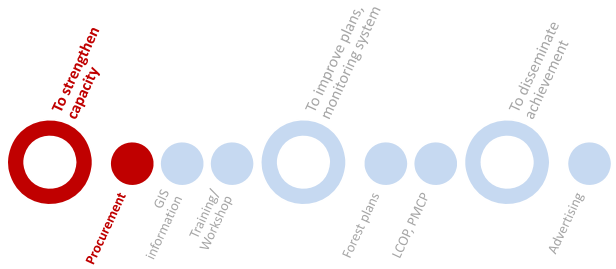
Contents of activity2 in order to achieve output2



Contents

1. A brief review of the objective of activity2
2. **Current progress**
3. Future prospects

2. Current progress



2. Current progress

Equipment handed over

Vehicle

GPS

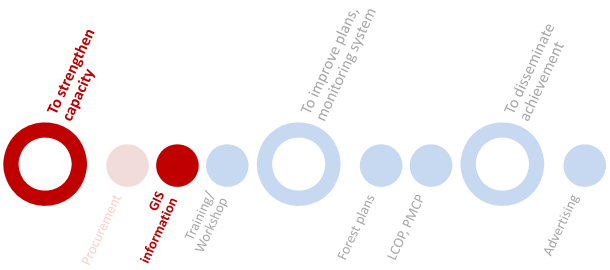
Laptop with GIS

2. Current progress

Equipment handed over

	HQ			Area and Provincial offices			total
	Grant Aid	previous project	current Project	Grant Aid	previous project	current Project	
Data server	1	-	-	-	-	-	1
Work station	6	1	-	5	-	-	12
Desktop PC	-	2	-	-	-	-	2
Laptop PC	6	2	3	6	-	18	35
GPS	4	2	5	14	-	17	42
A0 printer/ Scanner	1	-	-	-	-	-	1
A3 Laser Color Printer	1	-	-	5	-	-	6

2. Current progress

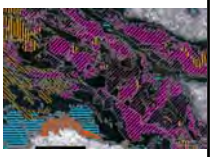


2. Current progress

New GIS information provided

Satellite imagery

Forest Base Map



Constraints

2. Current progress

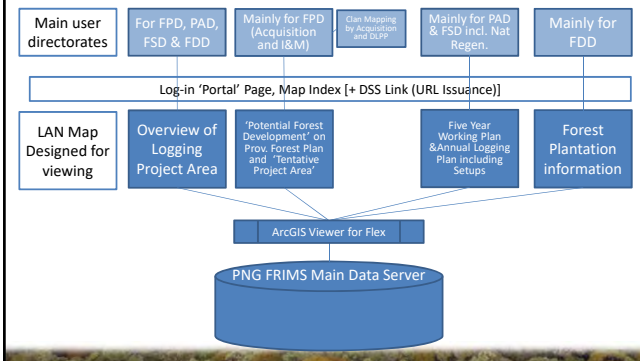
New GIS information provided

as of 21st/Aug/2017

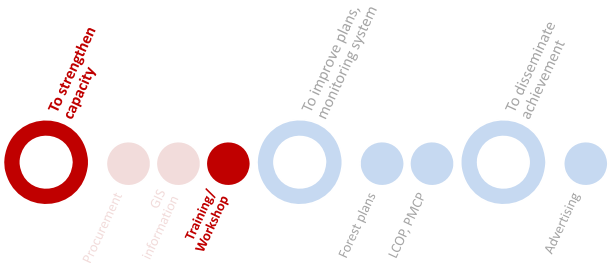
Data	HQ (for borrowing laptops)	Area Office					Provincial Office
		Southern	Highlands	Momase	NGI	WNB	Sandaun
Forest Base Map	✓			✓	✓	✓	✓
Landsat AGP	✓	✓	✓	✓	✓	✓	✓
Rapid Eye	✓	✓	✓	✓	✓	✓	✓
Hansen data	✓	✓	✓	✓	✓	✓	✓
10m pitch Contour		✓	✓	✓	✓	✓	✓
Hill-shade		✓	✓	✓	✓	✓	
Watershed/ (possible)Water courses		✓	✓	✓	✓	✓	
Soil erodibility information		✓	✓	✓	✓	✓	
Concession Boundary	✓	✓	✓	✓	✓	✓	✓
Topographic Map	✓	✓	✓	✓	✓	✓	✓
Census	✓			✓	✓	✓	✓
Constraints (from old FIMS)	✓			✓	✓	✓	✓
FWP&ALP (within pilot sites)	✓					✓	✓
Protected Area	✓			✓	✓	✓	✓

2. Current progress

Enhancement of data on LAN Map



2. Current progress



2. Current progress

Training for Map Reading, GPS/GIS and LAN Map

AO – West in June, 2016

HQ in October, 2016

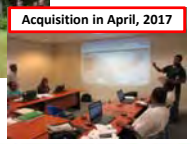
PFO – WSP in November, 2016

AO – Momase in June, 2016

AO – NGI in December, 2016

Bulolo in March, 2017

Acquisition in April, 2017

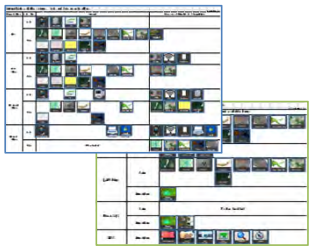


2. Current progress

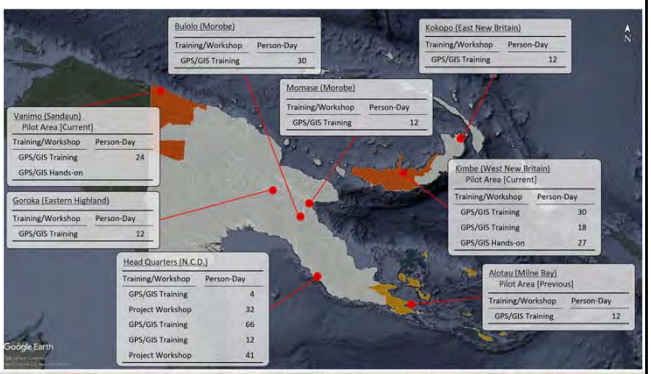
Training for Map Reading, GPS/GIS and LAN Map

New monitoring methods have been considered

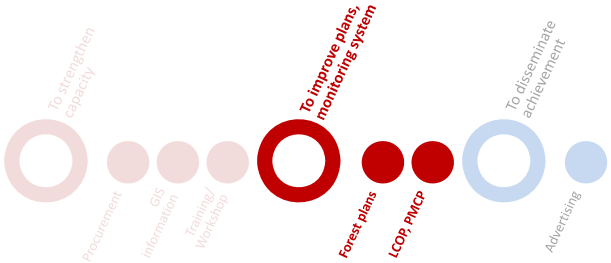
Deployment of new data and tools has been considered



2. Current progress



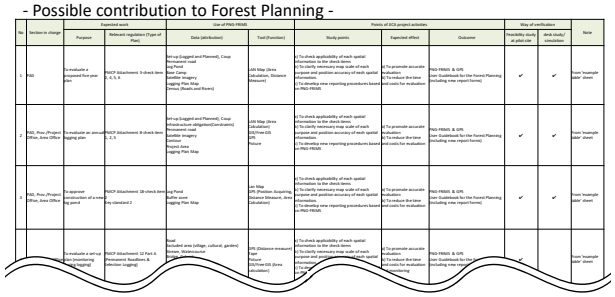
2. Current progress



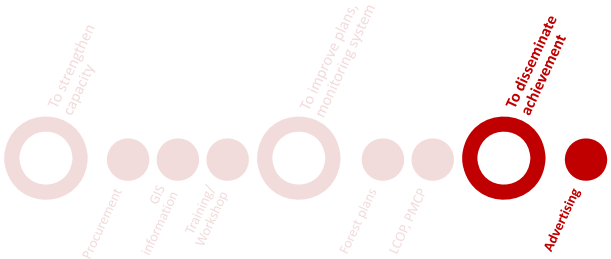
2. Current progress

Consideration of contribution of the project

- Possible contribution to Forest Planning -



2. Current progress



2. Current progress

Public awareness activity

Facebook pages

Web pages

Contents

1. A brief review of the objective of activity2
2. Current progress
3. **Future prospects**

3. Future prospects

Monitoring of Logging	• To continue making reports • To develop appropriate solutions for issues to be found
Registration of ILG	• To enhance the information through actual exercise in the field
Forest Plantation Management	• To enhance the information through actual exercise in Bulolo Plantations
Forest Plans and LCOP, PMCP	• To continue digitizing • To consider possibility of utilizing FRIMS taking into view of outputs

Thank you very much.

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

PRACTICAL APPLICATION OF PNG FRIMS (FOREST REAOURCE INFORMATION SYSTEM) DATA BASE

PRESENTATION BY:
Mr JEHU ANTIKO (CARTOGRAPHER)
PNG FOREST AUTHORITY

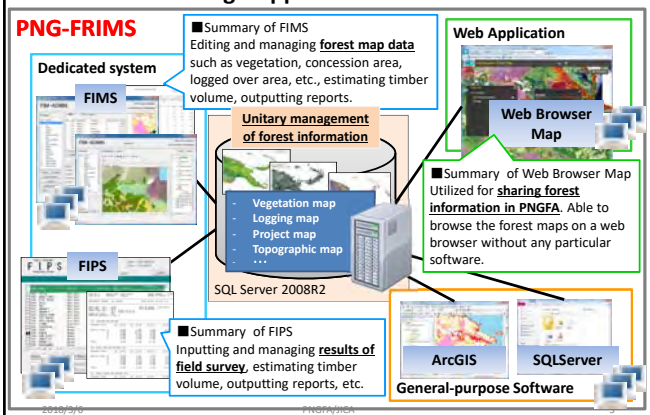
DATE: 22/11/2017
VENUE: PNGFA HQ

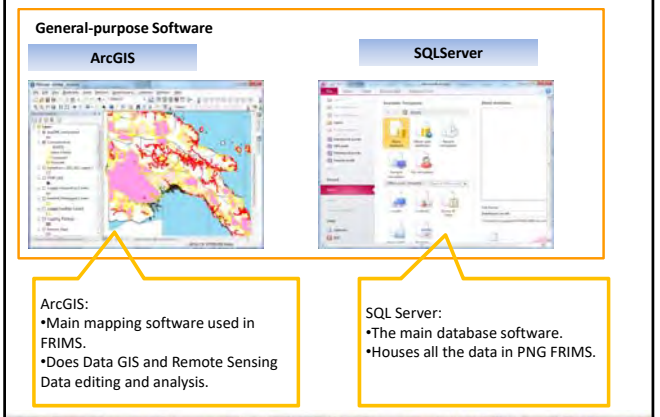
What is PNG FRIMS?

FRIMS (FOREST REOURCE INFORMATION SYSTEM)

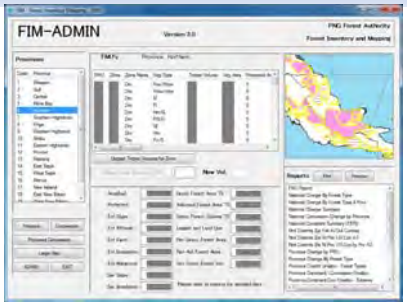
- **It is basically a digital data base which houses all forest data and information in PNGFA.**
- **Functions of this database:**
  - Estimate the Forest volume.
  - Digitize and compile maps.
  - Process and make reports.
  - Edit / Process field book data.
  - Share forest information to non-GIS users.

Basic Design Applications of PNG-FRIMS





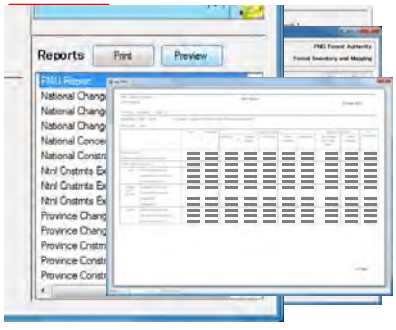
FIMS: FOREST INFORMATION AND MAPPING SYSTEM



Provide a consistent and country wide set of information on the type and extent of the forest resource and of its current use by the forest industry in PNG.

FIMS: FOREST INFORMATION AND MAPPING SYSTEM

Basic Functions



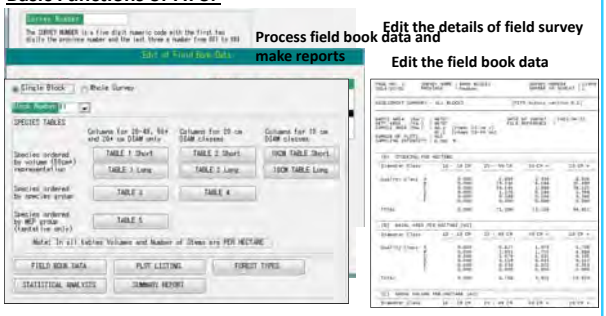
Estimate Forest Volume
(From Forest Mapping Unit; PNG Forest Basemap)
Digitize and compile maps
Process and make reports.

FIPS: Forest Inventory and Processing System

FIPS is a simple computer system to process PNG inventory assessments of natural forest..

FIPS: Forest Inventory and Processing System

Basic Functions of FIPS:



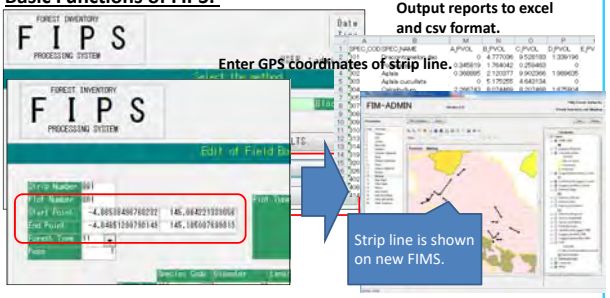
Process field book data and make reports

Edit the details of field survey

Edit the field book data

FIPS: Forest Inventory and Processing System

Basic Functions of FIPS:



Output reports to excel and csv format.

Enter GPS coordinates of strip line.

Strip line is shown on new FIMS.

Web Application (LAN MAP)

An off-line platform which allows for sharing and viewing of FIMS map data within PNGFA HQ.

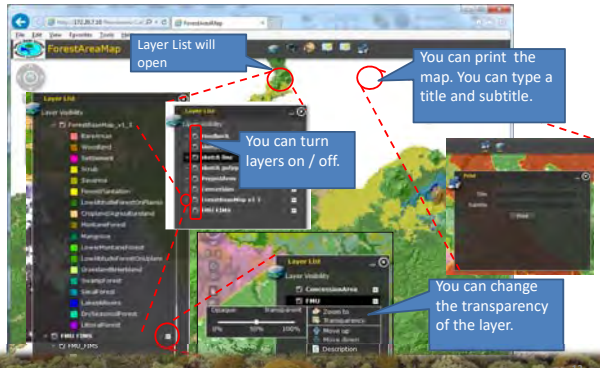
It allows for a more user friendly approach for non GIS/Remote Sensing officers to view maps in FIMS. It does not need internet to run.

Information on Forest Area Map (Web Browser Map)

Category	Forest Information (Layer)	Attributes in Layer (You can see the following on the Map)	Remarks
Logging	Concession Area	Name, Type (TRP, LFA or FMA), Status (Concession or Proposed), Purchase Date, Expiry Date, Remarks (Current or Expired), Remarks2 (Detailed memo)	Managed by FIMS
Vegetation	ForestBaseMap.v1.1	-	2012 based
	FMU	Vegetation Type	1972 based
Project Area	FCA	Name	Created by I&M branch
	Forest Plantation	Name	
	Protected Area	Name	From DEC
Topography (Basemap)	Satellite	-	Rapid Eye Image
	Topomap	-	1/100,000
	Hillshade	-	Based on SRTM

Web Browser Map

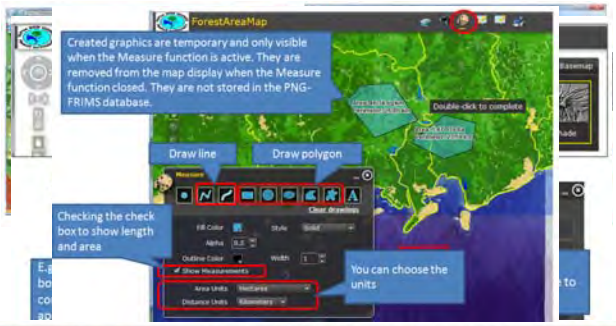
Main Window of Web Browser (LAN Map)



Web Browser Map

Basic Functions of Web Browser (LAN Map)

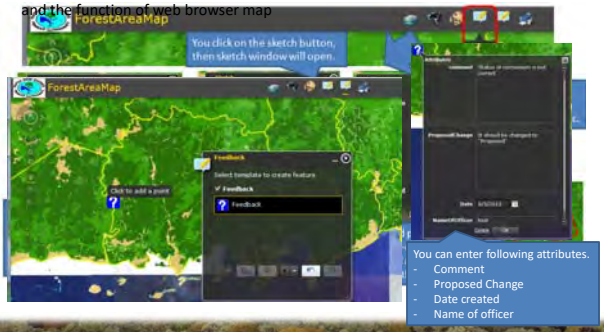
Viewing Attribute Table of Concessions Measure length and area of Area of Interest



Web Browser Map

Basic Functions of Web Browser (LAN Map)

Sketch forest information for planning or monitoring
Feedback on the forest information inside PNG-FRIMS and the function of web browser map



END OF PRESENTATION

THANK YOU VERY MUCH

Digitizing of ALP's

Venue: Board Room PNGFA Headquarter

Date: 22nd November, 2017

Time: 10:00am – 12:30pm

Presenter: Miss Everlyn Paul Mel
JICA/ Inventory and Mapping Branch, PNGFA

- **What is Digitizing?**

The process of converting geographic features on an analog/hard copy map into digital format .

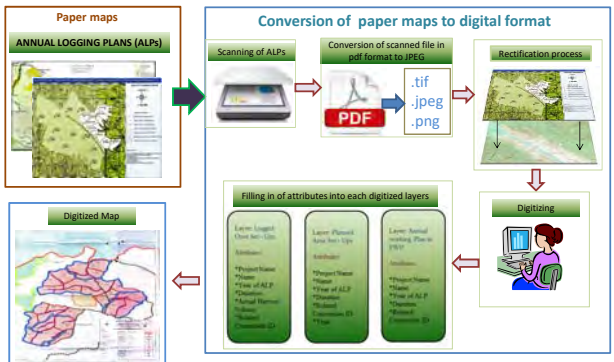
- **Why Digitizing?**

1. Update logging concession information in FIMS database.

2. Monitoring the progress of logging concessions.

3. Logging roads are used as indicators of forest degradation/disturbance.

The process involved in digitizing the ALP's



Progress of Digitizing

- Total number of scanned ALP's: 162
- Already Digitized: 87
- Yet to be digitized: 75

Recommendation

- Submit both the hard copy and soft/electronic copy to PNGFA.

- Reduce digitizing/rectification error
- Time Factor

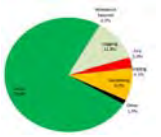
End of Presentation

Thank you!

Consider information in PNG-FRIMS to support the deployment of REDD+ in the Forestry sector in Papua New Guinea

Summary of activities realized in Output 3 (over 6 missions from 2014 to 2017). Stephane Salim.

Needs from now in REDD+ in the Forestry sector



1. FRL identified LOGGING as one of the first drivers of emission

=> Continue update forest cover changes and carbon stocks

2. NRS identified SUSTAINABLE TIMBER PRODUCTION as one of the priority PaM

=> Plan and implement countermeasures

3. Consider funds for Results based Payment system

=> Measure benefits from REDD+ interventions

Action area	PaM involving PNGFA
Strengthen environmental management, protection and enforcement	Strengthen forest management and enforcement practices: - Regulations - Capacities - Alternative timber production

Objective of Output 3 is to see how forest info can be prepared to contribute to these 3 areas.

Prepare forest information in PNG-FRIMS to support carbon monitoring

General information for carbon monitoring

Review carbon methodologies (IPCC, CF-MF, VCS-JNR) ⟷ PNG-FRIMS gap analysis (data required vs. available) → Analyze PNG-FRIMS (with Output 1 team)

Data and conditions required	Data available and conditions respected in PNG-FRIMS
Boundaries delimitation	
• Forest cover map	PNG FBM 2012 (but need update)
• Forest Monitoring Units	FBM divided in FMU (province, forest type, watershed)
• Forest state (>10%)	Yes (GIS function)
• Forest vs. non-forest map accuracy (>89%)	87% at national level. National/local improvement possible
Stratification	
• Images for 3 time points	FBM 2000 and 2005 (in pilot), and 2011
• Corrected (<20% of clouds) and rectified images	Original images used are corrected and verified
• Ancillary data attributed to pixels	Climate, slope, elevation (but not soil and tenure)
Assessment of Carbon stock changes	
• Agents, motivations, pre-disposing factors of DD	Input from high resolution (Collect Earth) analysis
• Map of DD drivers (relative importance)	On-going work in Output 1
• Maps, areas, matrices of transitions	On-going work in Output 1
• Carbon stocks per stratum	Now only merchantable volumes D>50cm (from FIPS)

Specific information to monitor degradation from logging

Sources of emissions

Forest degradation from logging

Timber extraction

Logging collateral damage

CO2 absorption stopped

Emission from the decay of wasted trees

Parameters to monitor

- Harvested volumes
- Area of Logging roads, camps, landings & tracks
- Volume of trees abandoned, wasted & damaged

Operations of monitoring

Forestry records

- Field assessment (during)
- Post harvest waste assessment (after logging)

Consider PNG-FRIMS functions to support collateral damage assessment

LCoP items	Parameters to monitor	Possible support (to review with output1&2)
Logging roads	L (length)	RS LAN Map
	l (width) in several points	RS & GIS (if > 30m) GPS
Log landings and camp sites	Position and number	RS & GIS (if > 30m) GPS; Lan Map
	L and l	GPS; Lan Map
Skid trails	L	GPS Lan Map (if in ALP)
Tree degradation	Position; H and DBH of abandoned felled trees/logs	GPS; Field measure
	Position; H and DBH of damaged trees (by skidding or felling)	GPS; Field measure
Stumps	Position and number; and H, DBH of wasted stumps	GPS; Field measure

During and after logging

Measure Total emissions from logging at province level =
Province emission from Collateral damage = SUM of concessions emission = SUM of setup emission + Province emission from volume extracted (province level proxy)

Prepare forest information in PNG-FRIMS to support the planning and implementation of interventions relevant with REDD+ objectives

Land Use Planning

LUPs refer to the spatial repartition of human activities, they can be designed at different levels:

	Explicit in:	Done by:
1) Land use planning *sensu stricto* (Sectors activities): • *Forestry* • *Agriculture* • *Mining, Conservation, etc.*	National and provincial LU plans	PNG Land department
2) Forest planning (Forestry activities): • *Logging in natural forests* • *Tree plantations* • *FCA (clearance)*	National and provincial forest plans	PNGFA
3) Concessions planning (logging activities)	Forest management plans	PNGFA
4) Zoning of concession activities	Logging plans (5y, 1y, setup)	Logging operators

REDD+ LUP has for objective to promote development activities in all sectors (Logging, business Agriculture, Mining, etc.) by limiting deforestation, forest and environmental degradation.

Support to LUP

LUP can be preceded of a "Land suitability analysis", an analysis of areas suited with the development of land activities such as Forestry, Agriculture, Conservation, etc.

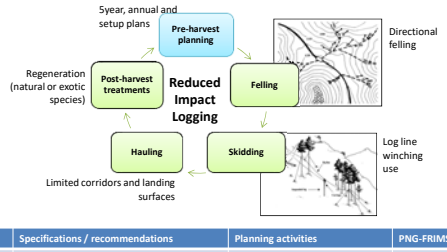
Development objectives	Zones sought
Selective logging (FMA)	Lowland forest
Forest timber plantation	- Grasslands - Strongly degraded areas
Large scale agriculture (FCA)	Any area covered by forest
Conservation	High value (Biodiversity, etc.)

Possible PNG-FRIMS support

Info sought	PNG-FRIMS functions used
Land potential (timber volumes per area)	FIMS, Forest Base Map
Environmental constraints (grassland, degraded)	Lan Map, GIS
Maps of clan (on-going analysis)	Lan Map, GIS
Deforestation and Degradation spots and drivers	RS imagery, GIS map of drivers

Support for planning and implementing good harvest practices

Good practices = practices recommended in the LCoP



LCoP items	Specifications / recommendations	Planning activities	PNG-FRIMS support
Logging roads	Minimize road length (for an area < 10% of setup area); Keep road l < 40m	5YP, 1YP	RS, GIS, LAN Map
Log landings	Minimize landing numbers (< 3) Keep landing area < 0.25 ha per setup	5YP, 1YP	LAN Map
Skid trails	Minimize length of skid trails	Setups planning Planning of use of winch/skyline	LAN Map, GPS
Tree damage	Minimize trees not felled into gaps	Planning of Directional felling	LAN Map, GPS
Stumps	Keep stump height <50 cm	Planning of techniques of RIL	LAN Map, GPS

Support to forest plantation development

Plantations in PNG (Vilamur, 2015)

Largest State-owned plantation

Largest plantation in pilot provinces

Province	Plantation	Start	Area (ha)	Species	Ownership
Central	Brown River	1955	1266	Tectona grandis	State
	Kuriva	1985	1440	T. grandis	State
Milne Bay	Ulabo	1985	1500	E.deglupta	State
Morobe	Bulolo/Wau	1985	12,000	Araucaria, Pinus	State
	Umi	1990	764	Pinus/Eucalytus	State
Madang	Gogol	1975	12,375	A.Mangium	(JANT)
	North Coast	1985	1,748	E.deglupta	State
New Irel.	Kaut	1986	570	E.deglupta	Community
WNB	SBLC	1972	12,000	E.Deglupta	(SBLC)
East New Britain	- Kerevat	1950	2,385	T. grandis	State
	- Open Bay	1972	14,000	E.Deglupta	(OBT)
West High.	Waghi	1962	2100	E.grandis, robusta	State
South High.	Lalibu	1972	440	Pinus patula	State

Possible PNG-FRIMS support

Info sought	PNG-FRIMS functions used
Update of boundaries of operational plantations	Lan Map, GIS, GPS
Lands suitable for new plantations (ex.: grasslands, heavily degraded areas)	Lan Map, GIS
Plots of possible project areas	Lan Map

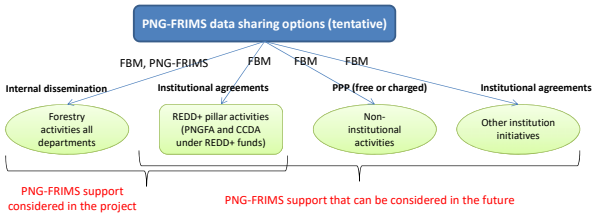
Other information

PNG-FRIMS capacities for other types of activity and data sharing

1) Other Forestry activities: FCA, Regeneration, etc.

2) Other land activities: protection, agriculture, etc.

3) Non-institutional activities from the private sector in Forestry (logging operators) or other sectors.



Test monitoring and planning capacities of PNG-FRIMS in pilot provinces

Simulation of interventions to reduce logging impact

Logging concessions map | Logged Over Area map | Under-exploited lands

=> Appropriate practices | => Regeneration activities | => Forest plantation development

Estimation of the potential ERR (Emission Reductions and Removals)

1- Assess forest cover changes
- Proxy
- RS
- field

2- Plan and implement activities
- Logging
- Forestry others
- Other sectors

3- Measure benefits

ERR potential in WNB and WS

Key information for future donors/programmes

Actors and costs for carbon monitoring

Possible actors and roles

PNGFA project supervisors
Supervision and/or inventory

- Logging company workers — inventory
- Local communities — Participatory monitoring of carbon and socio-cultural values

Needs | **Estimated costs**

- Funding to cover additional staffs → 1 staff x 100 concessions x 10000 USD/year = **1 MUSD**
- Vehicles for distance matter and efficiency → 1 vehicle for 5 concessions i.e. 100 000 USD x 20 concessions = **2 MUSD**
- Capacities to monitor carbon parameters → 1 project supervisor per concession trained: 10000 USD x 100 = **1 MUSD**
- Regulation: integrate a climate component into PMCP and field checked items → No specific cost

Communication of the project outcomes during UNFCCC COPs

Conclusions

Opportunities for REDD+ from the operationalization of PNG-FRIMS

- Estimation of emissions from logging using PNG-FRIMS from 3 methods field, RS and proxy. *Act. 3.1-2*
- Options of actors for monitoring. Act. 3.4
- Indicative range of budgets for monitoring. Act. 3.6
- Options for supporting logging companies in planning harvest operations. Act. 3.5
- Possibility of sharing with CCDA information on logging collateral damage. Act. 3.6
- Possibility of sharing with CCDA ideas of MMRV systems that can be used for SIS. Act. 3.6

Challenges and remaining needs

- Material and in priority vehicles (to enable time for carbon monitoring)
- Human resources for carbon monitoring
- Capacities of supervisors in monitoring carbon parameters and of companies in RIL practices
- Awareness of REDD+, challenging harvesting techniques and their benefits
- Workshop in the Forestry sector on solutions to finance and organize the reduction of impact from logging
- Research activities in PNGFA (FRI?) to test new practices and offer a visit site
- Test (in focus areas) capacities and tools for carbon monitoring and planning REDD+ interventions

Nota Bene: possible sources of budget to cover needs:

- Country and PNGFA internal budgets
- Private logging company contributions as offset
- T/C for capacity building (including workshops)
- Grant aid for acquisition of car and new staff necessary
- RBP finance (REDD+ phase II) to finance integrated action in a paradigm change perspective

添付資料 48

TLVS ワークショップ発表資料

Timber legality Verification System(TLVS)
National Dialogue Workshop
- June 20, 2018 -

How Can PNG-FRIMS contribute to TLVS ?

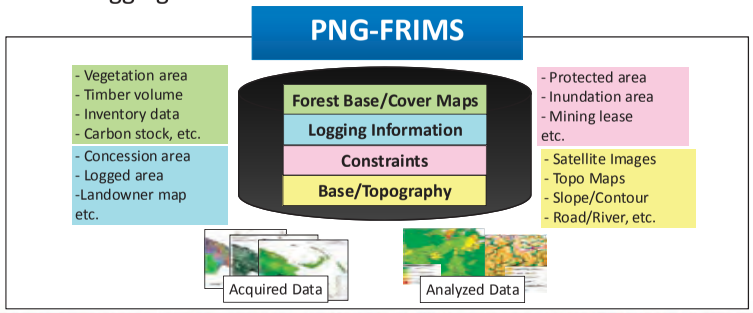
Mr. Constin Otto Bigol
Manager – Inventory and Mapping Branch, DFPP,PNGFA
[Project Manager – PNGFA/JICA forestry project]

What is FRIMS ?

- **FRIMS** stands for **F**orest **R**esource **I**nformation **M**anagement **S**ystem.
- FRIMS is **GIS database** responsible for acquiring and managing **"spatial information /data"** on forests. This aims to support PNGFA decision making.
- FRIMS can display various spatial information/data on **maps with attributes** which can be overlaid to compare relativeness of the information and data.
- FRIMS also has the functions **estimating commercial timber volume**, **projecting land use change** and **sharing information** with PNGFA Head office staffs.

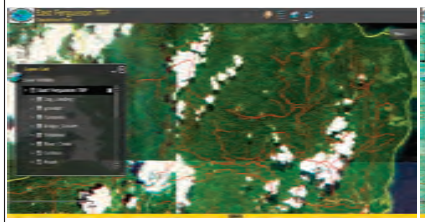
What is in FRIMS? (available GIS data/layers)

- There are four principal types of data and info.
  - Base Information/Topography
  - Forest Base Map and Forest Cover Maps
  - Constraints (which limit forestry activities)
  - Logging Concession Information

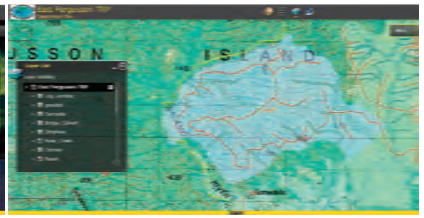


What is in FRIMS? (available GIS data/layers)

- **Base Information/Topography**
  - Satellite imagery :RapidEye (5m), ALOS/PALSAR(10m), LANDSAT Annual Greenest Pixel (cloud-free composite mosaic)
  - Topographic Map (Scale=1:100,000: scanned by A0-scanner)
  - Topographic Data: DEM(Digital Elevation Model: 5m mesh), Contour-lines (10m-interval), Slope, Hill-shade, Watershed (3 levels: basin to catchment) etc.
  - PNG GIS layers: Main Roads and Rivers, Settlements, Administrative boundaries (Province/District/LLG), ILG and Clan boundaries, etc.
  - Global Dataset: Hansen data (Annual Tree-cover Loss/Gain data), etc



Satellite Image + Roads & Contours

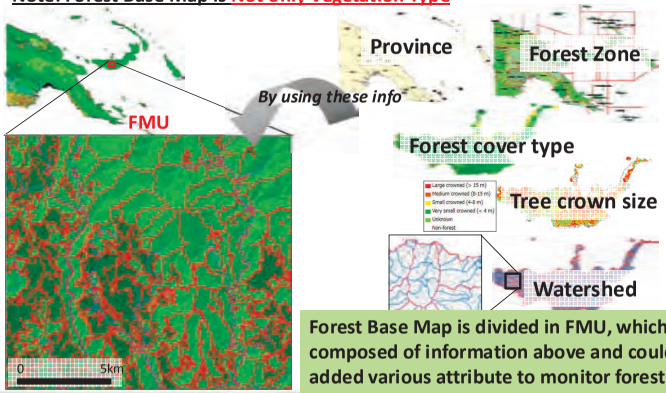


Topo Map + River & Contours

What is in FRIMS? (available GIS data/layers)

- **Forest Base Map and Forest Cover Maps**
  - Forest Base Map 1.1 (2012): Base for Forest Plan and Forest Management
  - Forest Cover Map(2000, 2005, 2011 & 2015) for Pilot Provinces (WNB & WSP)

Note: Forest Base Map is Not only Vegetation Type

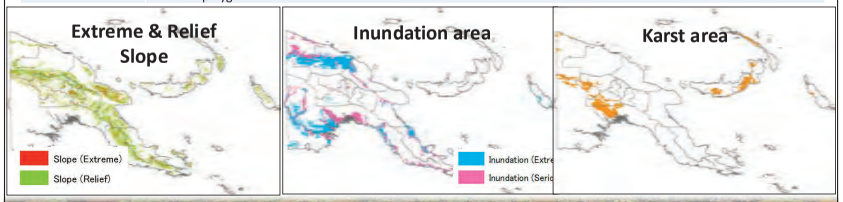


Forest Base Map is divided in FMU, which is composed of information above and could be added various attribute to monitor forest.

What is in FRIMS? (available GIS data/layers)

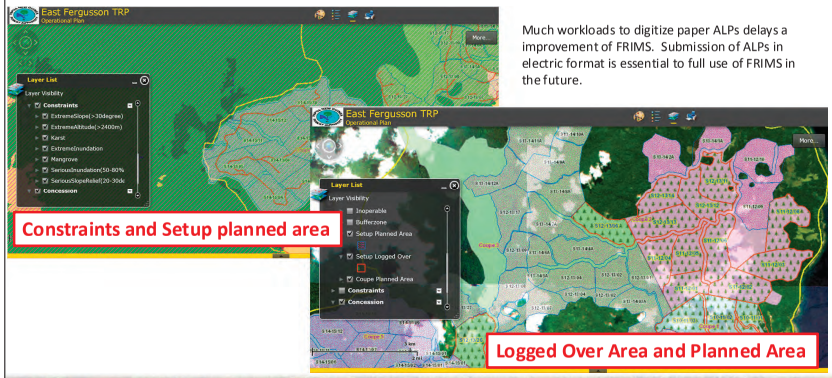
- **Constraints(which limit forestry activities)**
  - Social Conditions:
    - Forest Clearing Authority, Plantation, Protected Area, Mining operation area.
  - Natural Conditions:
    - Slope(Extreme/Relief), Altitude(Extreme), Inundation, Mangrove, Karst

Layer	Description
Altitude	land over 2400m altitude.
Slope (Extreme)	land with over 30 degree dominant slope.
Slope/Relief	land with dominant slope of 20-30 degrees and sub-dominant slope over 30 degrees and with high to very high relief.
Mangroves	land covered by mangroves.
Inundation (Extreme)	land permanently or near permanently inundated extending over more 80% of the area of that land.
Inundation (Serious)	50-80% permanent or near permanent inundation.
Karst	land with polygonal karst landform.



What is in FRIMS? (available GIS data/layers)

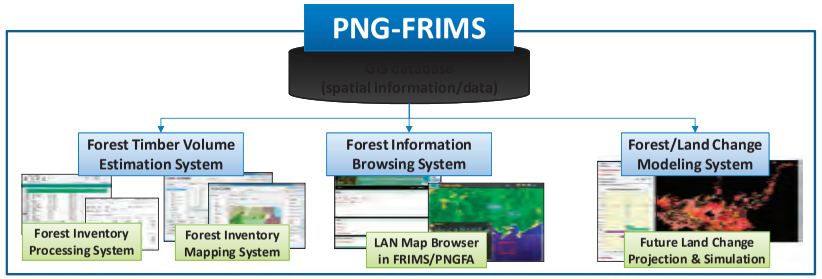
- **Logging Concession Information**
  - Concession Area
  - Set-up boundaries of planned and actual logged over area, buffer zone, bridge/culvert, campsite, gravel pit, log landing, logging road, building, river/stream etc.(these info. are being captured from paper based ALPs.)



Much workloads to digitize paper ALPs delays a improvement of FRIMS. Submission of ALPs in electric format is essential to full use of FRIMS in the future.

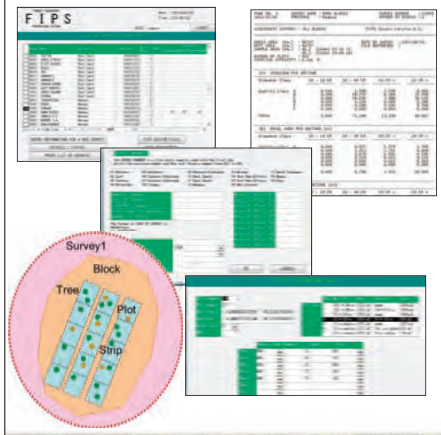
What are functions of FRIMS?

- There are three main functions;
  - Forest Timber Volume Estimation(FIPS and FIMS)
    - FIPS (Forest Inventory Processing System)
    - FIMS (Forest Inventory Mapping System)
  - Forest Information Browsing System (LAN-Map)
  - Forest/Land Change Modeling System (F-LCM)



What are functions of FRIMS?

- **Forest Timber Volume Estimation (1)**
  - ➢ **FIPS (Forest Inventory Processing System)**



Overview:

- FIPS estimates the timber volume of the expected logging project area based on the data of the inventory survey.
- The estimated volume is to be used to determine an annual allowable cut of timber volume for the expected logging project.

Basic functions:

- Enter survey information and assessment data from field books (such as species, diameter and length)
- Edit and process assessment data
- Produce survey result and printout as summary report
- Import assessment data from Excel file into FIPS, and Export the Result of processed data from FIPS into Excel format

What are functions of FRIMS?

- **Forest Timber Volume Estimation (2)**
  - ➢ **FIMS (Forest Inventory Mapping System)**

Overview:

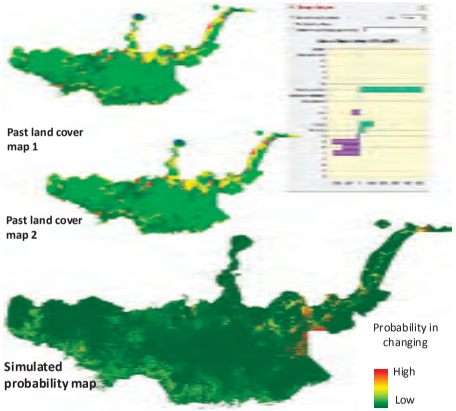
- FIMS calculates the potential timber volume in any level of area such as national, provincial and logging project.
- The volume is calculated using forest type per unit timber volume and to be adjusted by logged volume data.
- The volume estimate is to be utilized to develop forest plans (National/Provincial forest plan).

Basic functions:

- Manage not only planned and operational concession boundaries but also logged over areas reported by logging companies.
- Import assessment data from FIPS and show strip lines on map, which were used for surveys and timber volume processed by FIPS.

What are functions of FRIMS?

- **Forest/Land Change Modeling System**
  - ➢ Future Land Change Projection & Simulation



Overview:

- Analyzing chrono-sequential spatial data including forest information, future land change (such as deforestation) and simulate probability in each location.
- This system uses Land Change Modeler, which is a product of Clark Labs, Clark University, USA.

Basic functions:

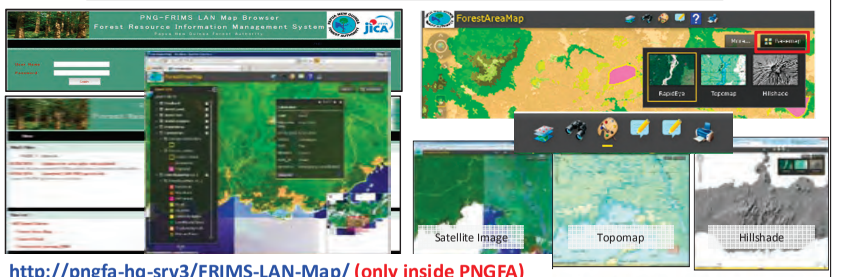
- The results of the simulation is useful for developing policies such as provincial forest plans and action plan of the national REDD+ strategy.
- Evaluation of the model is needed for utilization of the results.

What are functions of FRIMS?

- **Forest Information Browsing System**

LAN Map Browser enables HO staff to access information in FRIMS without GIS skill. It can overlay specific layers and measure distance or area etc.. It could improve the efficiency of desktop works such as evaluation/approval of FWFWP.

Evaluation /Approval of 5yrs FWP; Check
-Area to be logged in the next 5yrs.
-Permanent Roads and Log ponds constructed are in practical and logical order.
-Consistency of ALP with FYFWP on area to be logged.
-Area of set-up and buffer zone width etc..



http://pngfa-hq-srv3/FRIMS-LAN-Map/ (only inside PNGFA)

PNG-FRIMS: Overview

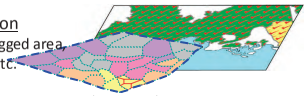
PNG-FRIMS

Data

Constraints information
Slope, Altitude, Mangrove, Karst, Inundation, Protected area (Wildlife), Plantation, FCA, Mining area etc.

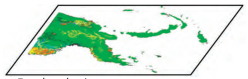
For planning and monitoring

Logging information
Concession area, Logged area, Connection to DSS etc.



For planning and estimation

Forest Base/Cover Maps
Vegetation, Timber Volume, Carbon stock, Regrowth model etc.



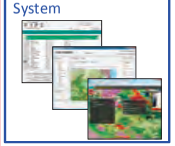
For developing, updating and monitoring

Base/Topographic data
Satellite image (RapidEye, PALSAR, Landsat Annual, Greenest Pixel), TopoMap etc.

【Main activities】

- Update current map layers using latest resources (PINGRIS2008, SRTM etc.)
- Quality evaluation
- Data entry on harvesting history
- Improve procedures for updating logging information etc.
- Define forest monitoring unit (FMU)
- Examine forest growth model, harvested timber volume etc.
- Detect forest changes (Hansen, CLASLite)
- Identify drivers on degraded forest, etc.
- Contribute to carbon change estimation,.

System

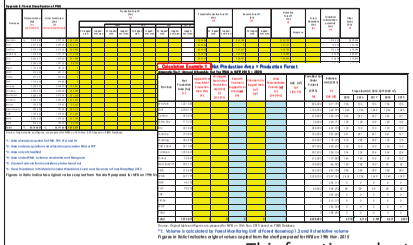


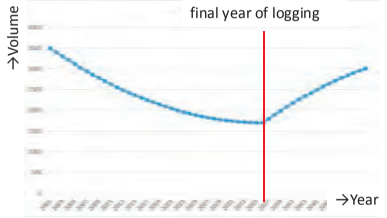
Rule / Procedure
- Updating FRIMS database
- Data sharing
- Making Forest Management Plans
- Reduced impact logging etc.

Human resources
- GIS / Remote Sensing techniques
- Utilize FRIMS for REDD+ activity etc.

Additional function of FRIMS (under development)

- **AAC (Annual Allowable Cut) calculation**
  - AAC calculation function based on Forest Base Map 2012 has been developed on a trial basis. The draft results of the calculation are being verified for now.
  - Current FIMS only subtracts the harvested area from forest area for a rough estimate of timber volume. Not taking account of re-growth.



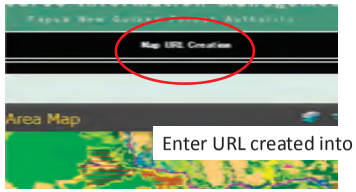


This function adopted the idea that timber volume will recover over the next 35 years linearly, although we examined PINFORM.

Contribution to TLVS through the DSS

- FRIMS can contribute to TLVS implementation through providing data and information of DSS.
- FRIMS(FIPS) would provide some data and information of DSS, such as Inventory data generated by FIPS and -----.
- FRIMS(LAN-Map) can create a URL link which shows the map with focus on the point of interest by magnifying or scaling down the map (see next slide).

Cooperation with DSS (Decision support system)



Enter URL created into DSS

Display a map on a Web Browser via LAN Map

Table in the DSS (image)

Project name	Setup name	***	LAN Map URL
EastFurgasson	S13-14 10A	***	http://pngfa-hq-srv3/flexviewers/123
EastFurgasson	S13-14 11A	***	http://pngfa-hq-srv3/flexviewers/456
EastFurgasso			

If DSS can add a new column for recording a URL link, LAN Map provides a URL to the map

添付資料 49

プロジェクト最終セミナー

アジェンダ

発表資料

ポスター

Capacity Development Project for Operationalization of
PNG Forest Resource Information Management System for Addressing Climate Change

Final Seminar

- Agenda -

- Date & Time: 18 July

- Venue: Hilton Hotel (TBD)

Time	Length	Topic	Presenter
Opening:			
09:30		Registration	
10:00	5	Opening remarks	Mr. Tunou Sabuin
10:05	5	Statement by Minister	Hon. Solan Mirisim
10:10	5	Speech	A secretary of Japanese embassy
10:15	15	Introduction and Objectives	Mr. Daisuke Kadowaki
Output1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS)			
10:30	15	Enhanced Information in Forest Base / Cover Map	Mr. Perry Malan
10:45	15	Capability and Potential of PNG-FRIMS (with demo)	Mr. Patrick Laa
Morning break:			
11:00	15	Promotion (Posters and Videos)	
Output2: Improvement of Forest Planning System utilizing "PNG-FRIMS"			
11:15	15	Contributions to National Forest Plan (AAC/PFP)	Ms. Margaret Tongo
11:30	15	Capacity improvement of forest monitoring (LCoP)	Mr. Peter Lat
11:45	15	Drone application for forest inspection in PNGFA	Mr. Steven Saki
Lunch break:			
12:00	60	Promotion (Posters and Videos)	
Output3: Prepared/Identified Forest Information for addressing/contributing-to REDD+			
13:00	15	Potentials of using logging data for carbon estimation	Ms. Elizabeth Kaidong
Closing:			
13:15	15	General overview of the project and way forward	Dr. Ruth Turia
13:30	20	Q&A/Discussion	
13:50	5	Speech	A representative of JICA-PNG office
13:55	5	Closing remarks	Dr. Ruth Turia

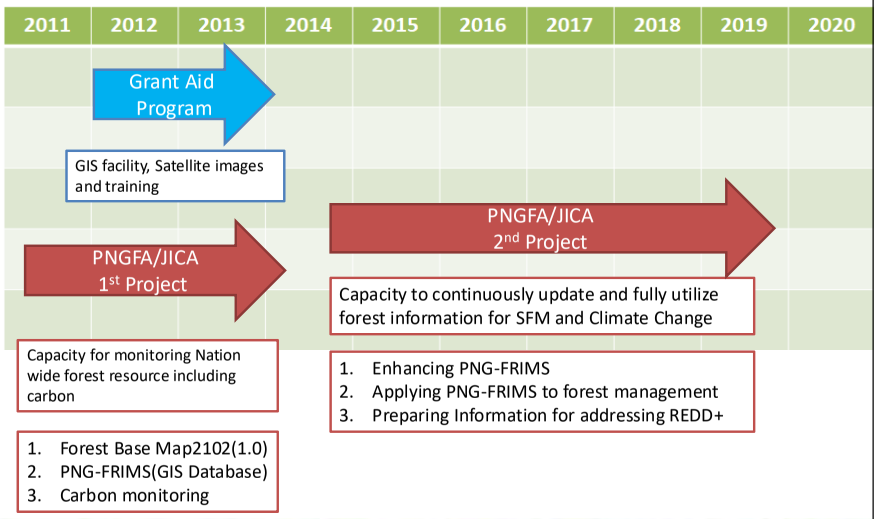
The PNGFA/JICA Project Wrap-up Seminar
Hilton Hotel, Port Moresby, Papua New Guinea,

Introduction and Objectives

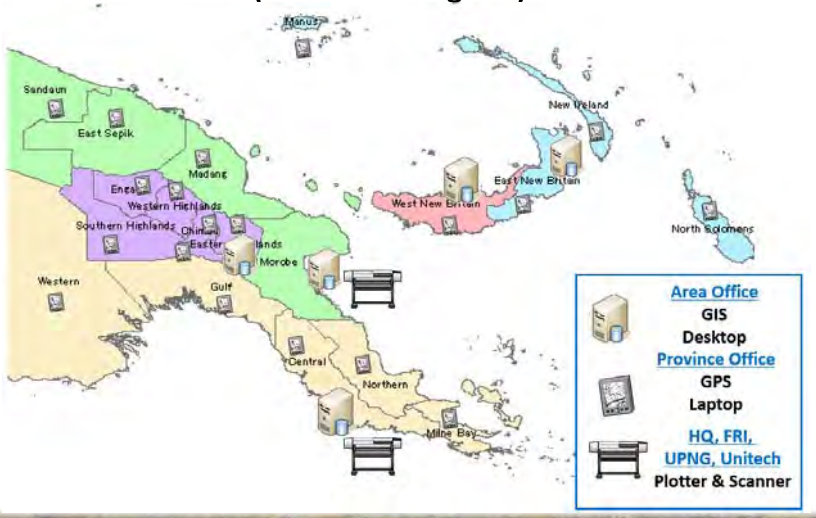
18th July 2019
Daisuke KADOWAKI
Chief Advisor
Capacity Development Project for Operationalization of PNG-FRIMS for Addressing Climate Change

Table of Contents

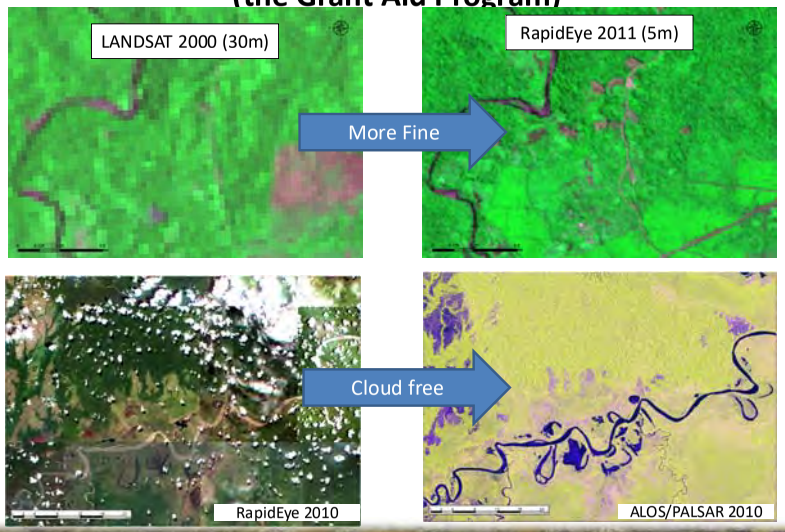
History of cooperation between PNG and Japan



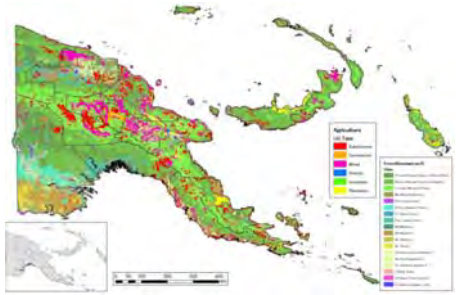
History of cooperation between PNG and Japan
(Grant Aid Program)



History of cooperation between PNG and Japan
(the Grant Aid Program)

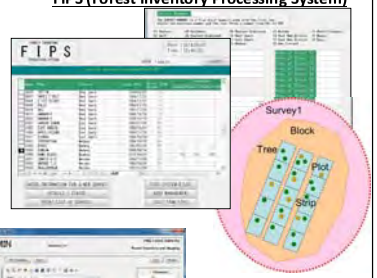


History of cooperation between PNG and Japan
(the 1st Project)



Forest Base Map 2012(v1.0)

FIPS (Forest Inventory Processing System)



FIMS (Forest Inventory Mapping System)

Overview of the Project
5 years (2014 -2019)

Overall Goal
Forests in PNG are conserved and managed in a sustainable manner, while at the same time, mitigation and adaptation measures against climate change are promoted.

Project Purpose
Capacity of the PNGFA to continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.

PNG-FRIMS

Output 1
FRIMS is expanded and enhanced

Output 2
The national forest plan, provincial forest plans, forest management plans and their monitoring system are improved through steady operation of FRIMS.

Output 3
Forest information for addressing REDD+ is prepared

Line up of the Presentations today

Topic	Presenter
Enhanced Information in Forest Base / Cover Map	Mr. Perry Malan Senior Cartographer, PNGFA
Capability and Potential of PNG-FRIMS (with demo)	Mr. Patrick Laa Cartographer, PNGFA
Contributions to National Forest Plan (AAC/PFP)	Ms. Margaret Tongo Acting Senior Forest Plans Officer
Capacity improvement of forest monitoring system utilizing GPS/GIS/Drone using (LCoP)	Mr. Peter Lat - Inventory & Mapping officer WNB, PNGFA
Drone application for forest inspection in PNGFA	Mr. Steven Saki – Acting Technical Supervisor, Vanimo PNGFA
Potentials of using logging data for carbon estimation	Ms. Elizabeth Kaidong – Officers Adaptation REDD & CC

Thank you

JICA-PNGFA Project (Phase 2)
Final Seminar – Hilton Hotel
July 18, 2019

Enhanced Information in PNG Forest Base/Cover Map

Perry Malan

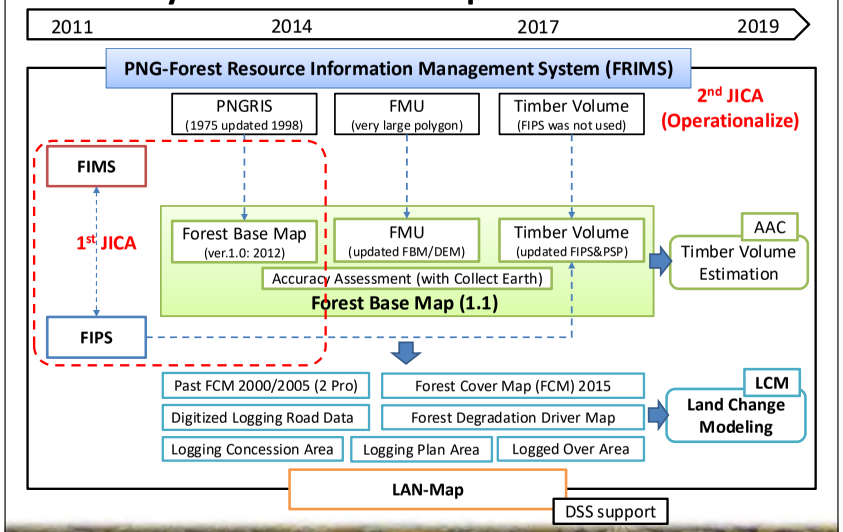
Presentation Contents

- **Aim of Presentation**

  To improve the accessibility to the information which were developed through JICA-PNGFA project by introducing the publications which explain the products to be understood and utilized appropriately

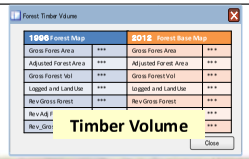
- **Contents of Presentation**
  - History of Forest Base Map and Enhancement
  - Goals of Utilizing Forest Base Map in FRIMS
  - Achievements/Outputs List (Maps/Layers)
  - Update of Forest Base Map FMU (Forest Monitoring Unit)
  - Update Timber Volume data using available data
  - Adding Forest Degradation and Drivers
  - Creation of Three Time Series Forest Cover Maps
  - Land Cover Change Simulation using Land Change Modeler
  - Forest Base Map and Atlas (Main Report/ Provincial Profiles)
  - Factsheets Series (Brief Descriptions of Products)
  - Deliverable Documents (for PNGFA operation)
  - Summary

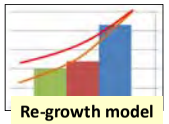
History of Forest Base Map and Enhancement



Goals of Utilizing Forest Base Map in FRIMS

Goal	Function	Objectives	Outcomes
To support designs for national and provincial forest plans	Estimates timber volumes utilizing the revised Forest Base Map	To estimate timber volume using the revised Forest Base Map 2012	This function verifies timber volume estimation using forest base maps in two different periods.
		To compare timber volumes based on FIMS 1996 and FBM 2012	
	Estimates timber volumes considering secondary forest	To identify the location of secondary forests	This function is useful to determine the actual situations of secondary forest.
		To estimate the timber volumes utilizing a forest regrowth model	





Achievements/Outputs List (Maps/Layers)

PNG-FRIMS (FS#3)

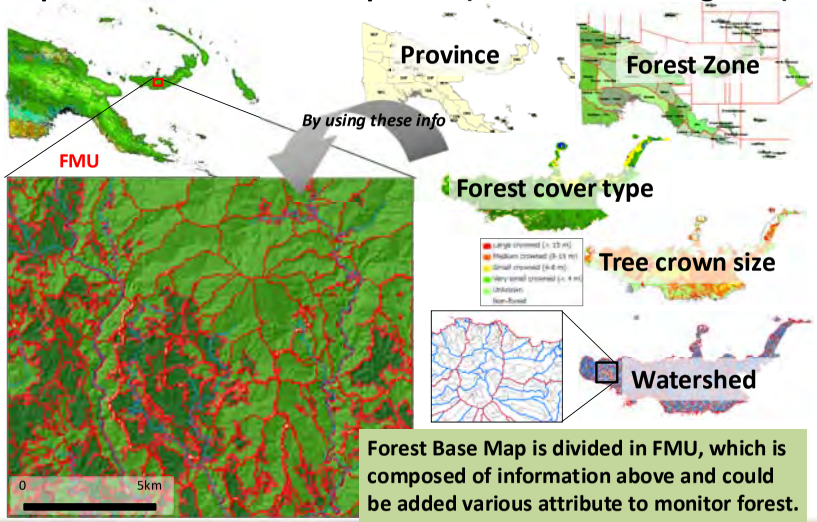
#	Maps/Layers	Target Area	Status
FS#2	Revised/Enhanced Forest Base Map 2012	National	Completed
	Past Forest Cover Maps 2000/2005/2011	WNB, WSP	Completed
FS#9	Updated Forest Cover Map 2015	National	Completed
AR#1	Developed Forest Degradation Driver Map	National	Completed
FS#5	Updated Constrains Information (Map)	National	Completed
FS#6	Watershed(Catchment): Large/Middle/Small	National	Completed
	Updated Timber Volume Information (Map)	National	Completed
FS#7	Digitized Logging Road 2000-2005-2010-2015	National	Completed
AR#2	Future Forest/Land Change Simulation Map	WNB	Demonstrated
FS#8	Logging Concession, Logged-Over Area	WNB, WSP	Completed/Working
FS#8	Forest Clearance Authority (FCA)	National	Working
FS#8	Forest Plantation Area (PNGFA/Private)	National	Working
	Satellite Images (RapidEye 2011, Landsat AGPs)	National	Completed
	Topographic Data (DEM, Contour, Slope, Hillshade)	National	Completed

FIPS | FIMS | FLCM

LAN Map Browser

Output1 | Output2 | Output3

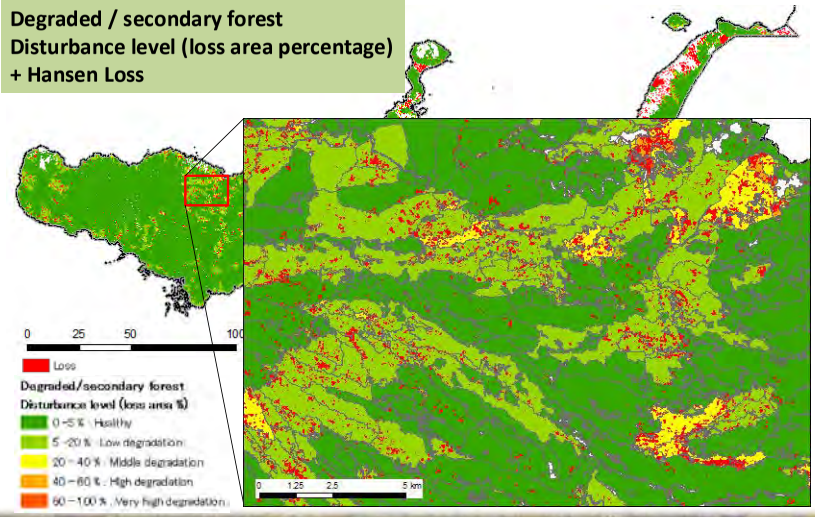
Update of Forest Base Map FMU (Forest Monitoring Unit)



Forest Base Map is divided in FMU, which is composed of information above and could be added various attribute to monitor forest.

Use of FMU: Disturbance level for Monitoring/Risk Assessment

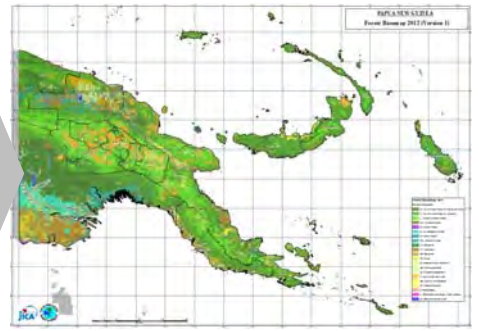
Degraded / secondary forest
Disturbance level (loss area percentage)
+ Hansen Loss



Update/Enhancement of Forest Base Map as Version 1.1

Update of sub-vegetation classes and other attribute

Addressing other issues:
P and H type, wetland, coastal vegetation assignment, islands and dominion, etc.



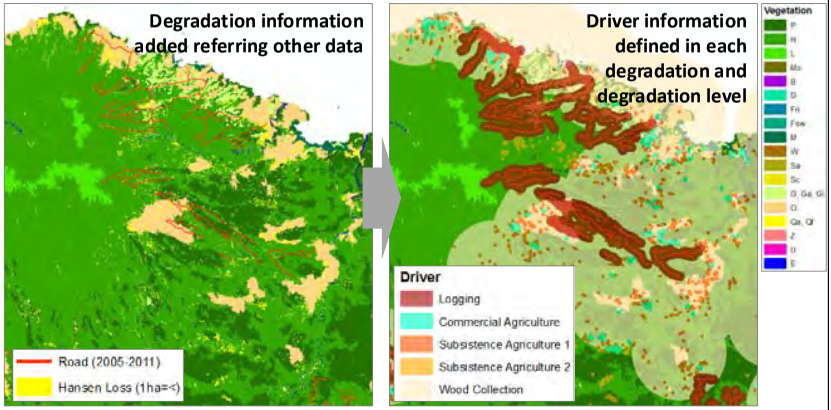
After updating and enhancing Forest Base Map, Old FIMS vegetation is replaced by Forest Base Map, which is one of main data of PNG-FRIMS database and is used for forest planning and monitoring.

Update Timber Volume data using available data

		PNGRIS	FIPS	PSP
Aboveground biomass	Merchantable timber (< 10 cm)			
	Merchantable timber (10-20 cm)			
	Merchantable timber (20-50 cm)		FIPS	PSP
	Merchantable timber (> 50 cm)	FIMS		
	Not-Merchantable timber (< 10 cm)			
	Not-Merchantable timber (10-50 cm)			
	Not-Merchantable timber (> 50 cm)	FIMS		PSP
	The other part of AGB			
Dead organic matter				
Belowground biomass				
Soil				

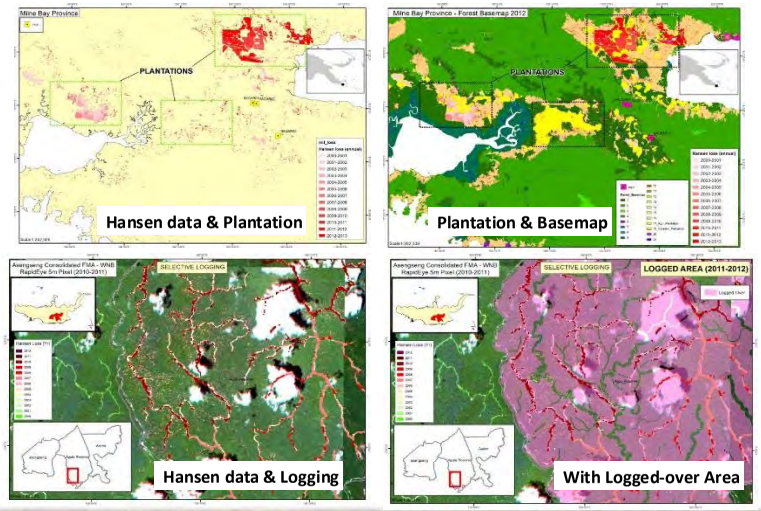
PNGRIS: PNG Resource Information System
FIPS: Forest Inventory Processing System
PSP: Permanent Sample Plots

Enhance Base Map: Adding Forest Degradation and Drivers



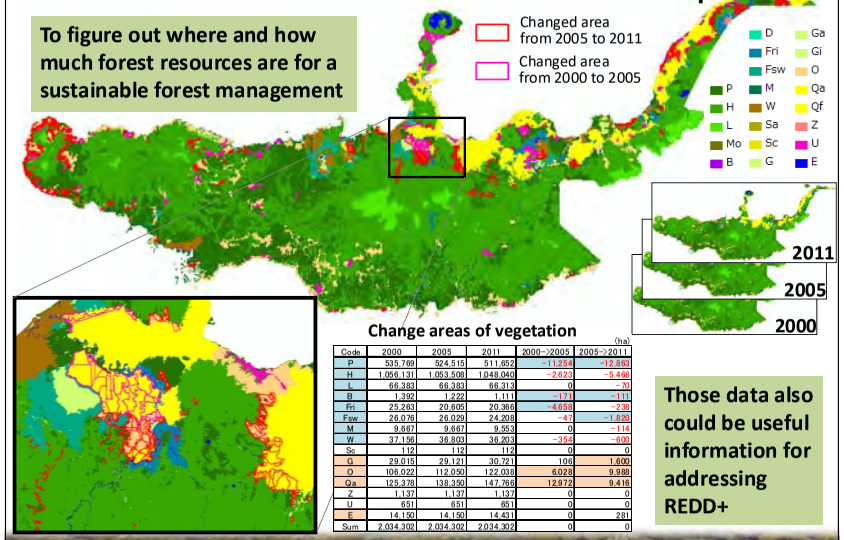
Adding degradation and driver information into the Forest Base Map enables detailed and reliable forest monitoring for forest management and planning.

Detail Analysis of Forest Degradation & Drivers



Creation of Three Time Series Forest Cover Maps

To figure out where and how much forest resources are for a sustainable forest management



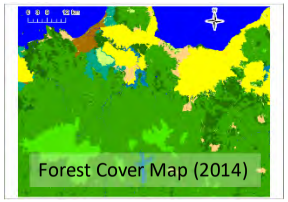
Change areas of vegetation

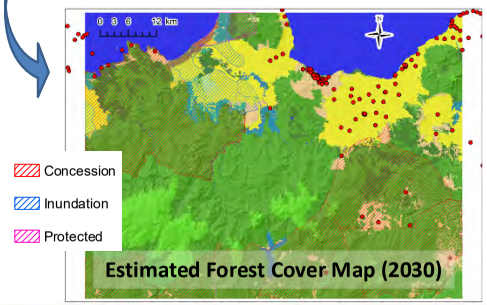
(ha)

Code	2000	2005	2011	2000->2005	2005->2011
P	535,769	524,515	511,652	-11,254	-12,863
H	1,056,131	1,053,508	1,048,040	-2,623	-5,468
L	69,388	66,388	66,313	0	-70
B	1,392	1,222	1,111	-171	-111
Fri	25,263	20,605	20,366	-4,658	-238
Fsw	26,076	26,029	24,208	-47	-1,830
M	9,667	9,667	9,553	0	-114
W	37,156	36,803	36,203	-354	-600
Sc	112	112	112	0	0
G	29,015	29,121	30,721	106	1,600
O	106,022	112,050	122,038	6,028	9,988
Qa	129,378	138,350	147,766	12,972	9,416
Z	1,137	1,137	1,137	0	0
U	651	651	651	0	0
E	14,150	14,150	14,431	0	281
Sum	2,034,302	2,034,302	2,034,302	0	0

Those data also could be useful information for addressing REDD+

Land Cover Change Simulation using Land Change Modeler





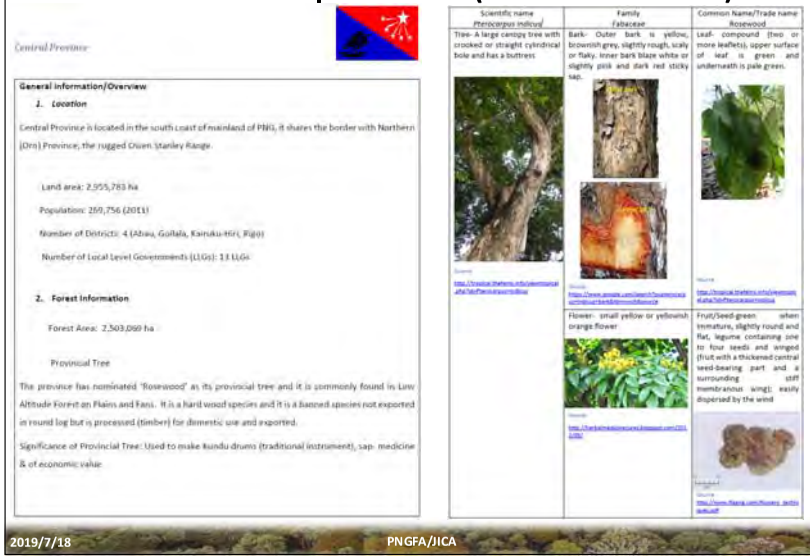
Employed Parameters

Altitude, Slope,
Distance from sea (log transformed),
Population density,
Protected Area, Inundation area,
Active Concession area
Forest Base Map

Size of target area: about 4,870 km^2

Forest Base Map and Atlas (Main Report)

Forest Base Map and Atlas (Provincial Profiles)



Central Province

General information/Overview

1. Location

Central Province is located in the south coast of mainland of PNG, it shares the border with Northern (Oro) Province, the rugged Owen Stanley Range.

Land area: 2,955,783 ha

Population: 260,756 (2011)

Number of Districts: 4 (Abau, Goilala, Kairuku-Hiri, Rigo)

Number of Local Level Governments (LLGs): 13 LLGs

2. Forest Information

Forest Area: 2,503,069 ha

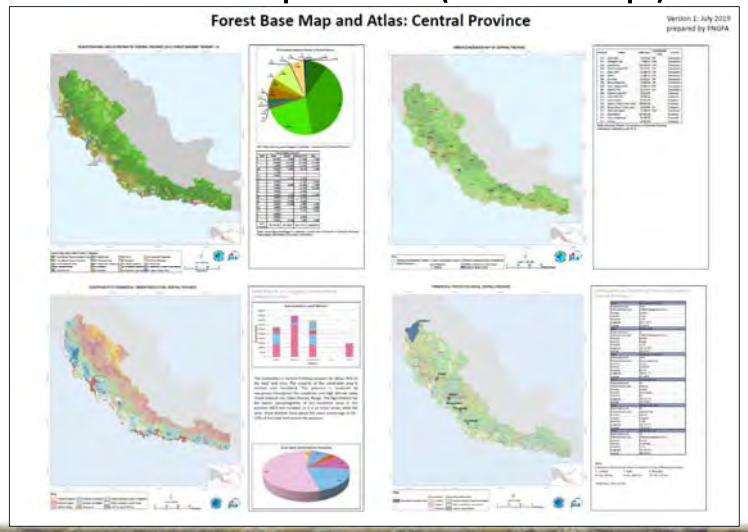
Provincial Tree

The province has nominated 'Rosewood' as its provincial tree and it is commonly found in Low Altitude Forest on Plains and Fans. It is a hard wood species and it is a Banned species not exported in round log but is processed (timber) for domestic use and exported.

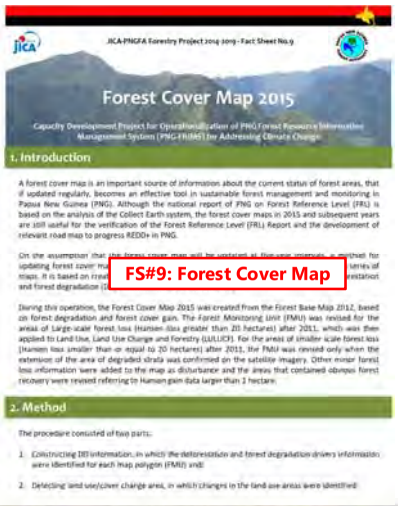
Significance of Provincial Tree: Used to make kundu drums (traditional instrument), sap- medicine & of economic value

Scientific name *Pterocarpus indicus*	Family *Fabaceae*	Common Name/Trade name Rosewood
Tree- A large canopy tree with crooked or straight cylindrical bole and has a buttress	Bark- Outer bark is yellow, brownish grey, slightly rough, scaly or flaky, inner bark blaze white or slightly pink and dark red sticky sap.	Leaf- compound (two or more leaflets), upper surface of leaf is green and underneath is pale green.
	Flower- small yellow or yellowish orange flower	Fruit/Seed-green when immature, slightly round and flat, legume containing one to four seeds and winged (fruit with a thickened central seed-bearing part and a surrounding stiff membranous wing); easily dispersed by the wind

Forest Base Map and Atlas (Thematic Maps)



Factsheets Series (Brief Descriptions of Products)


JICA-PNGFA Forestry Project 2014-2019 - Fact Sheet No.3

Forest Cover Map 2015

Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change

1. Introduction

A forest cover map is an important source of information about the current status of forest areas, that if updated regularly, becomes an effective tool in sustainable forest management and monitoring in Papua New Guinea (PNG). Although the national report of PNG on Forest Reference Level (FRL) is based on the analysis of the Collect Earth system, the forest cover maps in 2015 and subsequent years are still useful for the verification of the Forest Reference Level (FRL) Report and the development of relevant road map to progress REDD+ in PNG.

On the assumption that the forest cover map will be updated at five-year intervals, a method for updating forest cover ma... series of maps. It is based on remo... restation and forest degradation (...

FS#9: Forest Cover Map

During this operation, the Forest Cover Map 2015 was created from the Forest Base Map 2012, based on forest degradation and forest cover gain. The Forest Monitoring Unit (FMU) was revised for the areas of Large-scale forest loss (Human-loss greater than 20 hectares) after 2011, which was then applied to Land Use, Land Use Change and Forestry (LULUCF). For the areas of smaller scale forest loss (human loss smaller than or equal to 20 hectares) after 2011, the FMU was revised only when the extension of the area of degraded strata was confirmed on the satellite imagery. Other minor forest loss information were added to the map as disturbance and the areas that contained obvious forest recovery were revised referring to human gain data larger than 1 hectare.

2. Method

The procedure consisted of two parts:

1. Constructing DD information, in which the deforestation and forest degradation drivers information were identified for each map polygon (FMU) and;
2. Detecting land use/cover change area, in which changes in the land use areas were identified.


JICA-PNGFA Forestry Project 2014-2019 - Fact Sheet No.4

Forest Monitoring Unit (FMU) in Papua New Guinea Forest Cover Map

Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change

1. Background

National level vegetation map, which was created as at 1975 and updated in 1996, has been used in PNG Forest Authority (PNGFA). A unit of the vegetation map was called 'Forest Mapping Unit (FMU)' on PNG Resource Information System (PNGRIS) and Forest Inventory Mapping System (FIMS). This map caused various practical problems to PNGFA because it was out-dated and the units (FMU) were too large to capture forest conditions including timber volume. Responding to this situation, the PNG Forest Base Map 2012 was developed as a main layer of the PNG Forest Resource Information Management System (PNG-FRIMS) in 201... Forest Monitoring Unit (FMU)' was redefined. This ... could have various information, so that it could ... volume and carbon stock, etc. by monitoring forest ...

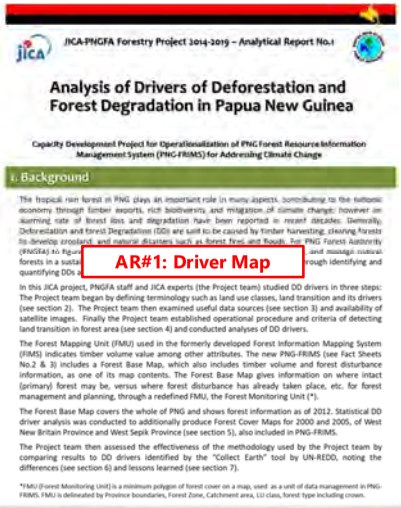
FS#4: FMU

2. FMU Definition and Selection Criteria

New 'FMU' was conceived as minimum unit of forest at 'not too small' scale for replacing legacy 'FMU (Forest Mapping Unit)'. The former FMU was 'too large' in relation to current available technology. The new FMU is to be used for monitoring and recording changes of forests on new PNG-FRIMS.

- The following name was decided: **Forest Monitoring Unit** on the Forest Base Map 2012 in the FRIMS
- Criteria used to delineate FMUs:
  - Province,
  - Forest Zone,
  - Catchment,
  - Landuse (LU) class, and
  - Forest type including crown size (see to next page)
- Minimum mapping unit (polygon) size: 1 hectare, while the mapping scale is between 1/25,000 and 1/50,000 for the data development.
- FMU has unique id (FMU_id) attribute, which would be used as a key attribute to link relational database.
- Subsequent forest cover maps to be developed will take over FMUs from the Forest Base Map.

Analytical Report Series (Brief Descriptions of Products)


JICA-PNGFA Forestry Project 2014-2019 – Analytical Report No.1

Analysis of Drivers of Deforestation and Forest Degradation in Papua New Guinea

Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change

1. Background

The tropical rain forest in PNG plays an important role in many aspects, contributing to the national economy through timber exports, rich biodiversity, and mitigation of climate change; however an alarming rate of forest loss and degradation have been reported in recent decades. Generally, Deforestation and forest Degradation (DD) are said to be caused by timber harvesting, clearing forests to develop cropland, and natural disasters such as forest fires and floods. For PNG Forest Authority (PNGFA) to figure ... and manage natural forests in a sustai... rough identifying and quantifying DDs a...

AR#1: Driver Map

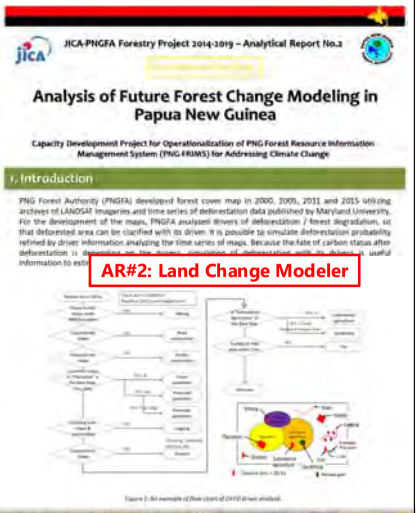
In this JICA project, PNGFA staff and JICA experts (the Project team) studied DD drivers in three steps: The Project team began by defining terminology such as land use classes, land transition and its drivers (see section 2). The Project team then examined useful data sources (see section 3) and availability of satellite images. Finally the Project team established operational procedure and criteria of detecting land transition in forest area (see section 4) and conducted analyses of DD drivers.

The Forest Mapping Unit (FMU) used in the formerly developed Forest Information Mapping System (FIMS) indicates timber volume value among other attributes. The new PNG-FRIMS (see Fact Sheets No.2 & 3) includes a Forest Base Map, which also includes timber volume and forest disturbance information, as one of its map contents. The Forest Base Map gives information on where intact (primary) forest may be, versus where forest disturbance has already taken place, etc. for forest management and planning, through a redefined FMU, the Forest Monitoring Unit (*).

The Forest Base Map covers the whole of PNG and shows forest information as of 2012. Statistical DD driver analysis was conducted to additionally produce Forest Cover Maps for 2000 and 2005, of West New Britain Province and West Sepik Province (see section 5), also included in PNG-FRIMS.

The Project team then assessed the effectiveness of the methodology used by the Project team by comparing results to DD drivers identified by the "Collect Earth" tool by UN-REDD, noting the differences (see section 6) and lessons learned (see section 7).

*FMU (Forest Monitoring Unit) is a minimum polygon of forest cover on a map, used as a unit of data management in PNG-FRIMS. FMU is delineated by Province boundaries, Forest Zone, Catchment area, LU class, forest type including crown.


JICA-PNGFA Forestry Project 2014-2019 – Analytical Report No.2

Analysis of Future Forest Change Modeling in Papua New Guinea

Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change

1. Introduction

PNG Forest Authority (PNGFA) developed forest cover map in 2000, 2005, 2011 and 2015 utilizing archives of LANDSAT imageries and time series of deforestation data published by Maryland University. For the development of the maps, PNGFA analysed drivers of deforestation / forest degradation, so that deforested area can be clarified with its driver. It is possible to simulate deforestation probability refined by driver information analyzing the time series of maps. Because the fate of carbon status after deforestation is ... useful information to esti...

AR#2: Land Change Modeler

Deliverable Documents (for PNGFA operation)

Defined in PDM

	Document Name	Status
1-1	Manual on updating forest base map	Completed
1-3	Design document of DB	Completed
1-8	Manual of PNG-FRIMS	Completed
2-1	Methods/procedures for solving the issues of the current forest planning system	Completed
2-2	The document on the usage of PNG-FRIMS→[PNG-FRIMS & GPS User Guide Book for the Forest Planning]	Completed
2-4	Guidelines of the forest planning	Completed
3-1	Document on the draft of the technical procedures for estimation of forest carbon emissions and removals	Completed
3-2	The document on the results of consideration on the usage of PNG-FRIMS	Completed
3-3	Guidelines on the method of access and provision of the information	Completed

Others than PDM

	Document Name	Status
	Manual for Land Change Modeler Analysis	Completed
	Digitizing road network utilizing LANDSAT imagery	Completed
	PNG-FRIMS (from JICA-PNGFA project) support to forest plantations development in Papua New Guinea and considerations for REDD+	Completed
	An overview of institutional conditions conducive to Sustainable Forest Management to input supports from the JICA-PNGFA project and REDD+ in Papua New Guinea	Completed

Summary

- In order to effectively monitor secular change of forest resource in PNG, Forest Basemap (ver.1.1) was utilized to develop Forest Cover Map 2015 for whole country and past forest cover maps for pilot provinces.
- The FMU in Forest Basemap (ver.1.1) was improved to calculate volume, carbon stock, record changes in forest etc by monitoring forest conditions in each FMU.
- Forest Basemap (ver.1.1) was utilized to develop forest degradation and driver maps for whole country as analytical study
- Forest Basemap (ver.1.1) generated information by national and provincial level is available in GIS layers and in publications such as maps (PDF), factsheets, manuals and main report.

Thank you

From the People of Japan

Japan Asia Group
KOKUSAI KOGYO CO.,LTD.

JICA

Final Seminar
Hilton Hotel

Capability and Potential of PNG-FRIMS (Demo)

18th July, 2019
Patrick Laa

AIM

Distribution and accessibility of PNG-FRIMS.

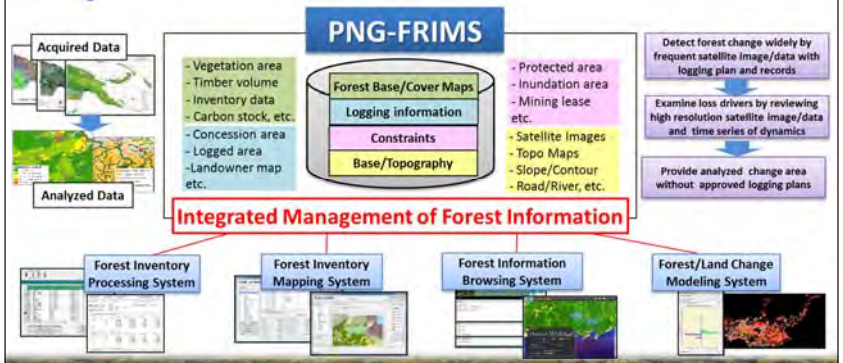
Content

- What is PNG-FRIMS
- PNG-FRIMS Data Composition
- Functions of PNG-FRIMS
- Summary

What is PNG-FRIMS?

Fact Sheet #3 PNG-FRIMS

- **FRIMS** stands for **F**orest **R**esource **I**nformation **M**anagement **S**ystem.
- FRIMS is **GIS database** responsible for acquiring and managing **"spatial information /data" on forests**.
  - This aims to support PNGFA decision making.
- FRIMS can display various spatial information on **maps with attributes** which can be overlaid to compare relativeness of the information and data.
- FRIMS also has the functions **estimating commercial timber volume**, **projecting land use change** and **sharing information** with PNGFA Head office staffs.



Information in PNG-FRIMS

Fact Sheet #3 PNG-FRIMS

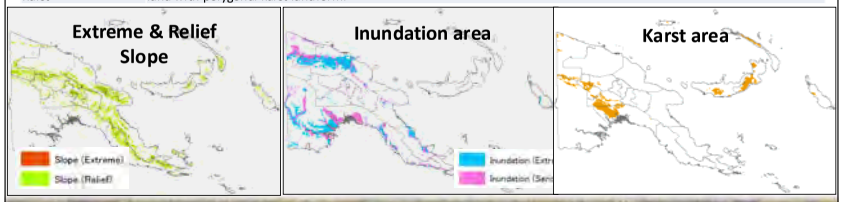
Logging Concession Information	Concession Area, Logged Area, Planned Area , Buffer zone Topographic info: Logging road, River/ Stream, Contour Facility info: Bridge/ Culvert, Campsite, Gravel pit, Log landing, Building, etc.
Constraints and Land Use	Social condition: FCA (Forest Clearing Authority), Plantation, Protected Area, Mining operation area Natural condition: Slope (Extreme/ Relief), Altitude (Extreme), Karst, Inundation (Extreme/ Serious), Mangrove
Forest Base/ Cover Maps	Data: Forest Base Map 1.1 (2012) Time-series forest cover maps (2000/ 2005/2011) (WNB/ WSP, as of 15th Nov 2017) Forest cover map 2015 (benchmark map) Old vegetation (FIMS Forest Mapping Unit) Collect Earth Landuse change Assessment (Point Sampling) PSP (Permanent Sample Plots) ©FRI (Forest Research Institute) PINFORM (PNG International Tropical Timber Organization Natural Forest Model) ©FRI Attributes: Vegetation area, Tree crown size, Forest Zone, Timber volume, Carbon stock, Degradation driver,
Base/ Topography	Satellite imagery: RapidEye (2011), Landsat AGP (1990/1995/2000/2005/2010/2011/2015), PALSAR (2010/2011) Topomap (scale = 1:100,000, Raster) Topography: 5m mesh Digital Elevation Model (Airborne Radar in 2006 from National Mapping Bureau) Hillshade, Slope, Contour (10m), Watershed (made from GeoSAR) Global Dataset: Hansen data (Tree cover loss/ loss year/ gain) Main road (time-series), River, Incorporated Land Group and Clan boundary/Settlement/ Local Level Government & District boundary/ Province-Region boundary (PNG Census 2000 and 2011)

Information in PNG-FRIMS

Fact Sheet #5
Constraints

- **Constraints(which limit forestry activities)**
  - Social Conditions:
    - Forest Clearing Authority, Plantation, Protected Area, Mining operation area.
  - Natural Conditions:
    - Slope(Extreme/Relief), Altitude(Extreme), Inundation, Mangrove, Karst

Layer	Description
Altitude	land over 2400m altitude.
Slope (Extreme)	land with over 30 degree dominant slope.
Slope/Relief	land with dominant slope of 20-30 degrees and sub-dominant slope over 30 degrees and with high to very high relief.
Mangroves	land covered by mangroves.
Inundation (Extreme)	land permanently or near permanently inundated extending over more 80% of the area of that land.
Inundation (Serious)	50-80% permanent or near permanent inundation.
Karst	land with polygonal karst landform.

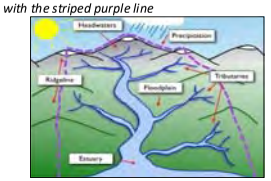


Information in PNG-FRIMS

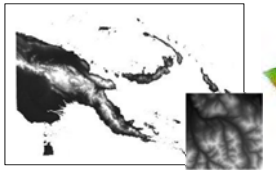
Fact Sheet #6
Watersheds

- **Watershed and Catchments**

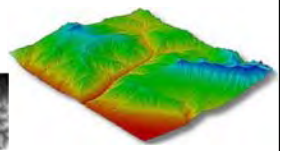
An illustration showing the different aspects of a watershed. The Watershed Boundary is symbolized with the striped purple line



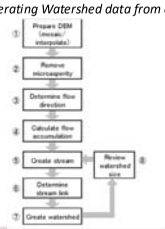
2D representation of a DEM. (Image courtesy of University of Minnesota)



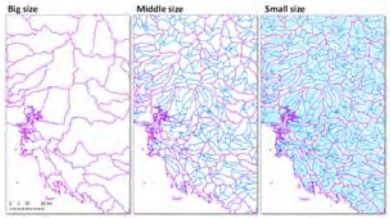
3D representation of a DEM (Image courtesy of the GPS Power)



The Work-Flow Diagram showing the processes involved in generating Watershed data from a DEM.



Three level of Watershed Data of Papua New Guinea



Information in PNG-FRIMS

Fact Sheet #7
PNG-FRIMS

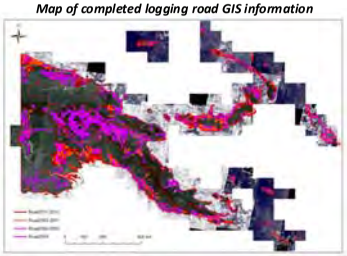
- **Digitized Logging Road Data**

Layer (Dataset)	Source	Remarks
Road GIS information	GeoBook	Derived from NEFC[1] 2005 Cost of Services surveys, satellite imagery
River GIS information	GeoBook	Derived from 1:250 000 topographic maps
Census Unit Information	GeoBook	Derived from PNG 2008 Census
Provincial Boundaries	Developed by the Project[3]	
LANDSAT AGP 2000	Developed by the Project	
LANDSAT AGP 2005	Developed by the Project	
LANDSAT AGP 2011	Developed by the Project	
LANDSAT AGP 2015	Developed by the Project	
RapidEye 2011	Procured by Grant Aid Program	

Road information of Geobook is a good reference to digitize unclear roads on LANDSAT AGP

To avoid digitizing rivers as roads, refer to the river GIS information (light green line).

Map of completed logging road GIS information



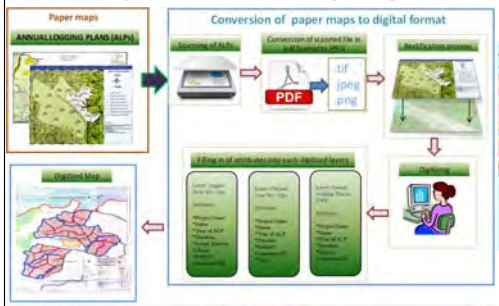
Information in PNG-FRIMS

Fact Sheet #8
PNG-FRIMS

- **Forest Concession and Land Management Layers**

Data	Source	Format
Logging Concession Boundary	Acquisitions Branch - PNGFA	Hardcopy/Softcopy
Logging Plan and Logged Over Area	Annual Logging Plans or Forest Working Plans maps provided by logging company	Hardcopy/Softcopy
Forest Clearance Authority	Logging company or Allocations Branch - PNGFA	Hardcopy/Softcopy
Forest Plantation Boundary	Surveyed by GPS or extracted from Forest Basemap 2012	Softcopy

The process involved in digitizing



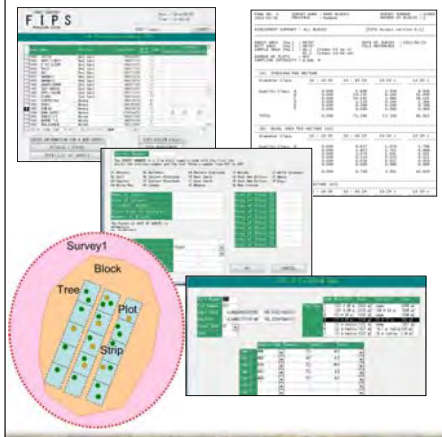
Logging Plan

Logged over Area

Functions of FRIMS

Fact Sheet #3
PNG-FRIMS

- **Forest Timber Volume Estimation (1)**
  - ➢ **FIPS (Forest Inventory Processing System)**



Overview:

- FIPS estimates the timber volume of the expected logging project area based on the data of the inventory survey.
- The estimated volume is to be used to determine an annual allowable cut of timber volume for the expected logging project.

Basic functions:

- Enter survey information and assessment data from field books (such as species, diameter and length)
- Edit and process assessment data
- Produce survey result and printout as summary report
- Import assessment data from Excel file into FIPS, and Export the Result of processed data from FIPS into Excel format

Functions of FRIMS

Fact Sheet #3
PNG-FRIMS

- **Forest Timber Volume Estimation (2)**
  - ➢ **FIMS (Forest Inventory Mapping System)**

Overview:

- FIMS calculates the potential timber volume in any level of area such as national, provincial and logging project.
- The volume is calculated using forest type per unit timber volume and to be adjusted by logged volume data.
- The volume estimate is to be utilized to develop forest plans (National/Provincial forest plan).

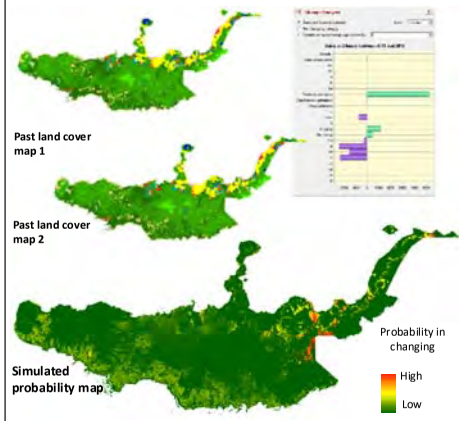
Basic functions:

- Manage not only planned and operational concession boundaries but also logged over areas reported by logging companies.
- Import assessment data from FIPS and show strip lines on map, which were used for surveys and timber volume processed by FIPS.

Functions of FRIMS

Fact Sheet #3
PNG-FRIMS

- **Forest/Land Change Modeling System**
  - ➢ Future Land Change Projection & Simulation



Overview:

- Analyzing chrono-sequential spatial data including forest information, future land change (such as deforestation) and simulate probability in each location.
- This system uses Land Change Modeler, which is a product of Clark Labs, Clark University, USA.

Basic functions:

- The results of the simulation is useful for developing policies such as provincial forest plans and action plan of the national REDD+ strategy.
- Evaluation of the model is needed for utilization of the results.

Functions of FRIMS

Fact Sheet #3
PNG-FRIMS

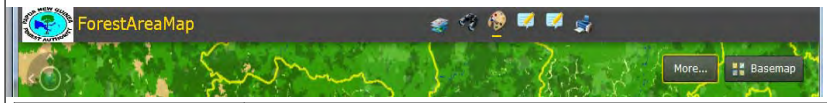
- **Forest Information Browsing System (LAN Map)**

LAN Map Browser enables HQ staff to access information in FRIMS without GIS skill. It can overlay specific layers and measure distance or area etc.. It could improve the efficiency of desktop works such as evaluation/approval of FWP.

Evaluation /Approval of 5yrs FWP; Check
-Area to be logged in the next 5yrs.
-Permanent Roads and Log ponds constructed are in practical and logical order.
-Consistency of ALP with FYFWP on area to be logged.
-Area of set-up and buffer zone width etc..

http://pngfa-hq-srv3/FRIMS-LAN-Map/ (only inside PNGFA)

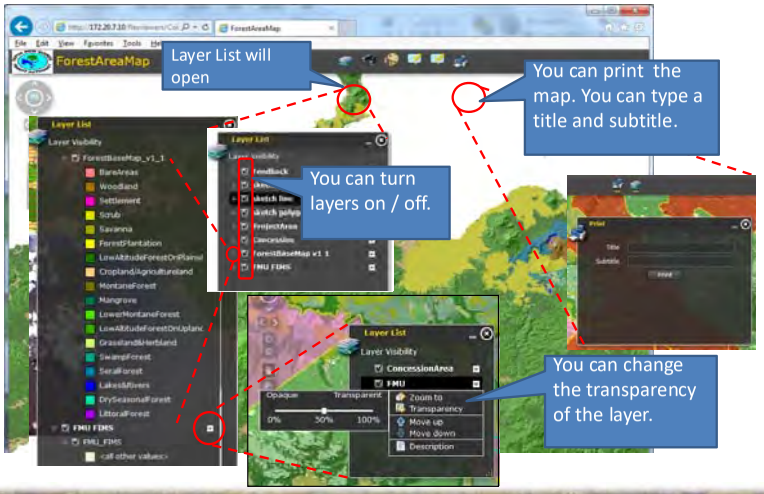
Basic functions of Forest Information Browsing System (LAN Map)



	Functions	Note
1	Layer List	Turn layers (forest info) on and off.
2	Search	Search for location/ point of interest
3	Measure	Measure length or area on the map.
4	Sketch	Sketch simple graphics (point, line, polygon) on the map
5	Feedback	Send feedbacks to Administrator (e.g. the data error that you found etc.)
6	Print	Print a visible map displayed.
7	Switch background maps	Satellite imageries, topographic maps, etc (RapidEye2011, Landsat Annual Greenest Pixel 2000/ 2013/ 2014, Topomap, Hillshade)

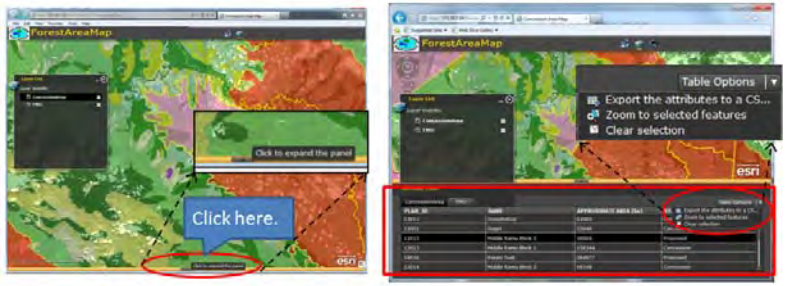
Graphical User Interface of Web Browser (LAN Map)

Main Window of Web Browser (LAN Map)



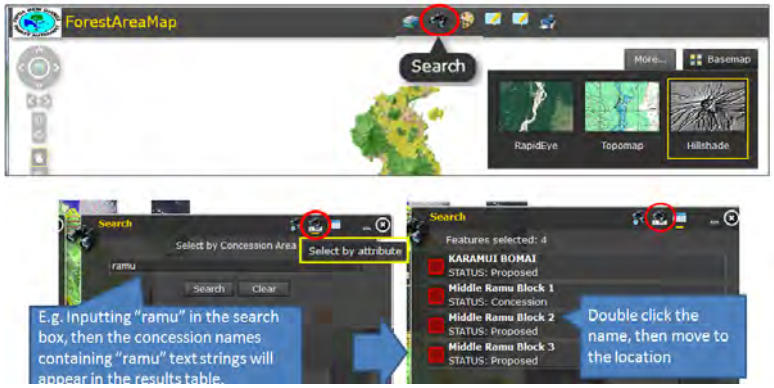
Basic Functions of Web Browser (LAN Map)

Viewing Attribute Table of Concession



Basic Functions of Web Browser (LAN Map)

Search by name of the concession area



Basic Functions of Web Browser (LAN Map)

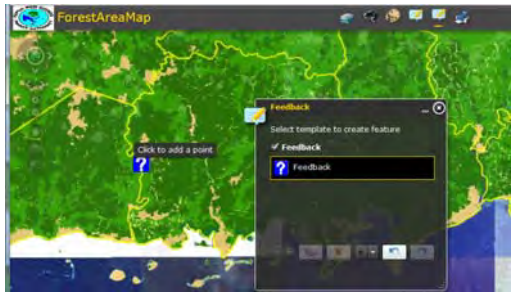
- Measure length and area of Area of Interest

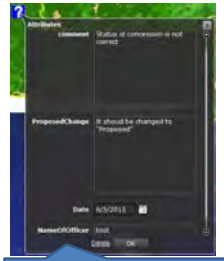
Basic Functions of Web Browser (LAN Map)

Sketch forest information for planning or monitoring

Basic Functions of Web Browser (LAN Map)

Feedback on the forest information inside PNG-FRIMS and the function of web browser map



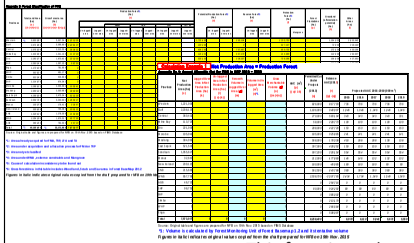


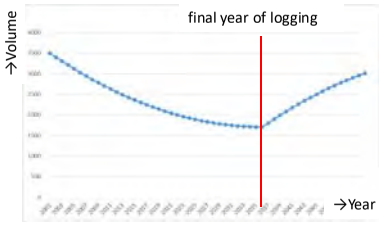
You can enter following attributes.
- Comment
- Proposed Change
- Date created
- Name of officer

Applications of FRIMS

Contributing to PFP

- **AAC (Annual Allowable Cut) calculation**
  - AAC calculation function based on Forest Base Map 2012 has been developed on a trial basis. The draft results of the calculation are being verified for now.
  - Current FIMS only subtracts the harvested area from forest area for a rough estimate of timber volume. Not taking account of re-growth.



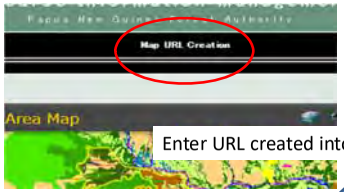


This function adopted the idea that timber volume will recover over the next 35 years linearly, although we examined PINFORM.

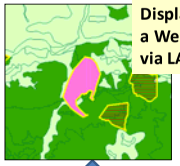
Applications of FRIMS

Future support to DSS

- **Map URL Creation (Spatial Book Mark)**



Enter URL created into DSS



Display a map on a Web Browser via LAN Map

Table in the DSS (image)

Project name	Setup name	***	LAN Map URL
EastFurgasson	S13-14 10A	***	http://pngfa-hq-srv3/flexviewers/123
EastFurgasson	S13-14 11A	***	http://pngfa-hq-srv3/flexviewers/456
EastFurgass			

If DSS can add a new column for recording a URL link, LAN Map provides a URL to the map

SUMMARY

PNG-FRIMS

- A digital data base which stores all forest data and information in PNGFA.
- Functions:
  - Digitize and compile maps.
  - Estimate the Forest volume.
  - Process and make reports.
  - Edit / Process field book data.
- Estimates Annual Allowable Cut (AAC) for National/Provincial Forest Plans
- A system that shares forest information stored in PNG-FRIMS with relevant officers

THANK YOU

Capacity Development Project for Operationalization of
PNG Forest Resource Information Management System for Addressing Climate Chang
Final Seminar

JICA Project Contributions to National Forest Plan & Provincial Forest Plans

18st July 2019

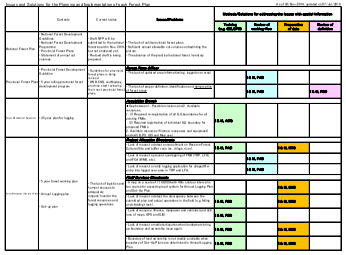
Margaret Tongo
a/Senior Forest Plan Officer, FPPD, PNGFA
PNGFA/JICA Project

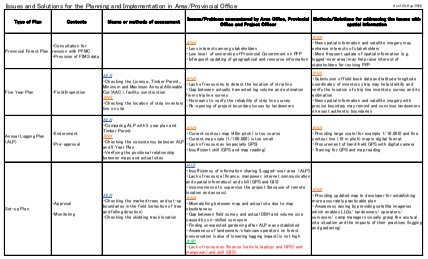
Objectives of the Project in Forest Planning System in PNGFA

The National Forest Plan, Provincial Forest Plans, Forest Management Plans and their monitoring system are improved through steady operation of PNG-FRIMS.
(output 2)

Objectives of the Project in Forest Planning System in PNGFA

Gap analysis and searching its solutions through the Project's activities





- **Deficiency in Annual Allowable Cut volume**
- **Inconsistency with Provincial Forest Plans**
- The lack of logistics and human resources to adequately inspect/monitor the forest resources and logging operations

Objectives of the Project in Forest Planning System in PNGFA

Appropriate methods/procedures for solving the issues

Approach	Target Issues	Procedures
Enhance AAC calculation in PNG-FRIMS	・Deficient annual allowable cut volume contradicting the picture.	・Design the new AAC calculation methodology and its manner of utilization in forest planning
		・Redefine the calculation method using updated PNG-FRIMS and Add in new functions suchas regrowth volume
		・Gather and update administrative information stored in PNG-FRIMS where necessary
		・Apply the concrete role of updated AAC in forest planning using updated figures
		・Develop guidelines how to utilize updated AAC calculation function in PNG-FRIMS for forest monitoring
Promote PFP formulation	・The lack of valid provincial forest plans	・Clarify the scope and directionality of PFP formulation in PNGFA and its supportive role of the Project
		・Explore the capability and input the importance of revising PFP guidelines, and participate the process of guidelines revision where necessary
		・Explore the capability of developing PFPs in some provinces and participate the process of PFP formulation where necessary
		・Apply the concrete role of PNG-FRIMS in PFP formulation and orientation in PFP guidelines
		・Develop guidelines how to utilize PNG-FRIMS for PFP formulation and update the data/information supposed to be stored in PNG-FRIMS
Develop the capacity to monitor the forest recources in ground level	・The lack of logistics and human resouces to adequately inspect/monitor the forest resources and logging operations	・Select the items for improving forest inspection/monitoring in field and procure it to enforce the field activity in mainly pilot sites
		・Consolidate/develop the training materials and methodology through pilot sites' trial
		・Develop the capacity to monitor the forest resouces using above items to pilot sites' offices and other PNGFA officers where necessary
		・Consider the practical utilization of above items to implement PNGFA's regulations such as LCoP and PMCP through trainings and workshops
		・Develop manuals/guidelines to fully operate above items to improve forest inspection/monitoring

Enhance AAC calculation in PNG-FRIMS

AAC calculation and its role in forest planning in PNG

- AAC is commonly defined as the volume of timber which may be cut in one year in a given area.
- AAC is a required content of National Forest Plan, which is the only plan in PNG to guide the current forest management and the future development of forest area at the national level.
- Thus, AAC in PNG plays an important role in planning and managing the forest resource by indicating estimated volume to be logged in a certain area in a year.

The National Forest Plan shall consist of a statement, prepared annually by the Board, of **allowable cut volumes**, being the amount of allowable cut for each province **for the next succeeding year which will ensure that the areas of forest resource set out** in the Provincial Forest Plan, for present or future production.

Section 47(2)(C)(iii), the Forestry Act 1991

Forest resources shall only be developed in accordance with the National Forest Plan.

Section 54, the Act

AAC calculation and its application for forest planning in PNG

- The initial formula was defined in the National Forest Policy (1991) in a tentative fashion.
- Though AAC before the Project was calculated by Forest Information Mapping System based on the past Forest Base Map and , the Project made changes to deal with several problems.
- "**Adding regrowth volume**" and "**Removing the constraints from net production area**" based on new Forest Base Map 2012 are the noteworthy updates as a new concept of AAC calculation by PNG-FRIMS.

Before-after of the concept of AAC calculation

Old Concept (before the Project)

$$AAC = (Atotal - Alogged) * Vstandard \_\_\_\_ / 35 * 0.4$$

(0.4: Adjusting index)

New concept (The Project's output)

$$AAC = \{(Anet - Alogged) * Vstandard + Vregrowth\} / 35 \_\_\_\_$$

(Anet: Redefining net production area; Vregrowth: Adding regrowth volume)

Notice:
Formula calculates total volume of stone concession by 35 years later after launching logging.

Abbreviation:
Atotal : Total Forest Area (inc. constraints)
Anet : Net Production Area (exc. constraints)
Alogged : Logged Over Area in net production area
Vstandard : Standard Volume of each forest type
Vregrowth : Regrowth Volume of each forest type

A benchmark formula shall be used for calculating initial allowable cut in each province. The allowable cut will be set initially by dividing the total merchantable resource within the production forest by an assumed cutting cycle of 40 years.

This formula will be subject to review in the light of further research.

National Forest Policy 1991, Page 6

AAC calculation and its application for forest planning in PNG

As of 17th June 2019

Net Production Area = Production Forest

Provinces	Net Production Area(ha) (j)	Logged Over Area in Net Production Area (ha) (k)	Un-logged Area in Net Production Area (ha) (l) ((j)-(k))	Regrowth Volume in Logged Over Area(m^3) (m)	Volume in Un-Logged Area(m^3) (n) *1	Gross Merchantable Volume(m^3) (o) ((m)+(n))	AAC(m^3) (p) ((o)/35)
Western	1,044,498	467,937	576,561	7,014,736	18,116,357	25,131,093	718,031
Gulf	1,203,287	430,864	772,423	5,085,260	22,152,619	27,237,879	778,225
Central	321,928	89,367	232,561	1,106,542	4,879,271	5,985,813	171,023
Milne Bay	71,405	9,046	62,359	80,221	1,987,692	2,067,913	59,083
Northern (ORO)	147,183	14,276	132,907	73	3,412,403	3,412,476	97,499
Southern Highlands	87,510	0	87,510	0	3,028,881	3,028,881	86,539
Eastern Highlands	0	0	0	0	0	0	0
Simbu	296	0	296	0	14,486	14,486	414
Western Highlands	0	0	0	0	0	0	0
West Sepik	888,338	103,276	785,071	573,402	23,520,193	24,093,595	688,388
East Sepik	252,101	27,783	224,318	0	10,119,570	10,119,570	289,131
Madang	290,726	81,112	209,614	1,187,675	7,581,379	8,769,054	250,544
Morobe	159,559	46,008	113,551	528,141	3,687,920	4,216,061	120,459
West New Britain	955,127	539,423	415,704	4,616,085	12,709,873	17,325,958	495,027
East New Britain	18,629	10,182	8,447	120,728	244,942	365,670	10,448
New Ireland	103,591	73,111	30,480	1,395,694	666,078	2,061,772	58,908
Autonomous Bougainville Government (ABG)	38,871	0	38,871	0	779,391	779,391	22,268
Manus	38,943	25,531	13,412	250,431	460,907	711,338	20,324
Enga	0	0	0	0	0	0	0
National Capital District	0	0	0	0	0	0	0
Hela	0	0	0	0	0	0	0
Jiwaka	0	0	0	0	0	0	0
Total	**5,621,992**	**1,917,916**	**3,704,085**	**21,958,988**	**113,361,962**	**135,320,950**	**3,866,311**

*1: Volume is calculated by Forest Monitoring Unit of Forest Basemap 1.2 and its tentative volume

AAC calculation and its application for forest planning in PNG

As of 17th June 2019

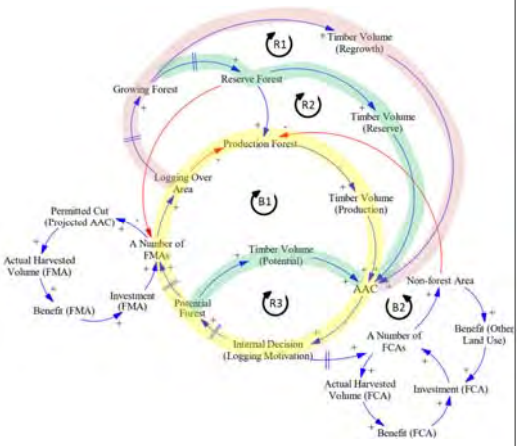
Net Production Area = Production Forest + Potential Production Forest + Reserve Forest

Provinces	Net Production Area(ha) (j)	Logged Over Area in Net Production Area (ha) (k)	Un-logged Area in Net Production Area (ha) (l) ((j)-(k))	Regrowth Volume in Logged Over Area(m^3) (m)	Volume in Un-Logged Area(m^3) (n)*1	Gross Merchantable Volume(m^3) (o) ((m)+(n))	AAC(m^3) (p) ((o)/35)
Western	6,669,860	817,030	5,852,830	7,516,904	169,917,727	177,434,631	5,069,561
Gulf	2,170,919	509,025	1,661,894	6,438,603	48,652,821	55,091,424	1,574,041
Central	2,085,878	286,365	1,799,513	2,581,064	45,927,677	48,508,741	1,385,964
Milne Bay	904,292	176,394	727,898	3,070,497	21,679,027	24,749,524	707,129
Northern (ORO)	1,546,215	101,633	1,444,582	1,095,049	41,934,479	43,029,528	1,229,415
Southern Highlands	647,529	13,374	634,155	333,505	22,926,011	23,259,516	664,558
Eastern Highlands	484,995	8,938	476,057	0	15,486,371	15,486,371	442,468
Simbu	258,266	0	258,266	0	8,697,756	8,697,756	248,507
Western Highlands	99,665	22,007	77,658	600,091	4,753,673	5,353,764	152,965
West Sepik	2,874,210	377,882	2,496,328	6,743,936	89,179,000	95,922,936	2,740,655
East Sepik	1,813,436	70,649	1,742,787	509,530	73,366,369	73,875,899	2,110,740
Madang	1,737,962	181,414	1,556,548	3,564,013	53,751,140	57,315,153	1,637,576
Morobe	1,918,799	177,859	1,740,940	1,132,216	66,043,919	67,176,135	1,919,318
West New Britain	1,464,855	909,974	554,881	15,629,287	17,386,992	33,016,279	943,322
East New Britain	811,472	412,115	399,357	4,695,714	11,514,601	16,210,315	463,152
New Ireland	663,801	391,805	271,996	4,850,891	7,525,085	12,375,976	353,599
Autonomous Bougainville Government (ABG)	713,663	41,129	672,534	711,660	14,440,789	15,152,449	432,927
Manus	156,806	36,569	120,237	346,518	5,374,614	5,721,132	163,461
Enga	324,420	32,804	291,616	450,165	9,108,849	9,559,014	273,115
National Capital District	7,192	0	7,192	0	23,822	23,822	681
Hela	477,546	0	477,546	0	16,285,644	16,285,644	465,304
Jiwaka	211,932	48,621	163,311	1,257,153	7,562,556	8,819,709	251,992
Total	**28,043,713**	**4,615,587**	**23,428,126**	**61,526,796**	**751,538,922**	**813,065,718**	**23,230,450**

*1: Volume is calculated by Forest Monitoring Unit of Forest Basemap 1.2 and its tentative volume

AAC calculation and its application for forest planning in PNG

AAC derived from PNG-FRIMS in forest management cycle in PNG



Old concept (Before the Project): (B1)
AAC consistently decreases due to expanding logged over area.

New concept 1: (B1) + (R1)
Regrowth volume after logging is added to AAC, though it grows up by slow degrees.
This concept is suitable to grasp the situation of remaining timber volume on active concessions with regard to logging operation.

New concept 2: (B1) + (R1) + (R2) + (R3)
Timber volume on Potential and Reserve Forests is added to AAC.
This concept is suitable to formulate future forest development and forest zoning considering outside current concessions.

AAC calculation and its application for forest planning in PNG

The role of AAC in forest planning in PNGFA

- Decision making for future development of the project and demarcating between forest (FMAs) and non-forest (FCAs) is dominated by only NFP, and AAC provides estimated timber volume with NFP.
- Permitted cut with subsequent Actual Harvested volume should be monitored under National Sustainable Cut to be checked its sustainability in practical logging phase.
- Permitted Cut with Actual Harvested Volume supports forest planning as an indicator of potential and practical logging operations.
- To utilize both NFP with AAC for forest planning and Permitted cut with Actual Harvested Volume for controlling logging operations as wheels of a car promotes sustainable forest management.

AAC calculation and its application for forest planning in PNG

Comparison AAC to Permitted Cut, Actual Harvested Volume and National Sustainable Cut

As of 17th June 2019

Provinces	AAC (Production)	AAC (Production + Potential + Reserve)	Permitted Cut (2017) (Production)	Actual Harvested Volume (2017) (Production)	National Sustainable Cut
Western	718,031	5,069,561	1,209,918	389,604	-
Gulf	778,225	1,574,041	1,441,941	349,742	-
Central	171,023	1,385,964	341,535	125,230	-
Milne Bay	59,083	707,129	85,223	20,570	-
Northern (ORO)	97,499	1,229,415	85,930	49,571	-
Southern Highlands	86,539	664,558	74,062	-	-
Eastern Highlands	0	442,468	-	-	-
Simbu	414	248,507	-	-	-
Western Highlands	0	152,965	-	-	-
West Sepik	688,388	2,740,655	886,208	415,993	-
East Sepik	289,131	2,110,740	561,500	-	-
Madang	250,544	1,637,576	279,427	201,289	-
Morobe	120,459	1,919,318	163,475	260,605	-
West New Britain	495,027	943,322	1,355,743	753,123	-
East New Britain	10,448	463,152	191,771	101,666	-
New Ireland	58,908	353,599	183,065	250,981	-
Autonomous Bougainville Government (ABG)	22,268	432,927	46,720	-	-
Manus	20,324	163,461	51,734	18,120	-
Enga	0	273,115	-	-	-
National Capital District	0	681	-	-	-
Hela	0	465,304	-	-	-
Jiwaka	0	251,992	-	-	-
Total	**3,866,311**	**23,230,450**	**6,958,252**	**2,936,494**	**3,500,000**

AAC (Pr):
Estimated allowable cut volume per year **based on existing volume within concessions**.

AAC(Pr, Po, Re):
Estimated allowable cut volume per year **based on existing volume within concessions and outside concessions**.

Permitted Cut:
Summation of each project's estimated permitted cut volume **based on initial condition** before starting operation.

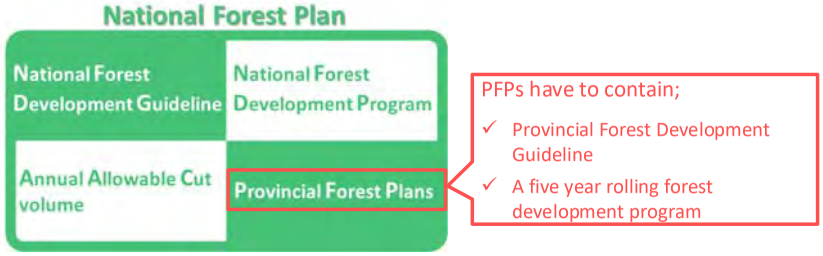
Actual Harvested Volume:
Summation of recorded each project's practical logged volume.

National Sustainable Cut:
Estimated allowable cut volume per year by Australian research in 1970's.

Promotion of PFP formulation and PFP guidelines

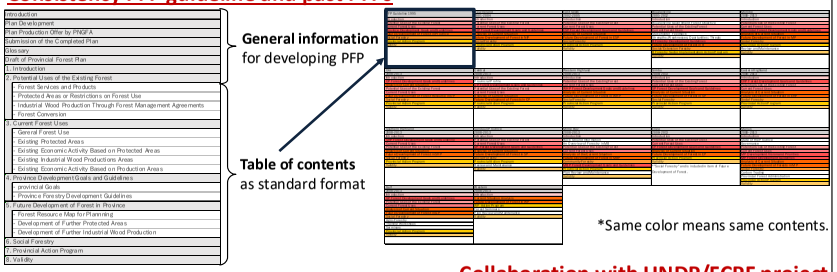
Developing revised PFP guidelines and formulating PFPs

- Provincial Forest Plans (PFPs) contribute to the development of NPF in conformity with National Forest Development Guideline.
- PFPs have potential to assume the role as land use planning of forest from both developmental and conservational aspects.
- All PFPs are expired now. Next NFP requires valid PFPs.



Developing revised PFP guidelines and formulating PFPs

Consistency PFP guideline and past PFPs



- In terms of the importance of PFP guidelines, PNGFA decided to review the guidelines 1995 for next NFP.
- The Project supports PNGFA to develop revised PFP guidelines and promote PFP formulation in harmony with UNDP/FCPF project.

Collaboration with UNDP/FCPF project

Developing revised PFP guidelines and formulating PFPs

Workshop Bialla for developing revised PFP in West New Britain Province

- WNB province launched formulation process of their next PFP in consultation with WNB Provincial Forest Management Committee and PNGFA, organized by UNDP/FCPF project.
- To enhance the ownership in WNB province, not only PNGFA but CEPA, CCDA and private sector participated this workshop and discussed the preferable status of next WNB PFP.
- It is expected that some functions in PNG-FRIMS would be utilized for next PFPs based on this role model in Bialla.

Options to utilize PNG-FRIMS

PFP formulation process

Future scenario for the better forest planning in PNGFA

- Assist in Planation Development Program (OPGPD)
- Enhance Provincial Government & Resource Owners ability to make wise decision on how to develop their forest resources
- Integrate NFI Information & Data to enhance Forest Management
- PNGFA to use PNG-FRIMS as a planning and decision making tools

Issues and Challenges

- Timely updating of Logged Over Information.
- Regular updating of Satellite images
- Over cutting by issuance of FCA
- Using Models (LCM) to predict future scenarios.

Acknowledgement

Dr. Ruth Turia for your leadership and vision, giving us elegant directions

Mr. Constin Bigol as the Project Coordinator (before promotion to Acting Director, Forest Development)

Mr. Ledino Saega for your coordination as acting Manager, Inventory and Mapping

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Dr. Gae Gowae for your leadership and lightening up our load

Fellow Colleagues

Finally to the Government, people of Japan , JICA Experts & KKC Team

Outline of Presentation

1. Objective
2. Activities of PNGF/JICA project
   - *Procument of equipments (vehicle,laptops, GPS/GIS/ UAV)*
   - *Development of Manuals for GPS/UAV/GIS*
   - *Trainings for field Officers*
   - *Formulation of Voluntary Guidelines*
3. Voluntary Guidelines
4. Importance of feedback (reporting format)
5. Future Challenges
6. Conclusion

Objective

- To improve the capacity in field inspection/monitoring for full implementation of LCoP/PMCP for sustainable forest management.

Project Activities-PNGFA/JICA

- Procurement of Equipments
- Development of database
- Development of Manuals
- Training of Field Officers
- Formulation of Voluntary Guidelines

Project Activities cont....

1. Procurement of equipment (WNB Area Office)

-Vehicles, GPS, GIS, Laptops, UAV, Computer set

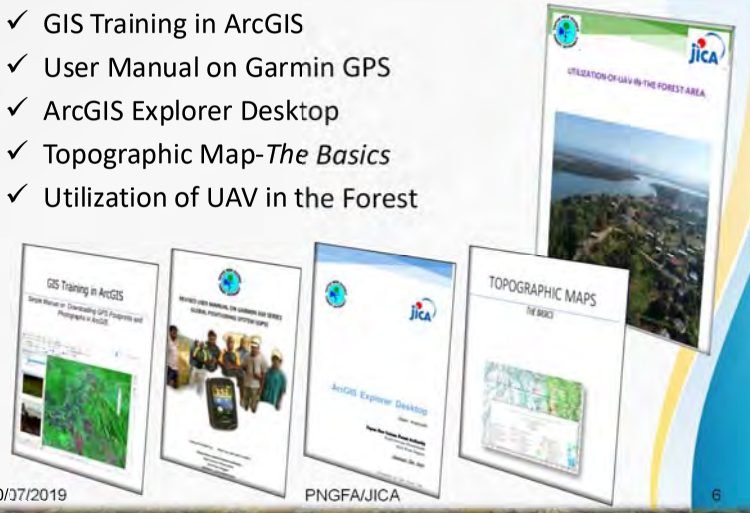
JICA EQUIPMENT PROVIDED THROUGH 1st & 2nd PROJECT

Product Name	Model/Serial No.	Units	Reference
Desktop PC Workstation		1	Grant Aid
CPU	Hewlett-Packard (HP)	1	Grant Aid
LCD Monitor	HP Compaq LA2405wg	1	″
Mouse	Hewlett-Packard (HP)	1	″
Keyboard	Hewlett-Packard (HP)	1	″
UPS	EATON 5110	4	″
A3 Scanner	Epson Expression 10000 XL	1	″
A3 Printer (Color)	HP Color LaserJet CP5525	1	″
Digital Camera		1	″
Laptop	HP Probook 6560b	1	″
External Hard Drive	ADATA HV620	1	″
GPS	Garmin Oregon 550	2	″
Length Tape (50M)	12-50HRW		″
Length Tape (100M)	12-100HRW		″
Diameter Tape(10M)	Million Diameter Tape	3	″
Densiometer	Item No. 27	1	″
Compass	Suunto A-30 Recreational	2	″
Rangefinder	Trimble 1000 rangefinder	1	″
Wedge Prism (BAF1)		2	″

Product Name	Details	Model/Serial No.	No. of Units	Reference
Vehicle		HZJ78-Trooper	1	2nd Project
Laptop PC	HP 250 G4	CND55236MG	4	2nd Project
Printer		Hewlett-Packard (HP)	1	2nd Project
External Hard Drive		Toshiba	1	2nd Project
GPS-1 (IS)	Garmin Oregon 650	30D064777	11	2nd Project
GIS Software	ArcView		1	2nd Project

2. Development of Manuals for GPS/GIS/UAV

- ✓ GIS Training in ArcGIS
- ✓ User Manual on Garmin GPS
- ✓ ArcGIS Explorer Desktop
- ✓ Topographic Map-*The Basics*
- ✓ Utilization of UAV in the Forest



3. Training for field Officers

Place	Session		Training Period (Days)	Participants (Trainees)	Man-Days	Contents				
	Month	Year				Training	Workshop	GPS	GIS	UAV(Drones)
Area Office - WNB*	March	2016	2	15	30	✓		✓	✓	
Provincial Forest Office - MBP	March	2016	3	6**	10	✓		✓		
Area Office - WNB*	June	2016	2	11	22	✓		✓	✓	
Headquarters	November	2016	3	22	66	✓		✓	✓	
Provincial Forest Office - WSP*	November	2016	3	8	24	✓		✓	✓	
Area Office - Momase	November	2016	2	6	12	✓		✓	✓	
Area Office - NGI	December	2016	2	6	12	✓		✓	✓	
Bulolo plantation	March	2017	3	10	30	✓		✓	✓	
Headquarters	April	2017	2	6	12	✓		✓	✓	
Headquarters/Kuriva	June	2018	10	13**	58	✓	✓		✓	✓
Provincial Forest Office - WSP*	October	2018	4	9**	34	✓				✓
Headquarters/Kupiano	February	2019	10	16	160	✓	✓		✓	✓
Area Office - WNB*	April	2019	1	11	11	✓				✓
Provincial Forest Office - WSP*	May	2019	5	3	15	✓			✓	✓
Total Number			52	114	496	14	2	9	11	5

** The place which includes pilot site of the project in its administrative jurisdiction.*
*** Trainees participated in the training in defferent days.*

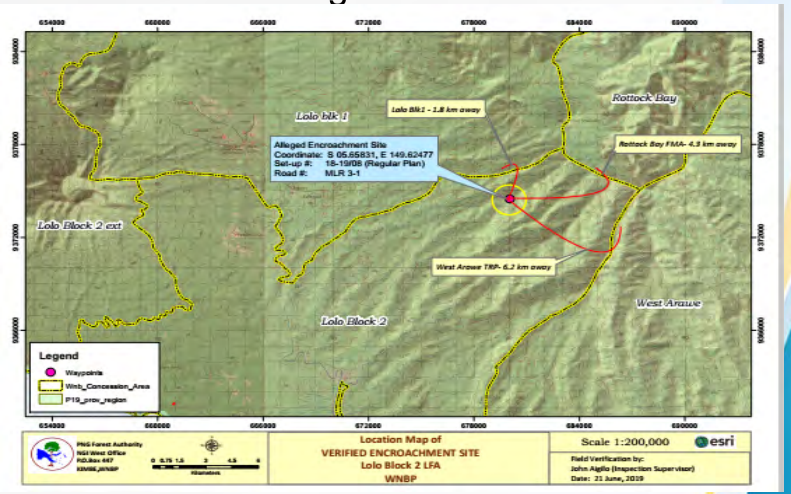
Field training on GPS/GIS through the PNGFA/JICA Project in West New Britain

First training on GPS/GIS-Kori-Ru TA Project

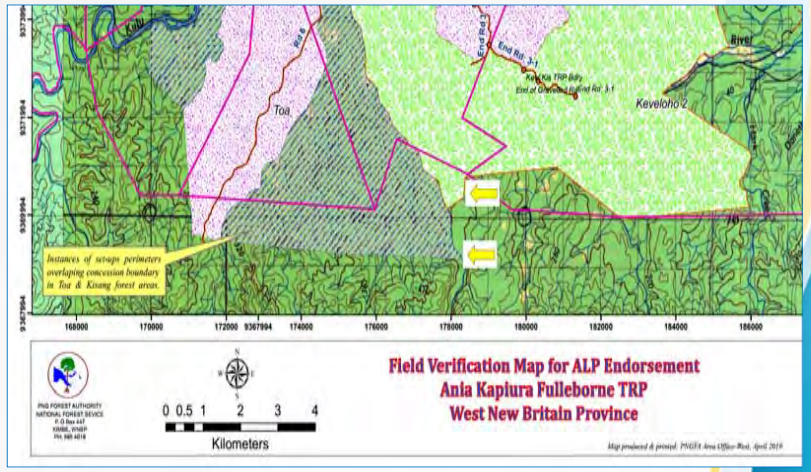
-11 GPS Issued to field officers
-4 laptops plus printer issued
-Training on GPS/GIS conducted at 2 different logging operation sites
-1 drone issued recently
-Latest training on drone conducted at Area Office-WNB

Second training on GPS/GIS-Rottock Bay FMA Project

Outcome of training in GPS/GIS



Field verification Set-up Boundary-AK Cons. TRP



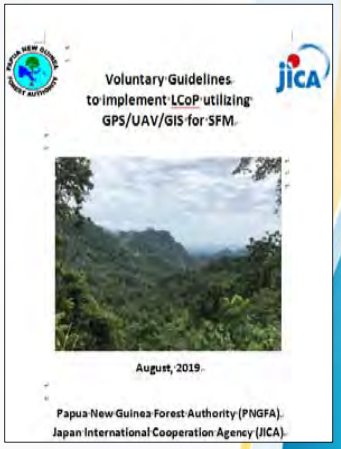
Field verification of Base camp- AVB3

Check category:	Base Camp Field Layout
Check No:	Two (2)
Check item:	Check consistency of the map plan with the field layout
Date checked:	03/10/2016
Checked by:	Peter Lat & Douglas Wutt

Applicant Planned Camp Area (ha):	5.2 Hectares	Verified Camp Area: (GIS/GPS)-PNGFA	8.742 hectares
Company's Coordinates		GPS/GIS Verified location	
No. Easting	Northing	No. Easting	Northing

4. Formulation of Voluntary Guideline

- Developed through the project specifically to support field officers utilize GPS/UAV/GIS to implement LCoP/PMCP
- Comprises 6 Sections
- Section 4 outlines four monitoring/analysing tools that field officers can utilize to efficiently monitor/inspect forest operations based on LCoP. These are new technology introduced to improve monitoring.



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Quick reference guide

Criterion 5: Forest Roads – Construction					
Practices		Tips	Applicability		
			other	GPS	Drones
5.1	Follow the survey road line during construction. Do not deviate from the line. If changes are required for practical reasons they should be approved by the PNGFA Project Supervisor.	*ALP, Advance Roadline & Set-Up Plan *Use of GIS	✓	✓	✓✓
5.2	The maximum cleared forest edge, to be cleared for roading should be felled directionally along the road corridor. To avoid canopy damage to the standing forest at the edge of the corridor. Minimize the amount of vegetation cleared during road construction to assist wildlife passage and minimize canopy clearance.	*ALP, Advance Roadline & Set-Up Plan *Use of GIS *Regular field monitoring	✓	✓	✓✓
5.3	Roadway and day lighting can almost always be accommodated within a maximum cleared edge to cleared edge width of 40m. Excessive road clearance does not enhance drying from the sun.	ALP, Advance Roadline & Set-Up Plan *Use of GIS *Regular field monitoring	✓	✓	✓✓

Importance of Reporting (Reporting format)

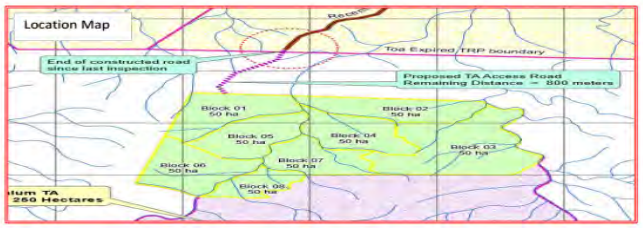
- Provide update on the progress of implementation LCoP and Annual Logging Plan
- Provides information on actual achievements compared to intended achievements.
- Assist identify significant deviations from LCoP/ALP as the basis for id of problems and opportunities.
- Recommend fo corrective actions for problems identified during monitoring.
- New information can be provided through reporting for the purpose of updating forest base map.

Sample of Report format

2.3b SET-UP CLOSURE(S)

Set-up No.:		Date Inspected:	*dd/mm/yy*
Gross Area (ha):		Date Closed:	*dd/mm/yy*
Net Area (ha):		Projected Vol. (m^3):	1000
No. Pieces:		Actual Harvest Vol. (m^3):	950
Trees/ha:		Difference (+/- 10 %):	-5.0
Stand Density (m^3/ha):	#DIV/0!	Corrective Action Taken:	*Yes/No*
Tot. Set-ups Logged (ALP):		Total Set-up Closed:	0

*Note; Formula for calc. +/_10% difference between projected volume & actual harvest volume is: [(AH/PV*100)-100], PV = Projected Volume, AV = Actual Volume.*

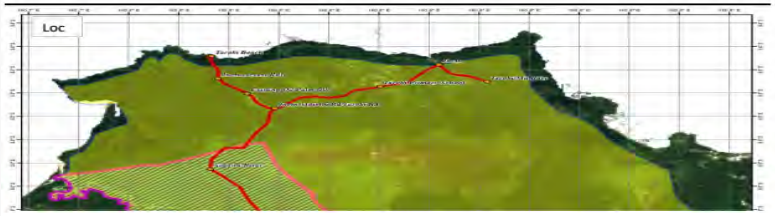


Cont.....

Roads #:		Water Crossing (#):	
Road Type:	MR/SR/VAR	W/Crossing Type:	LB/LC
Proposed Distance (km):		Proposed W/C (#):	
Actual Dist. Constr'd (km):		W/C Constr'd:	0
Status per TP Condition:	Yes/No	Status per TP Condition:	Yes/No

Note; MR = Main Road, SR = Spur Road, VAR = Village Access Road LB = Log Bridge, LC = Log Culvert

Total Dist.Constr'd (km):		Total W/C Constr'd:	#REF!
Tot. Planned Rd Dist. (km):		Tot. Planned W/Crossings:	0
Progre. Dist (km) this ALP:		Progre. W/C Built this ALP:	0
Distance Balance (km):		W/Crossings Balance (#):	0



cont....

KS # 07. Check that road compaction equipment (rollers) was used during road construction.	**KS # 08.** Check that roads follow surveyed road line during road construction.
	
Comments:	**Comments:**
KS # 9. Check that maximum cleared forest road width is 40m.	**KS # 10.** Check that there is no soil in streams from road construction or skid trails.
	 
Comments: NC #: (M/m)	**Comments: NC #: (M/m)**

Issues/Challenges

Logistics/Budget

- financial constraints
- lack logistic support
  - *Vehicle*
  - *Boat*
  - *House*
  - *Basic Instruments*
  - *Computers/printers*
  - *Documents (KS/LCoP/PMCP) for monitoring logging operations*

Technical Knowledge

- gaps in technical knowledge
- indicators to measure during monitoring
- knowledge of LCoP, PMCP, KS etc..
- collect, prepare, interpret, and include in reports

Risk management

- Identify risk involved with use of new monitoring tools
- Set rules for safe operation and maintenance of tools or equipments
- develop guidelines for use of equipments

Conclusion

- PNGFA/JICA project has done alot in terms of building capacity for enhancement forest monitoring system for SFM.
- PNGFA to continue what the project has started, identify the weakness/constraints, provide sufficient financial and logistic support.
- PNGFA conduct more training (inhouse) for field officers and provide the necessary tools and logistics needed for forest monitoring.

End of Presentation

Drone Application for Forest Inspection in PNG Forest Authority

18th July 2019
Steven Saki

Venue: Hilton Hotel – Port Moresby

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

Presentation Outline

- ❑ Objective of Introducing drone by PNGFA/JICA
- ❑ Current Progress of Drone Application
- ❑ Comparison of Drone Usage with other methods to implement Logging Code of Practice (LCoP)
- ❑ Examples of Drone Utilisation in field monitoring (Amanab Blk 1-4 FMA & Kupiano)
- ❑ Examples of Drone Utilisation in the Field (Bewani Oil Palm)
- ❑ Limitations of Drone Usage
- ❑ Conclusion

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

Objective of introducing Drones by PNGFA/JICA

1. To assist PNGFA and field officers for forest monitoring and inspection.
2. The priority areas are;

a) Natural Forest Monitoring
b) Forest Plantations Monitoring
c) Forest Research

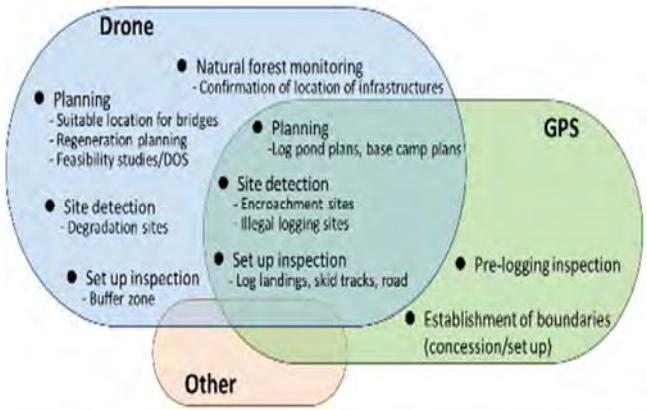
Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

Current Progress with Drone Applications by PNGFA/JICA

- ❑ Workshop/ Training conducted at PNGFA HQ
  - Software's, drone flight test, maps, flight plans
- ❑ Field demonstration conducted at;

a) Kuriva Plantation
b) Kupiano
c) Pilot Project sites in WNP and WSP

Comparison of Drone Usage and other Methods to implement Logging Code of Practice (LCoP)



Examples of drone utilization in field monitoring– Amanab Blk 1-4 FMA (Set- Up MU 83 – Pre-logging Inspection)

- ❑ Check streams/rivers during pre-logging inspection with drone.
- ❑ In this case, there is no stream/river.

Examples of drone utilization in field monitoring (Amanab Blk 1-4 FMA - Set-up UT 110 – Active Logging

- ❑ Felling gaps in the forest satisfactory.
- ❑ There is no much forest disturbances.
- ❑ Road width adequate.
- ❑ Road gravelled.

Examples of drone utilization in field monitoring (Kupiano - Set-up 04 – Active Logging)

Log Landing

- ❑ Log landing area sufficient
- ❑ Logs stock piled on the log landing

Examples of drone utilization in field monitoring (Amanab Blk 1-4 FMA – Set – up UT 98 - Post Logging Inspection)

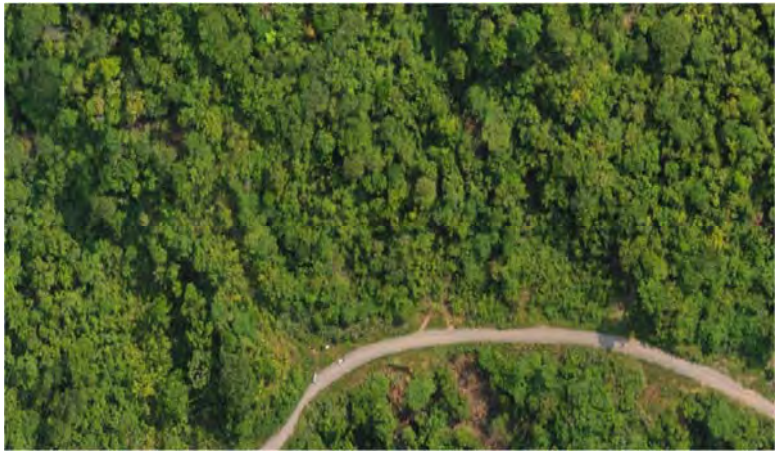
- Image captured after 7 months.
- Regeneration of the area is satisfactory.
- This can be compared with photo taken during active logging

Logging Set-up Comparison with Drone Image Amanab 1-4 FMA (SU UT98 – Active Logging & Post Logging)

Logging Set-up Comparison with Drone Image Amanab 1-4 FMA (SU UT98 – Active Logging & Post Logging)

- Active logging ortho image was taken in 2018
- Post Logging ortho image was taken after 7 months (2019)
- After 7 months, regeneration in set up UT 98 can be said to be satisfactory.
- The forest can be quickly retained within a year after selective logging.

Ortho Image of Logging area after 10 years in Amanab Blk 1-4 FMA – Regeneration



Examples of drone utilization in field monitoring (Bewani Oil Palm Audit Reporting – Courtesy of Jehu Antiko)

Drone can be used to check buffer zones for rivers/streams in the plantation areas

Examples of drone utilization in field monitoring (Bewani Oil Palm Audit Reporting – Courtesy of Jehu Antiko)

- Drone ortho image showing areas cleared but not planted with oil palm
- The management can take appropriate action to re-clear the area and plant oil palm.

Limitations of Drone Usage

1)Law and regulation (PNG)

- Use of drone can be blocked/delayed by the military even if there are no regulation

2) Cannot fly in rain and windy weather

– Wind speed should be under 5 m/s

3) Not suitable for obtaining data for large area

– Flight time around 20 minutes and distance 500~700 m

4)Takes time for image analysis after shooting

– Number of the image is a lot, as the imageries of small range is obtained in high resolution

5) Only be able to obtain information from the above

6) Information of the small trees and underground vegetation cannot be obtained in the dense forest

7) Requires open space for take off and landing

8) Risk of crashing down and losing

9) Requires repairs and maintenance

Conclusion/Summary

- Testing of drone application in natural forest monitoring proves to be successful and way forward.
- Drones can be further used in forest plantation inspection and research.
- PNGFA/JICA through the capacity building program to continue to ensure all field officers are trained.
- PNGFA to acquire some more drones for each provincial offices to enhance field officers capacity for monitoring.
- GPS/GIS to complement drone application.

Thankyou All!!

Potential in Papua New Guinea to estimate carbon emissions from forest degradation caused by logging based on field methods (by using PNG-FRIMS)

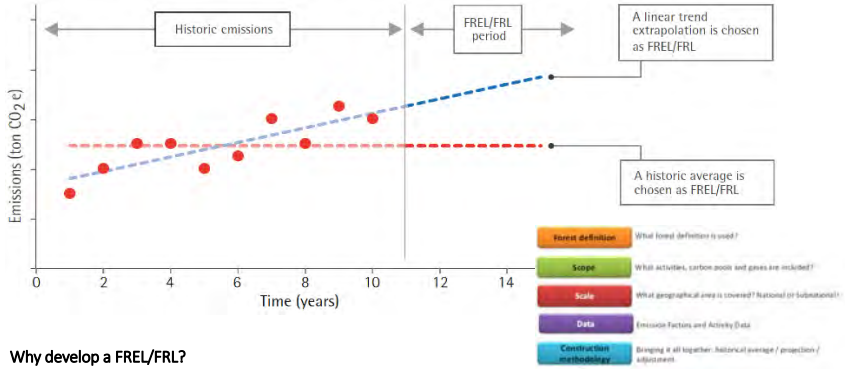
PNGFA JICA project seminar
18 of July 2019
Ms. Elizabeth Kaidong
PNG Forest Authority
Policy and Planning Directorate
REDD & Climate Change team

Background & Purpose

- **Timber production in Papua New Guinea** (PNG) is a key sector of the national economy but also one of the main sources of forest degradation.
- **Estimate the impact of activities in forest is important** because PNG is actively involved in
  - ➢Sustaining its forest resources,
  - ➢Addressing impacts from the sector,
  - ➢Attracting sustainable investments.
- **Carbon stock is a good indicator of impacts** and past emissions were estimated to make projections in FRL (Forest Reference Level).
- **To build the current FRL,** PNG assessed degraded areas by Remote Sensing analysis. These areas may also include post-logging emissions (from fire, gardening, etc.) and removals from regrowth because measures were taken in different times after logging (1 to 10 years).
- **Further FRL in some countries** estimated forest degradation by measuring the impacts directly and solely linked to harvesting practices which are observable in sites right after operations.
- **Most of information on logging impacts is actually available in PNGFA** from daily activities of monitoring so there is a potential to utilize field records for carbon monitoring.

Forest Reference Level (FRL)

Forest Reference Emission Level and Forest Reference Level (FREL/FRL) are **benchmarks** for assessing the performance of implementing REDD+ activities.



Why develop a FREL/FRL?

1. **Domestic purpose**: Assess effectiveness of PAMs &/or meet a national objective
2. **Global responsibility**: Demonstrate national contribution to mitigation of climate change
3. **Results-based REDD+ finance**: For reducing emissions below a certain level

Background & Purpose

PNG has prioritized to improve the compliance of timber extraction with PNG's Logging Code of Practice. Different supports from the JICA Project aims at facilitating the monitoring of field operations:

- ➢ Improvement of spatial information in PNG-FRIMS database
- ➢ Development of monitoring capacities for using satellite images, GIS software, GPS and drones.

Among LCOP items many parameters are linked with carbon levels (Roads, collateral damage…)
=> So improving capacities to monitor LCoP can facilitate carbon monitoring

Considering features of field methods to estimate logging impact on forest carbon for future PNG's FRL and further purposes linked with forest management.

Methodology

Methodologies recommended by IPCC

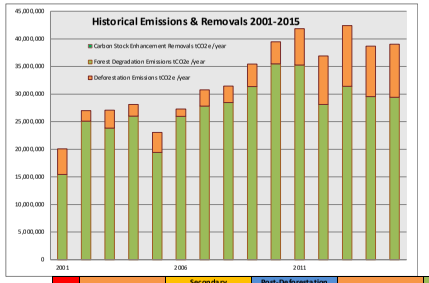
There are two main methodologies to estimate logging impact on forest carbon (GOFC-GOLD, 2016):

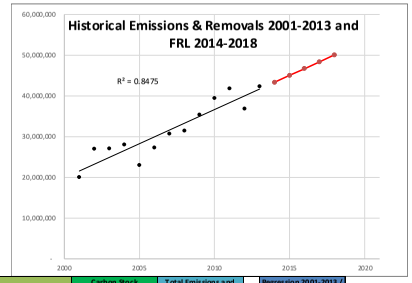
1. The Remote sensing (RS) method using medium-resolution imagery for determining Activity Data (AD) and the Stock-Change method for calculating Emission Factor (EF)
2. A combination of timber extraction rates, management plans and/or high-resolution imagery (for AD) and the Gain-Loss method (for EF).

Methodologies developed in FRLs

1. Many FRL countries opted for Method 1. This choice was facilitated by open sourced 30 m resolution images. In PNG, **RS** was applied to determine AD of both deforestation and forest degradation.
2. Four countries (*the Republic of Congo, Ghana, Guyana and Suriname*) chose the **Volume Method** (VM), to count direct loss in the ground associated to extraction. Measures to be taken as soon after harvest.

The Remote Sensing method: example in PNG





Years	Primary Deforestation	Secondary Deforestation	Post-Deforestation Regrowth	Deforestation	Forest Degradation	Carbon Stock Enhancement	Total Emissions and Removals 2001-2013	Regression 2001-2013 / FRL 2014-2018
	Emissions	Emissions	Removals	Emissions	Emissions	Removals	Emissions & Removals	Emissions & Removals
	tCO2e /year	tCO2e /year	tCO2e /year	tCO2e /year	tCO2e /year	tCO2e /year	tCO2e /year	tCO2e /year
2001	2,067,030	2,721,258	165,272	4,623,017	15,441,146	-	20,064,162	21,492,824.59
2002	-	2,189,016	277,525	1,911,491	24,952,653	-	26,864,144	23,135,270
2003	1,633,740	2,030,276	414,734	3,249,282	23,834,478	-	27,083,761	24,777,716
2004	1,951,160	691,861	511,867	2,131,153	25,602,243	-	27,733,397	26,420,161
2005	2,090,426	2,202,716	656,727	3,636,414	19,272,288	-	22,908,702	28,062,607
2006	-	1,838,795	740,296	1,098,500	25,960,659	-	27,068,159	29,705,052
2007	2,043,601	1,771,267	878,143	2,936,725	27,593,488	-	30,530,213	31,347,498
2008	2,662,314	1,367,741	1,015,677	3,014,378	28,145,718	-	31,160,096	32,989,944
2009	1,871,909	3,389,611	1,214,349	4,047,172	31,078,554	-	35,125,726	34,632,389
2010	2,715,841	2,713,741	1,408,035	4,021,547	35,312,006	-	39,333,554	36,274,835
2011	4,712,034	3,641,949	1,735,812	6,618,171	34,760,737	-	41,378,908	37,917,280
2012	3,740,834	7,208,970	2,151,678	8,798,126	27,678,049	-	36,476,175	39,559,726
2013	6,820,550	6,892,420	2,706,436	11,006,534	30,783,944	-	41,790,478	41,202,172
2014								42,844,617
2015								44,487,063
2016								46,129,508
2017								47,771,954
2018								49,414,399

The Volume Method (VM): as developed by Pearson et al. (2014)

Net emissions	=	Activity Data	x	Emission Factor
Emissions from industrial timber production tCO2e		Extracted volumes m3		Biomass loss associated to timber extraction activities tCO2e/m3

- **Activity Data**: use actual harvested volume data with following characteristics:
  - ✓ Complete ⇔ Covering all production areas
  - ✓ Accurate ⇔ From reliable monitoring
  - ✓ Transparent ⇔ From reliable sources
  - ✓ Consistent ⇔ Over more than 10 years
- **Emission Factor**: account all emission sources related to log harvest

Sources of emission	Monitoring parameters
ELE (extraction)	Extracted/harvested log
LDF (collateral damage)	Wasted logs, Deadwood (DW) caused by felling
LIF (Road & Infra)	DW (or carbon loss) from skidding; Carbon loss from roads, log ponds, decks, camps

Total Emission Factor (TEF) = Extracted Log (ELE) + Logging Damage (LDF) + Logging Infrastructure (LIF)

POTENTIAL IN PNG TO USE THE VOLUME METHOD

Potential in PNG to determine AD

Timber extracted volumes are recorded in the Field Services Directorate (FSD) database for all provinces, projects and since 2000 (digitized from 2010).

Harvested volume data in PNGFA

Data on harvested volumes in Setup scaling sheets

Potential to provide AD accurate, complete and consistent

Conditions	PNG potential	Explanation
All concessions	Yes	All projects followed by supervisors
National scale	Yes	Provincial & regional production reported to central database
Annual data	Yes	Annual reports
Period of > 10 yr.	Yes	2000-2018 (data digitized from 2010)
Reliable sources	Yes	PNGFA official records
Accuracy	Yes	Review by PNGFA supervisors, operators and landowners => Possible errors estimated at 5% (FSD Pers. Comm.)

POTENTIAL IN PNG TO USE THE VOLUME METHOD

Potential in PNG to calculate EF

Information on collateral damage is recorded in setup logbooks (but not in database) except for skid track areas and felling deadwood.

Sources of degradation		Data (unit)	Documents
Logging infrastructure Factor	Forest clearance for roads	- L, W, Area (ha) - Merchantable volume (m3)	- Setup logbook - Setup scaling sheet
	Forest clearance for log decks	- L, W, Area (ha) - Merchantable volume (m3)	- Setup logbook - Setup scaling sheet
	Forest clearance for skid trails	- L, W, Area (ha) - Merchantable volume (m3)	- NO RECORD - Setup scaling sheet
Logging Damage Factor	Felling	Felling deadwood	NO RECORD
	Wasted log pieces	Stump, top, buttress (m3)	Post harvest assessment (if available)
Extracted Log Emission	Log extraction	Merchantable log volume (m3)	Setup scaling sheet and DB

POSSIBLE UTILIZATION FOR FUTURE FRL

Simulation of AD

=> Sort out Volumes according to origin of timber

Assumption

+ TRP/LFA and FMA volumes => **Forest degradation**

+ FCA volumes => **Deforestation** (assuming all FCA areas clear cut*) (underestimation of total emissions but conservative)

+ TA volumes => Not counted

*: **Clear cutting volume and selective logging volume coming from FCA area are not distinguishable in FSD database.**

=> Activity Data in the Volume Method = Total annual actual timber harvested volumes

Year	2010	2011	2012	2013	2014	2015	2016	2017
AD (Million m3)	3.11	2.65	2.6	2.79	3.29	3.64	2.28	3.45

Simulated AD based on extraction 2010-17 (FCA excluded). Source: FSD

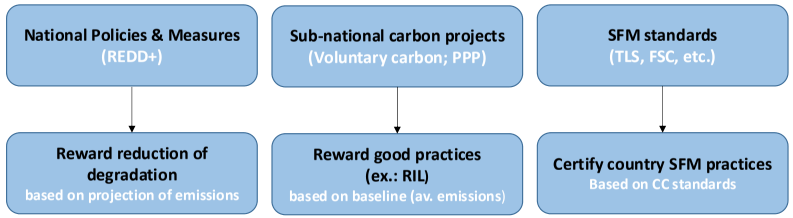
POSSIBLE USE FOR FOREST MANAGEMENT / REDD+

Information produced from the development of the Volume method in a country

- **VOLUME DATASET**: trends in the timber production can be used for general purpose of forest management including AAC (Annual Allowable Cuts) and province extraction rates.

- **LOGGING EF** ⇔ Environmental (carbon) efficiency of harvesting practices
  - ✓ Compare sustainability between countries, provinces or concessions (develop several EFs)
  - ✓ Differentiate environmental/carbon efficiency between conventional and improved practices
  - ✓ Use as tool to give incentive to logging operators for their improvement in practices

Context of utilization of values of emission estimated by field methods



Way Forward

Key findings

- Volume Method (VM) is specific to forest degradation (method different than for deforestation) and specific to logging (not including other drivers in logged areas)
- FSD volume data can be used to determine PNG's logging AD. A country-specific logging EF can be developed based on PNGFA information available from routine forest monitoring and a full sampling plan.
- Most of data required are available in PNGFA (at least not less than in the four FRL countries cited along this report)
- Challenging information types are deadwood from felling and skid track extent areas. These could be addressed through field inventory or new technologies introduced by JICA such as drones.
- Outcomes such as values of Emission, EFs and volume datasets are useful for forest management.

Way Forward

Main constraints

- The Volume method does not cover post-logging regrowth, and degradation (illegal logging, gardening, fire…)
- Capacity and availability of technical experts for developing EF
- Limited scientific publications on logging emission sources

Next steps

- Complementary review of guidance and FRLs to consider regrowth and post-logging degradation with the Volume Method
- Develop technical support by promoting Forest Research notably to make a Logging EF
- Further develop methods of monitoring notably for estimating skidding and coll. damage such as drones
- Rapid operationalization of DSS to improve management of actual harvested volume.

JICA-PNGFA Forestry Project 2014-2019 - Fact Sheet No.1

2014 – 2019

JICA-PNGFA PROJECT Outline

Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change

The Project

Overall Goal : Forests in PNG are conserved and managed in a sustainable manner, while at the same time, mitigation and adaptation measures against climate change are promoted.

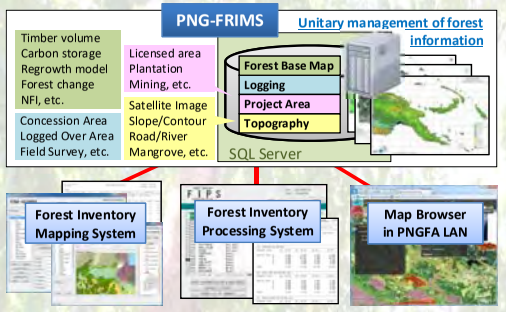
Project Purpose : Capacity of the PNGFA to continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.

Output 2
The national forest plan, provincial forest plans, forest management plans and their monitoring system are improved through steady operation of PNG-FRIMS.

Outputs -Acheivements

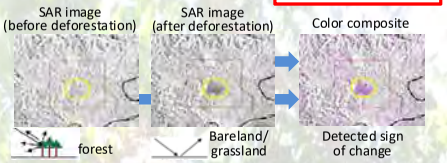
Output 1 — Expanded PNG Forest Resource Information Management System (PNG-FRIMS)

Updated the Forest Base Map and logging info, and added topography related info in PNG-FRIMS DB.



ALOS-2 (launched in May 2014)

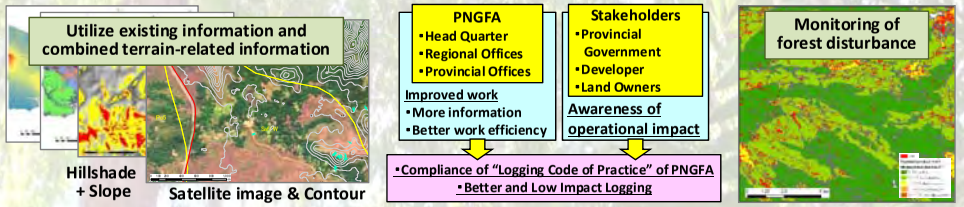
Forest Change Monitoring by Analysis Combining ALOS-2, Logging Plan, Existing Database System, etc.



Output 2 — Improved National Forest Plan, Provincial Forest Plans, Forest Management Plans and Their Monitoring System through steady operation of PNG-FRIMS

Possible pproach for improving forest management and planning assessed

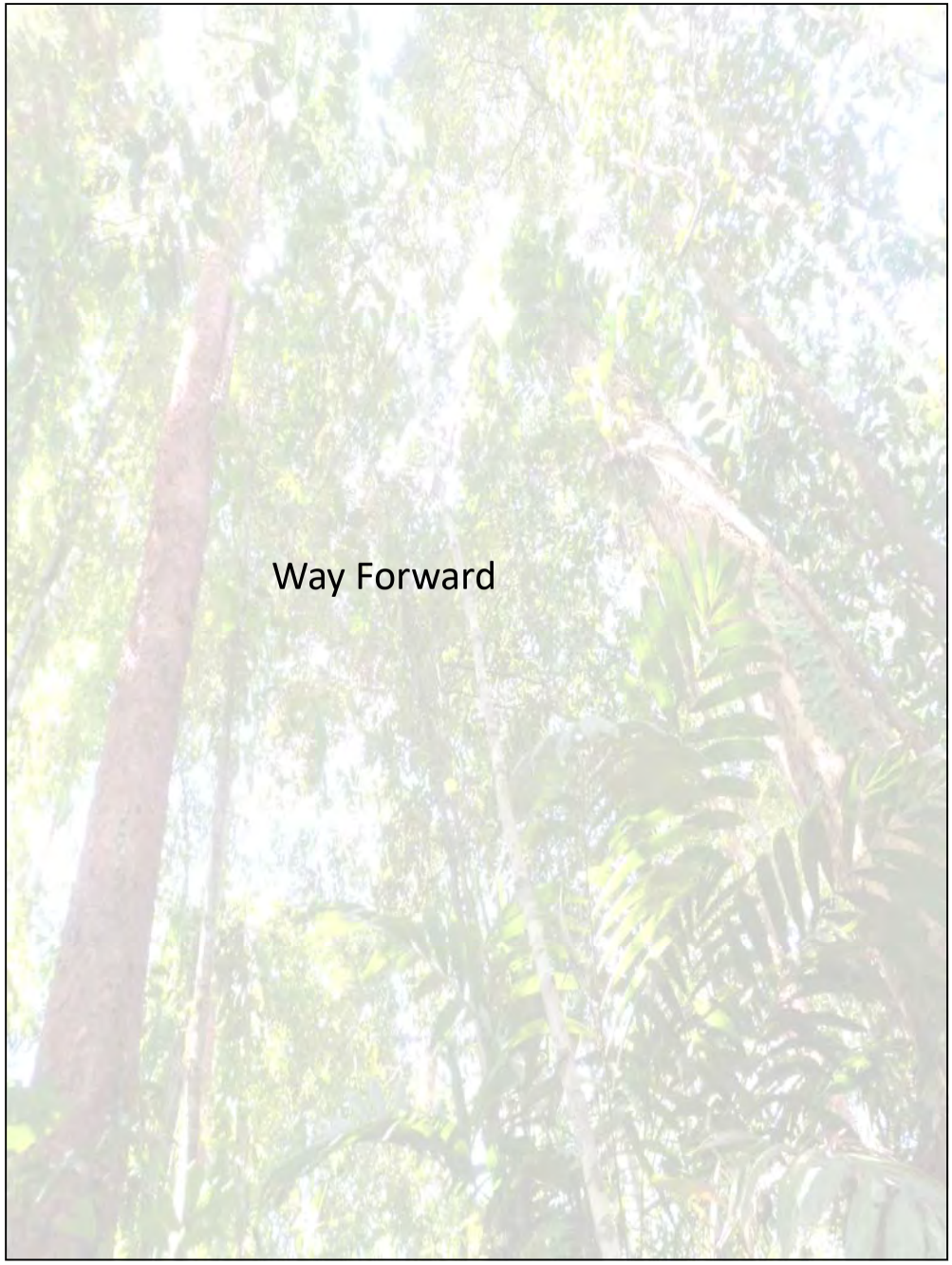
Improvement and Utilization of Forest Base Map and Forest Database for Forest Management and Planning



Output 3 — Forest Information for Addressing REDD+

Information provided for activities of other donors and stakeholders

Support for (1) National Forest Inventory, (2) REDD+ International Report, and (3) Forest Conservation Implementation and Administration

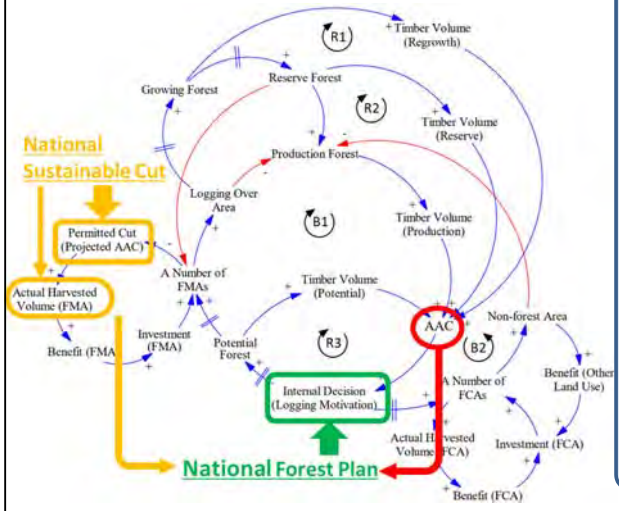


Information in PNG-FRIMS

Logging Concession Information	Concession Area, Logged Area, Planned Area , Buffer zone Topographic info: Logging road, River/ Stream, Contour Facility info: Bridge/ Culvert, Campsite, Gravel pit, Log landing, Building, etc.
Constraints and Land Use	Social condition: FCA (Forest Clearing Authority), Plantation, Protected Area, Mining operation area Natural condition: Slope (Extreme/ Relief), Altitude (Extreme), Karst, Inundation (Extreme/ Serious), Mangrove
Forest Base/ Cover Maps	Data: Forest Base Map 1.1 (2012) Time-series forest cover maps (2000/ 2005/2011) (WNB/ WSP, as of 15th Nov 2017) Forest cover map 2015 (benchmark map) Old vegetation (FIMS Forest Mapping Unit) Collect Earth Landuse change Assessment (Point Sampling) PSP (Permanent Sample Plots) ©FRI (Forest Research Institute) PINFORM (PNG International Tropical Timber Organization Natural Forest Model) ©FRI Attributes: Vegetation area, Tree crown size, Forest Zone, Timber volume, Carbon stock, Degradation driver,
Base/ Topography	Satellite imagery: RapidEye (2011), Landsat AGP (1990/1995/2000/2005/2010/2011/2015), PALSAR (2010/2011) Topomap (scale = 1:100,000, Raster) Topography: 5m mesh Digital Elevation Model (Airborne Radar in 2006 from National Mapping Bureau) Hillshade, Slope, Contour (10m), Watershed (made from GeoSAR) Global Dataset: Hansen data (Tree cover loss/ loss year/ gain) Main road (time-series), River, Incorporated Land Group and Clan boundary/Settlement/ Local Level Government & District boundary/ Province-Region boundary (PNG Census 2000 and 2011)

AAC calculation and its application for forest planning in PNG

The role of AAC in forest planning in PNGFA



- Decision making for future development of the project and demarcating between forest (FMAs) and non-forest (FCAs) is dominated by only NFP, and AAC provides estimated timber volume with NFP.
- Permitted cut with subsequent Actual Harvested volume should be monitored under National Sustainable Cut to be checked its sustainability in practical logging phase.
- Permitted Cut with Actual Harvested Volume supports forest planning as an indicator of potential and practical logging operations.
- To utilize both NFP with AAC for forest planning and Permitted cut with Actual Harvested Volume for controlling logging operations as wheels of a car promotes sustainable forest management.

POSSIBLE USE FOR FOREST MANAGEMENT / REDD+

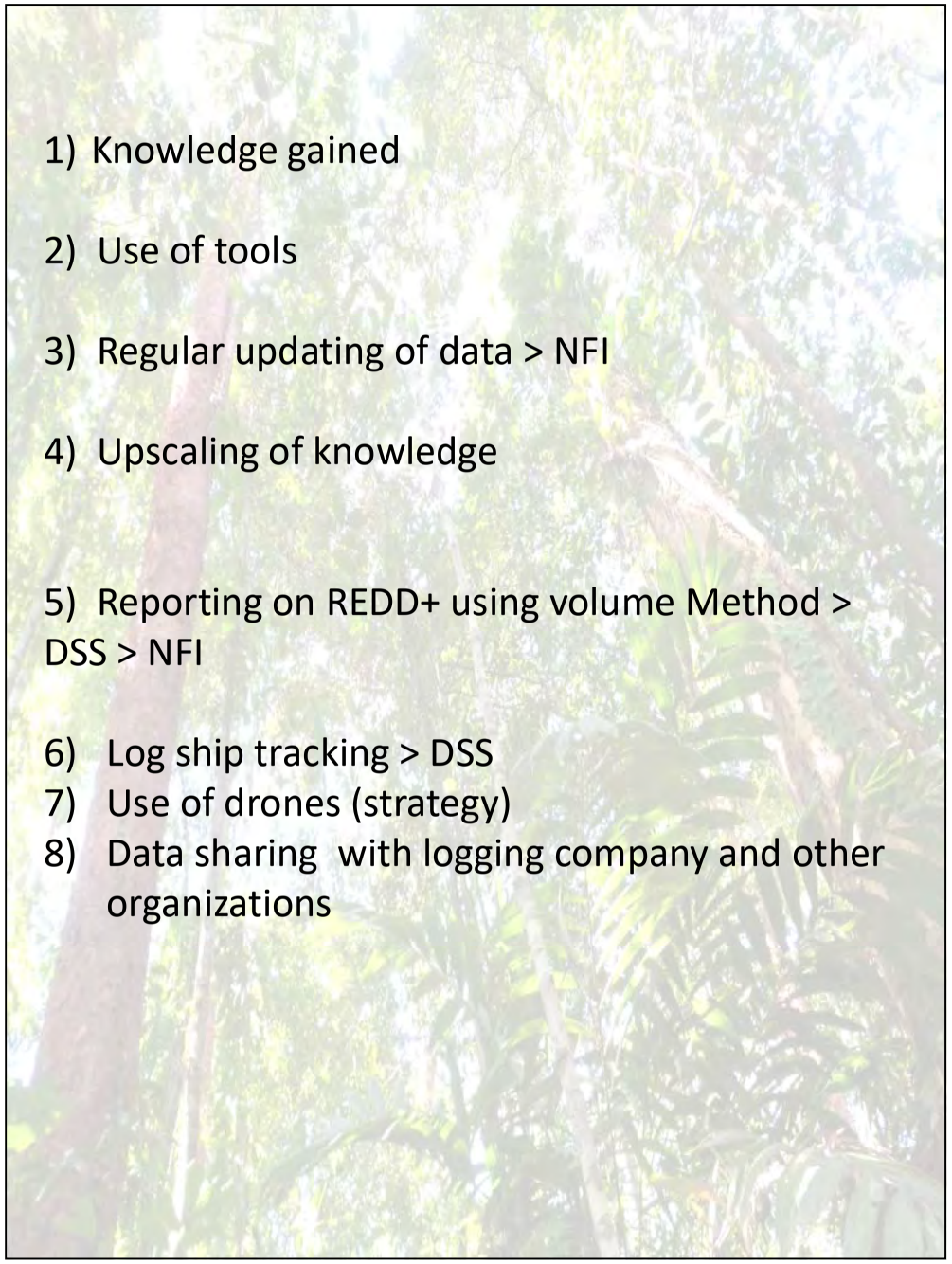
☐ Information produced from the development of the Volume method in a country

- **VOLUME DATASET**: trends in the timber production can be used for general purpose of forest management including AAC (Annual Allowable Cuts) and province extraction rates.

- **LOGGING EF** ⇔ Environmental (carbon) efficiency of harvesting practices
  - ✓ Compare sustainability between countries, provinces or concessions (develop several EFs)
  - ✓ Differentiate environmental/carbon efficiency between conventional and improved practices
  - ✓ Use as tool to give incentive to logging operators for their improvement in practices

☐ Context of utilization of values of emission estimated by field methods

National Policies & Measures (REDD+)	Sub-national carbon projects (Voluntary carbon; PPP)	SFM standards (TLS, FSC, etc.)
↓	↓	↓
Reward reduction of degradation based on projection of emissions	**Reward good practices (ex.: RIL)** based on baseline (av. emissions)	**Certify country SFM practices** Based on CC standards



1) Knowledge gained

2) Use of tools

3) Regular updating of data > NFI

4) Upscaling of knowledge

5) Reporting on REDD+ using volume Method > DSS > NFI

6) Log ship tracking > DSS
7) Use of drones (strategy)
8) Data sharing with logging company and other organizations

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

Forest Resource Information Management System (PNG-FRIMS)

Overall Goal : Forests in PNG are conserved and managed in a sustainable manner, while at the same time, mitigation and adaptation measures against climate change are promoted.

Project Purpose : Capacity of the PNGFA to continuously update forest information and to fully operationalize and utilize PNG-FRIMS for promoting sustainable forest management and for addressing climate change is enhanced.

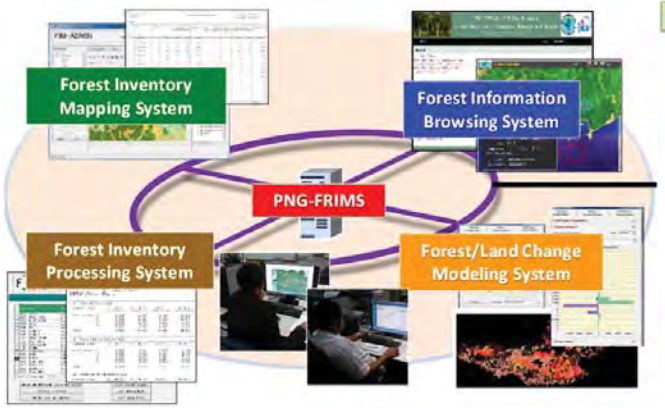
Output 1
PNG-FRIMS is expanded and enhanced

PNG Forest Resource Information Management System (PNG-FRIMS)

Output 3
Forest information for addressing REDD+ is prepared

Output 2
The national forest plan, provincial forest plans, forest management plans and their monitoring system are improved through steady operation of PNG-FRIMS.

Improvement of Forest Management and Administration



LAN (Local Area Network) Map Browser

Overview:
- Sharing forest information stored in PNG-FRIMS database within PNGFA and promoting its utilization for PNGFA's daily activities.
- Authorized users can see thematic maps through a Web Browser without special software.

Basic functions:
- Turn forest info on and off on the map.
- Search for location/ point of interest.
- Measure length or area on the map
- Sketch simple graphics on the map.
- Print visible displayed map.
- Show attribute info of each graphics.
- Switch background maps (satellite imageries, topographic maps, etc.).
- Develop and add processing functions.

Output 1 Enhanced PNG Forest Resource Information Management System (PNG-FRIMS)

Progress : Enhanced Forest Base Map (national), Progressing Time-series Forest cover Maps & Future Model (2 province), Classifying Forest Disturbance, Creating Logging Roads (5 years), Demonstrating Land Change Modeling using FRIMS

Output 2 Improved National/Provincial Forest Plans, Management Plan/Monitoring System

Progress : Considered utilization of PNG-FRIMS for forest planning/management, monitoring activities through trainings

Output 3 Prepared/Identified Forest Information for addressing/contributing-to REDD+

Progress: (1) Contributed to National Forest Monitoring System & Reference Level (2) Identified potential area for REDD+

Logging Concession Information	Concession Area, Logged Area, Planned Area , Buffer zone Topographic info: Logging road, River/ Stream, Contour Facility info: Bridge/ Culvert, Campsite, Gravel pit, Log landing, Building, etc.
Constraints and Land Use	Social condition: FCA (Forest Clearing Authority), Plantation, Protected Area, Mining operation area Natural condition: Slope (Extreme/ Relief), Altitude (Extreme), Karst, Inundation (Extreme/ Serious), Mangrove
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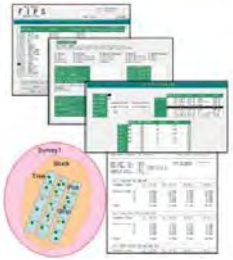
Base/ Topography	Satellite imagery: RapidEye (2011), Landsat AGP (1990/ 1995/ 2000/ 2005/ 2010/ 2011/ 2014/ 2015), PALSAR (2010/ 2011) Topomap (scale = 1:100,000, Raster) Topography: 5m mesh Digital Elevation Model (Airborne Radar in 2006 from National Mapping Bureau), Hillshade, Slope, Contour (10m), Watershed (made from GeoSAR) Global Dataset: Hansen data (Tree cover loss/ loss year/ gain) Main road (time-series), River, Incorporated Land Group and Clan boundary/Settlement/ Local Level Government & District boundary/ Province-Region boundary (PNG Census 2000 and 2011), etc.

Forest Timber Volume Estimate (upgraded FIPS and FIMS)

FIPS (Forest Inventory Processing System)



Overview:
- FIPS estimates the timber volume of the expected logging project area based on the data of the inventory survey.
- The estimated volume is to be used to determine an annual allowable cut of timber volume for the expected logging project.

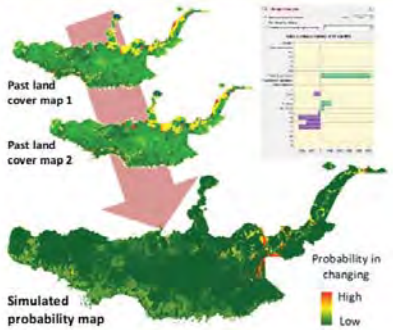
Basic functions:
- Enter survey information and assessment data from field books (including species, diameter and length etc.)
- Edit and process assessment data
- Produce survey result and printout as summary report
- Import assessment data from Excel file into FIPS, and Export the Result of processed data from FIPS into Microsoft Excel format

FIMS (Forest Inventory Mapping System)

Overview:
- FIMS calculates the potential timber volume in any level of area such as national, provincial and logging project.
- The volume is calculated using forest type per unit timber volume and to be adjusted by logged volume data.
- The volume estimate is to be utilized to develop forest plans (National/Provincial forest plan).

Basic functions:
- Manage not only planned and operational concession boundaries but also logged over areas reported by logging companies.
- Import assessment data from FIPS and show strip lines on map, which were used for surveys and timber volume processed by FIPS.

LAN (Local Area Network) Map Browser



Overview:
- Analyzing chrono-sequential spatial data including forest information, future land change (such as deforestation) and simulate probability in each location.
- This system uses Land Change Modeler, which is a product of Clark Labs, Clark University, USA.

Basic functions:
- The results of the simulation is useful for developing policies such as provincial forest plans and action plan of the national REDD+ strategy.
- Evaluation of the model is needed for utilization of the results.

Updating and Enhancing Forest Resource Information: Forest Cover Map 2015

Introduction

Background / objectives

The Forest Base Map 2012 was developed in the JICA PNGFA Project 2011-2014.
In the JICA PNGFA Project 2014-2019, the Forest Base Map was revised and enhanced, and the approach of updating forest cover map was examined.

Outputs

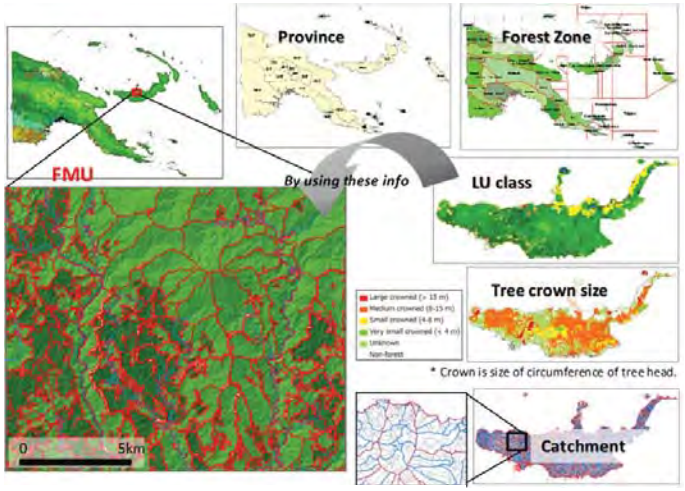
- **Forest Base Map 2012** (ver. 1.1, revised version)
- **Forest Cover Map** of **WNB** and **WSP** in the past (**2000, 2005**)
- **Forest Cover Map 2015** of entire **PNG**
- **New information** was added into the map attributes: **sub-vegetation type**, tree crown size, Forest Zone, catchment (watershed), forest cover gain, forest cover loss and loss year, **degraded driver**, **timber volume**.
- **FMU (Forest Monitoring Unit)** was set/updated in the maps from FMU (Forest Mapping Unit) for monitoring forest resource.
  * FMU: minimum base units of the map.
- The **manual** of updating forest base map was developed.
- The **capacity** of updating forest base map was developed and enhanced in PNGFA.

Impact / for the future

- Forest cover map of PNG shall be updated every five years after the Project.
- FMU can be utilized for calculating re-growth volume, combined with record of the logging history of logged over area.

Forest Cover Map 2015

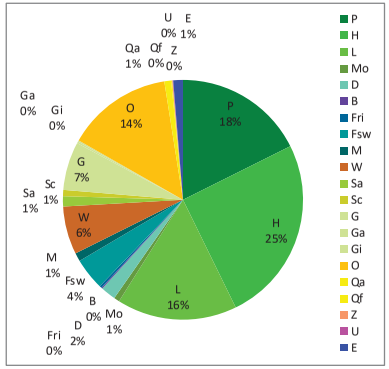
Forest Monitoring Unit (FMU)

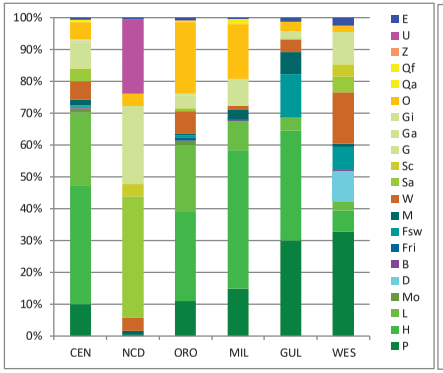


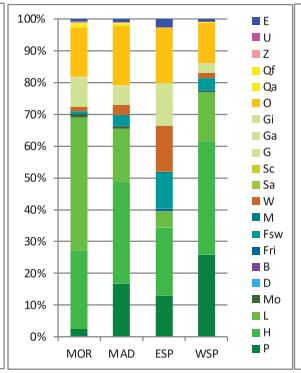
Forest Cover Map 2015: Vegetation Type Area (ha) x Province

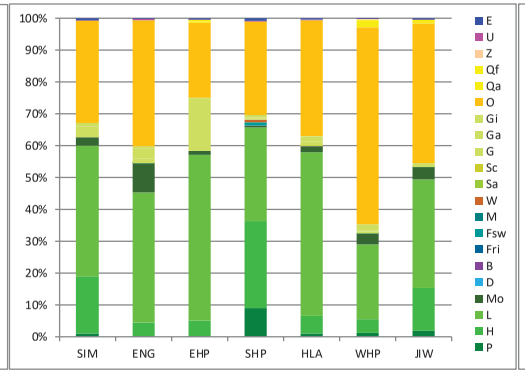
* Islands outside PNG, which are located to the south of WES and ARB, are removed.

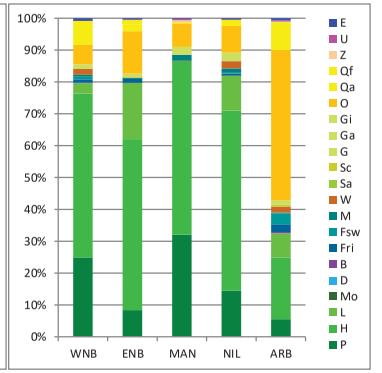
	VEG	VEGNAME	SUM	CEN	NCD	ORO	MIL	GUL	WES	MOR	MAD	ESP	WSP	SIM	ENG	EHP	SHP	HLA	WHP	JIW	WNB	ENB	MAN	NIL	ARB
	P	Low Altitude Forest on Plains & Fans	8,133,318	291,297	86	250,148	209,617	1,037,288	3,219,315	83,273	487,257	561,207	929,227	6,636	2,616	2,073	136,408	12,307	5,937	8,890	509,372	128,978	62,107	137,337	51,942
	H	Low Altitude Forest on Uplands	11,603,863	1,100,915	32	632,574	616,187	1,199,609	628,310	829,418	921,453	943,443	1,282,150	109,872	49,428	56,311	411,192	56,573	18,167	64,456	1,045,668	821,476	105,341	530,199	181,087
	L	Lower Montane Forest	7,465,348	680,095		474,980	129,735	149,739	289,140	1,409,655	482,290	224,211	550,342	251,897	480,057	579,057	443,042	544,065	101,833	164,273	66,313	269,688		103,008	71,928
	Mo	Montane Forest	354,495	39,006		30,097	647		2,661	39,179	21,849	4,055	18,002	15,852	107,762	13,368	9,163	19,510	14,676	18,668					
	D	Dry Seasonal Forest	935,207						935,207																
	B	Littoral Forest	66,616	12,076		70	4,379	1,023	37,194	1,103	1,059	1,262	1,611								1,111	2,345	20	1	3,364
	Fri	Seral Forest	147,631	6,762		25,796	1,166	356	9,833	3,504	5,801	24,393	2,976								20,140	17,638		6,910	22,355
	Fsw	Swamp Forest	1,989,886	9,065		12,803	1,118	465,631	684,599	20,519	95,286	492,947	135,886		183		14,417	212	80	14	23,525	58		644	32,900
	M	Mangrove Forest	518,964	52,658	305	11,533	46,700	241,236	111,843	3,150	277	17,575	667								9,553	2,636	3,649	14,622	2,561
	W	Woodland	2,989,010	172,725	1,071	160,862	12,001	136,701	1,574,900	51,379	97,924	630,395	63,962				13,110	380			34,719	2,309		20,193	16,380
	Sa	Savanna	635,125	113,592	9,970	18,914	35	14,486	478,110						18										
	Sc	Scrub	391,709	6,673	978	1,626	1,332		374,163	11			280					111			112	27			6,397
	G	Grassland and Herbland	3,005,981	241,444	6,395	87,406	120,132	72,940	1,009,448	283,329	163,822	581,845	100,034	20,804	16,486	185,494	6,174	13,450	2,936	1,524	30,357	18,935	4,860	25,203	12,964
	Ga	Grassland (Alpine)	107,065	19,612		8,379	2,148		941	10,798	2,246	446	1,802	736	37,858	763	2,249	17,741	1,228	100					16
	Gi	Grassland (Subalpine)	86,977	11,580		6,562	426		344	18,207	6,827	183	2,550	6,167	7,597	643	12,666	751	8,379	4,095					
	O	Cropland/Agriculture land	6,577,558	152,320	1,012	509,751	241,016	108,176	188,809	524,018	541,151	763,427	457,098	197,050	464,474	262,392	442,258	384,704	267,182	210,680	122,620	202,662	14,130	79,621	443,006
	Qa	Plantation other than Qf	422,484	7,534		10,628	23,051	1,069		30,798	23,639	2,482	12,936	169	126	4,592	1		9,847	6,158	154,594	35,412	877	17,621	80,951
	Qf	Forest Plantation	67,951	18,207			1,214			17,654	4,893				25	4,911	290		1,569			19,189			
	Z	Bare areas	24,151	152	6	360	50		1,298	9,341	2,890		2,022		16	171	363		315	257	1,137	1,427	967	656	2,724
	U	Larger Urban Centres	38,332	692	6,095	352	792	202	727	8,081	1,497	2,699	1,495	691	4,429	857	1,300	2,438	0	88	651	619	708	585	3,332
	E	Lake & Larger Rivers	599,488	19,378	165	20,530	4,921	43,404	250,937	25,206	30,164	118,028	29,725	3,467	2,362	4,043	12,119	3,352	849	1,319	14,129	6,025	418	3,095	5,853
		SUM	46,161,159	2,955,783	26,114	2,263,371	1,416,666	3,471,860	9,797,778	3,368,621	2,890,325	4,368,599	3,592,766	613,341	1,173,438	1,114,676	1,504,751	1,055,593	432,998	480,522	2,034,000	1,529,425	193,077	939,696	937,760









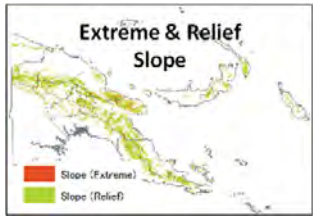


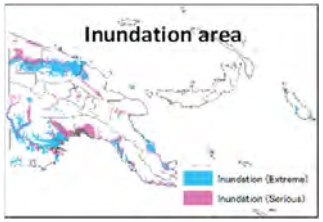
Examples of Forest Resource Information Layers in PNG-FRIMS

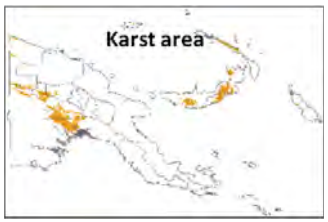
Constraints Data

Constraints data is one of the PNG Forest Resource Information Management System (PNG-FRIMS) data sets developed in the JICA-PNGFA Project. Sourced from PNG FIMS, Constraints is significant data for PNG Forest Authority since it defines natural conditions and defines logging constraints.
Constraints data covers entire PNG and it should have enough accuracy while maintaining sufficient performance in actual use on PNG-FRIMS. Constraints layers in PNG-FRIMS were updated in December 2016. This data set is mainly used to plan, control and monitor logging operations.

Layer	Description
Altitude	land over 2400m altitude.
Slope (Extreme)	land with over 30 degree dominant slope.
Slope/Relief	land with dominant slope of 20-30 degrees and sub-dominant slope over 30 degrees and with high to very high relief.
Mangroves	land covered by mangroves.
Inundation (Extreme)	land permanently or near permanently inundated extending over more 80% of the area of that land.
Inundation (Serious)	50-80% permanent or near permanent inundation.
Karst	land with polygonal karst landform.





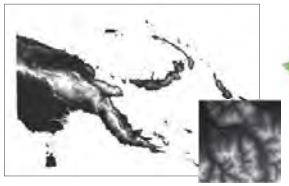


Watershed and Catchments

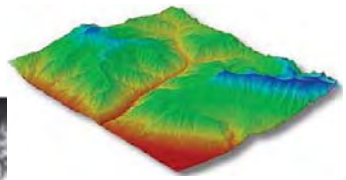
A watershed refers to a river system, i.e., an area drained by a river and its tributaries. It is sometimes called a drainage basin (National Geography 2019). For the development of PNG-FRIMS, watershed data that is acquired and analysed is predominantly focused on the Watershed Boundary. The boundary delineates the areal extent of surface water drainage to a point, accounting for all land and surface area. The boundaries of the watersheds can be derived through watershed analysis on remote sensing data.

An illustration showing the different aspects of a watershed. The Watershed Boundary is symbolized with the striped purple line

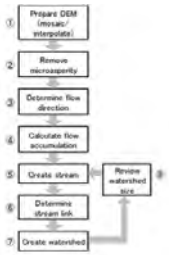
2D representation of a DEM. (Image courtesy of University of Minnesota)



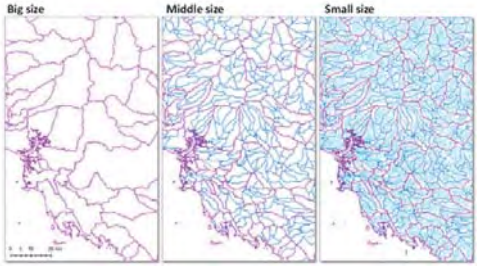
3D representation of a DEM (Image courtesy of the GPS Power)



The Work-Flow Diagram showing the processes involved in generating Watershed data from a DEM.



Three level of Watershed Data of Papua New Guinea



Forest Concession and Land Management Layers

Logging concessions refer to the permits or licences to perform logging operations in an area which PNGFA has acquired and/or allocated. Currently there are three concession types; Timber Rights Purchase (TRP), Local Forest Area (LFA) and Forest Management Agreement (FMA). LFA's and TRP's are no longer being issued under the Forestry Act, 1991 (as amended), however they are still in use as they were saved under the Forestry Act, 1991 (as amended). FMA's are the only type of concession allowed under the Forestry Act, 1991 (as amended).

Data	Source	Format
Logging Concession Boundary	Acquisitions Branch - PNGFA	Hardcopy/Softcopy
Logging Plan and Logged Over Area	Annual Logging Plans or Forest Working Plans maps provided by logging company	Hardcopy/Softcopy
Forest Clearance Authority	Logging company or Allocations Branch - PNGFA	Hardcopy/Softcopy
Forest Plantation Boundary	Surveyed by GPS or extracted from Forest Basemap 2012	Softcopy

The process involved in digitizing

Logging Plan

Logged over Area

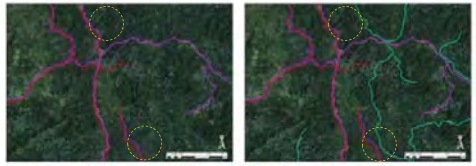
Digitized Logging Road Data

Road information is useful for estimating area affected by human activities. People move via roads quickly and enter into areas adjacent to the roads for various purposes, such as logging, subsistence agriculture, wood collection, mining, and plantations. As these activities continue to increase, so too does the need for more roads to cater for the logistics of these activities.
Road network information are acquired using mid-resolution satellite images that are a strong tool for capturing up-to-date national scale road network information. This has been made possible with the rising number of free mid-resolution satellite imagery such as LANDSAT and Sentinel-2 which are helpful in covering a nationwide network

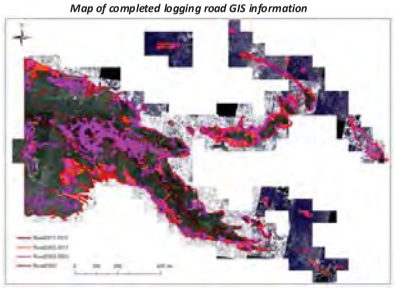
Layer (Dataset)	Source	Remarks
Road GIS information	GeoBook	Derived from NEFC[1] 2005 Cost of Services surveys, satellite imagery and RAMS[2] data
River GIS information	GeoBook	Derived from 1:250 000 topographic maps
Census Unit Information	GeoBook	Derived from PNG 2008 Census
Provincial Boundaries	Developed by the Project[3]	
LANDSAT AGP[4] 2000	Developed by the Project	
LANDSAT AGP 2005	Developed by the Project	
LANDSAT AGP 2011	Developed by the Project	
LANDSAT AGP 2015	Developed by the Project	
RapidEye 2011	Procured by Grant Aid Program[5]	

Road information of Geobook is a good reference to digitize unclear roads on LANDSAT AGP

To avoid digitizing rivers as roads, refer to the river GIS information (light green line).



Map of completed logging road GIS information



Utilizing PNG-FRIMS for better forest planning in PNG

Introduction

PNGFA/JICA project PDM (Project Design Matrix) ;

- *Examining the current forest planning system and document issues on the implementation of the National Forest Plan, Provincial Forest Plans, forest management plans*
- *Developing appropriate methods/procedures where necessary for solving issues*

To achieve the fourth goal stated in the Constitution, Papua New Guinea Forest Authority (PNGFA) pursues optimized utilization of the forest resources, balancing economic development with preserving multiple functions of forest. This means that PNGFA implement sustainable forest management (SFM) according to well-designed forest planning system. PNGFA/JICA project targets National Forest Plan (NFP) and Provincial Forest Plans (PFPs) to move the forest planning system by utilizing PNG-FRIMS.

Importance of National Forest Plan

The Forestry Act, 1991 (as amended) states that all forestry operations are to be in accord with the National Forest Plan. It is therefore important to have a robust National Forest Plan that is developed based on reliable and up to date data, which are part of the PNG-FRIMS.

Enhanced AAC calculation function in PNG-FRIMS and its application for forest planning in PNG

- The initial formula of Annual Allowable cut was defined in the National Forest Policy (1991) in a tentative fashion.
- Though AAC before the Project was calculatec by Forest Information Mapping System based on the past Forest Base Map and , the Project made changes to deal with several problems.
- "**Adding regrowth volume**" and "**Removing the constraints from net production area**" based on new Forest Base Map 2012 are the noteworthy updates as a new concept of AAC calculation by PNG-FRIMS.

Before-after of the concept of AAC calculation

	FMU calculation (old concept)	AAC calculation (New concept)
Forest Area	Total area of vegetation which has a positive number other than zero (0) in timber volume.	According to the definition of forest classification in PNG. Current figures includes Sa and Sc , which are set 0 in timber volume. Forest area in AAC is larger than FMU calculation.
Timber Volume calculated	Includes not only Production Forest but also Potential Production Forest, Reserve Forest and Protection Forest including Constraint Areas.	AAC calculation focus on only Production Forest inside operational concession areas. Total timber volume in each province is smaller than FMU calculation
Forest Re-growth	Only subtract the area of logged over areas, which will be regarded as no potential area (volume = 0). In order to recover the timber volume in FMU calculation, FIMS need to remove logged over areas in specific areas.	Logged over area will recover over the 35 years linearly. The attribute of Harvested year is important. As of Sep 2018, AAC calculation uses the purchased year of concession because of no information about harvested year.

Old Concept (before the Project)

$$AAC = (Atotal - Alogged) * Vstandard \quad / 35 * 0.4$$

Adjusting index

New concept (The Project's output)

$$AAC = \{(Anet - Alogged) * Vstandard + Vregrowth\} / 35$$

Redefining net production area — Adding regrowth volume

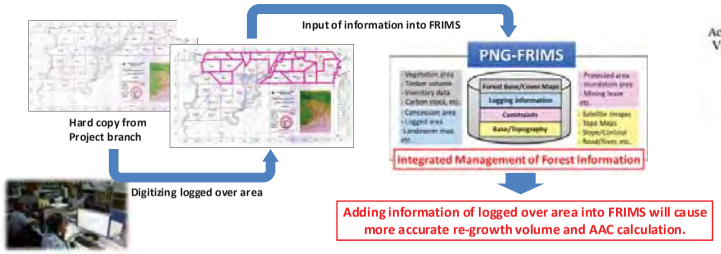
Notice: Formula calculates total volume of permit concession by 35 years later after finishing logging.

Abbreviation:
Atotal : Total Forest Area (inc. constraints)
Anet : Net Production Area (exc. constraints)
Alogged : Logged Over Area in net production area
Vstandard : Standard Volume of each forest type
Vregrowth : Regrowth Volume of each forest type

Sustainability of AAC calculation in PNG-FRIMS

Outputs of AAC is automatically renewed, when the information which is data source of AAC calculation stored in PNG-FRIMS such as logged over area, concession boundary, constraints, etc. is updated.

Digitizing logged over area for accuracy



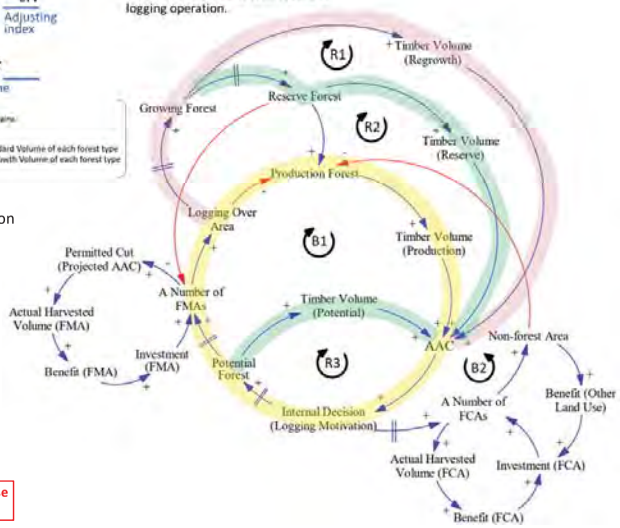
Adding information of logged over area into FRIMS will cause more accurate re-growth volume and AAC calculation.

AAC derived from PNG-FRIMS in forest management cycle in PNG

Old concept (Before the Project): B1
AAC consistently decreases due to expanding logged over area.

New concept 1: B1 + R1
Regrowth volume after logging is added to AAC, though it grows up by slow degrees.
This concept is suitable to grasp the situation of remaining timber volume on active concessions with regard to logging operation.

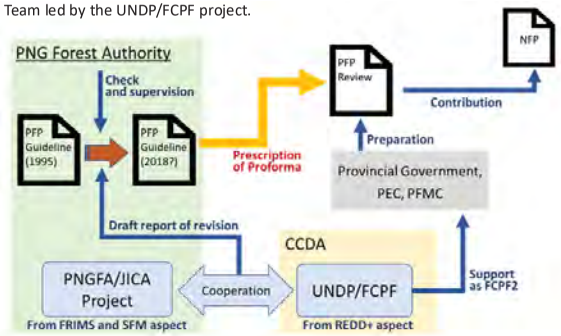
New concept 2: B1 + R1 + R2 + R3
Timber volume on Potential and Reserve Forests is added to AAC.
This concept is suitable to formulate future forest development and forest zoning considering outside current concessions.

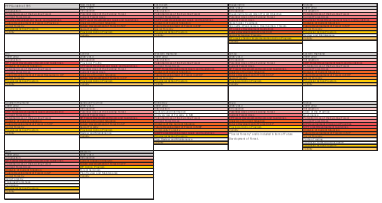


Promotion of PFP formulation and PFP guidelines

Collaborative approach with UNDP/FCPF project

The Project supported PNGFA to update the PFP guidelines in harmony with UNDP/FCPF project. The Project also supported revision of PFP in West New Britain Province as a member of National/Provincial Technical Working Team led by the UNDP/FCPF project.



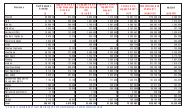
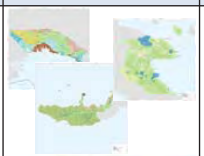
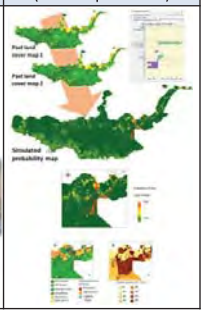


The consistency of each PFP guided by PFP guidelines

The 1995 PFP guidelines is being reviewed to make it consistent for all the Provinces.

Workshop at Bialla for developing revised PFP in West New Britain Province

Three days workshop in Bialla (from 3rd to 5th June 2019) was organized by UNDP/FCPF project, in West New Britain Province in collaboration with WNB Provincial Forest Management Committee and PNGFA to commence the process of reviewing the PFP Guidelines and the WNB PFP.

Forest Base Map	AAC	Tailor made maps	Land Change Modeler (Future potential)
			

Final Seminar
Of the JICA Technical Cooperation Project 2014-2019
Meeting Minutes Memo – July 2019

18th July 2019, 09:30am – 3:00pm
Hilton Hotel

Chairperson: Mr. Dambis Kaip — Manager - Policy & Aid Branch, FPPD, PNGFA
Co-Chair: Mr. Daisuke Kadowaki — Chief Technical Advisor, JICA-PNGFA Project

Meeting Agenda:
1. Output and Evaluation of the Project
2. Other Issues for Future

Attendance:

1	Aida Kai	GIS Officer – KKC-JICA
2	Alfred Tony	Field Services – PNGFA
3	Alois Jenkihau	Policy Officer (FPPD) – PNGFA
4	Andrew Aopo	Acting Director, Field Services Directorate – PNGFA
5	Ayako Ochi	KKC Expert
6	Bernard Tonjeran	Recruitment Officer – PNGFA
7	Cosmos Numbaru	Performance Management Officer – PNGFA
8	Daisuke Kadowaki	JICA-PNGFA
9	Dambis Kaip	Manager Policy & Aid Coordination (FPPD) – PNGFA
10	Dika Davai	GIS Technician – KKC-JICA
11	Dorcas Hutu	Dept. of National Planning & Monitoring
12	Ruth Turia	Director for Forest Policy & Planning – PNGFA
13	Emma Olmi	A/Admin Officer – JICA
14	Everlyn Paul	GIS Technician – KKC-JICA
15	Fiona Silo	Admin Officer – JICA
16	Geno Kini	Snr Technical Officer – PNGFA
17	Goodwill Amos	Manager REDD+ and Climate Change – PNGFA
18	Henry Kaikaru	Field Services – PNGFA
19	Ippei Shimizu	Project Formulation Advisor – JICA
20	Jason Sigamata	Desktop Network Technician ICT Branch – PNGFA
21	Javen Evera	Field Services – PNGFA
22	Jehu Antiko	Cartographer, Mapping Branch, FPPD – PNGFA
23	Joseph Kerowa	Timber Marketing – PNGFA
24	Kennewton Kennedy	Manager, Business Department – PNGFA
25	Killian Sesega	Dept. of National Planning & Monitoring
26	Leslie Ilias	Employee Dev. & OHS Officer – PNGFA
27	Lyall Umbo	Principle Management Officer, Field Services Directorate – PNGFA
28	Margaret Tongo	Forest Plans Officer – PNGFA
29	Masamichi Haraguchi	Food & Agriculture Organisation (FAO)
30	Meta Baik	Field Services – PNGFA
31	Michael Poesi	Food & Agriculture Organisation (FAO)-National Forest Inventory Project (NFI) – Project Coordinator

32	Mirzohaydar Isoev	Chief Technical Advisor - UNDP
33	Mitsugu Yachidate	First Secretary – Embassy of Japan
34	Patrick La'a	Cartographer, Mapping Branch, FPPD – PNGFA
35	Perry Malan	Snr GIS/RS Officer, Mapping Branch, FPPD – PNGFA
36	Raphael Moini	Snr Employee Development Officer – PNGFA
37	Samuel Gibson	Executive Officer (Office of MD) – PNGFA
38	Sarto Inaido	Snr Talent Management Officer – PNGFA
39	Takahashi Hirokazu	KKC Expert
40	Takahiro Koide	KKC Expert
41	Takashi Toyama	Chief Representative – JICA
42	Thomas Matambuai	Communication Technician, ICT Branch – PNGFA
43	Trinity Apupu	Field Services – PNGFA
44	Tsutomu Koyama	JICA-PNGFA
45	Yakop Pasul	Field Services – PNGFA

1. Opening Remarks

1.1 Opening Remarks by Mr Tunou Sabuin

- Provided background on the previous programmes in which the Government of Japan and JICA were working to improve the Forestry Sector in PNG since the 1980s
- Commented on the how the JICA-PNGFA Project (Phase 1 and Phase 2) was successful in providing technical assistance and high-level training in the operationalization of monitoring and managing forestry in PNG.
- Acknowledged JICA and the Government of Japan, as well as other development partners;
  The European Union, FAO of the United Nations, and ACIAR of AusAID on behalf of PNGFA, CEPA and CCDA.
- Urged for the maximum utilization of assistance provided by the project such as the logistics, equipment and technology.
- Made recommendations for future endeavours to:
  1. Continue the activities and training brought on by the project.
  2. Provide training for PNGFA officers throughout the country.
  3. Potentially commercialize skills and training for other agencies or departments as a revenue mechanism for PNGFA (although, current work is underway to provide information and training to other PNG government agencies at no cost)

  These are to ensure the continuous management and updating of information and skills within PNGFA, which will be available to the PNG Government and other interested parties.
- Mentioned the PNG Government's interest in the Forestry Sector, especially in new policies such as "Downstream Processing", the "Round-Log Ban" on exports, and also supporting replenishment programs.
- Gave an example on how CCDA can utilize the information and skills provided in PNGFA to better deal with the issues of Climate Change within the country
- Thanked all parties involved in the success of the project, particularly the Government of Japan and JICA, and expressed hope in more future projects and collaborations.

1.2 Statement by Minister Hon. Solan Mirisim *(see attached)*

1.3 Speech by the Secretary of the Japanese Embassy *(see attached)*

1.4 Introduction and Objectives by Mr. Daisuke Kadowaki

- Kadowaki-san's presentation was based on introducing the JICA-PNGFA Project, both the First Phase and the Second Phase, and highlighting its objectives.
- Made mention was the historical timeline of the cooperation between PNG and Japan, an overview of the JICA-PNGFA Project and concluding with presentations that were to be presented during the Final Seminar.

2. Agendas

2.1 Output 1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS)

2.1.1 Enhanced Information in Forest Base/Cover Map by Mr. Perry Malan

- Mr. Malan presented on how to enhance information in Forest Base/Cover Map through;
  - (i) the regular updating of its information and those of its derivative datasets, such as the Forest Base Map FMU (Forest Monitoring Unit), Timber Volume Data and Land Cover Change Simulation;
  - (ii) the use of publications regarding the information such as the Big Book, the Fact Sheets Series, Analytical Report Series, manuals, and guidelines for distribution of information.
- The Forest Base Map is important as it is utilized to develop future Forest Cover Maps, with its FMU being crucial in calculating volume, carbon stock and record changes in forests by monitoring forest conditions in each FMU.

2.1.2 Capability and Potential of PNG-FRIMS (with demo) by Mr. Patrick La'a

- Mr. La'a presented on the capabilities and potential of PNG-FRIMS by;
  - (i) Summarizing and defining the purposes of PNG-FRIMS as a GIS database
  - (ii) Introducing the functions and applications of the information stored in PNG-FRIMS (Digitizing, Map compilation, Estimation of Forest Volume, etc…)
  - (iii) Provided an overview of the Forest Information Browsing System (LAN Map)

2.2 Output 2: Improvement of Forest Planning System utilizing "PNG-FRIMS"

2.2.1 Contributions to National Forest Plan (AAC/PFP) by Ms. Margaret Tongo

- Ms. Tongo presented on how the JICA-PNGFA Project has impacted the National Forest Plan and the Provincial Forest Plan.
- Through Gap Analysis, it was found that there were three main areas that needed to be improved;
  - (i) Deficiency in ACC volume
  - (ii) Inconsistency with the Provincial Plans

(iii) The lack of logistics and human resources to adequately inspect/monitor the forest resources and logging operations

- Th mentioned areas were improved by the approaches;
  (i) Enhance AAC Calculation in PNG-FRIMS (the formula was redefined)
  (ii) Promote PFP formulation (redefine guidelines)
  (iii) Develop the capacity to monitoring the forest resources in ground level (introduction of UAV/GIS/GPS technology)
- Issues faced during the implementation of these approaches include:
  (i) timely updating of logged-over information
  (ii) regular updating of satellite images
  (iii) over-cutting by issuance of FCA
  (iv) using models (LCM) to predict future scenarios
- The way forward outlined in the presentation was to involve the provincial government and enhance resource owners' decision-making, assist in the Plantation development Program (OPGPD), integration with NFI information and for PNGFA to fully utilize PNG-FRIMS in decision-making.

2.2.2 Capacity improvement of forest monitoring (LCoP) by Mr. Peter Lat

- Mr. Lat presented on capacity improvement in field inspection/monitoring system for implementation of LCoP/PMCP for sustainable forest management.
- The main activities that were undertaken in this regard was the:
  (i) Procurement of Equipments (Vehicles, GPS, GIS, Laptops, Computer Sets)
  (ii) Development of database (PNG-FRIMS)
  (iii) Development of Manuals (for GPS/GIS/UAV technology)
  (iv) Training of Field Officers (for GPS/GIS/UAV technology)
  (v) Formulation of the Voluntary Guidelines (for support in GPS/GIS/UAV technology) to implement LCoP/PMCP
- Emphasis was also given on how reporting is done correctly and following guidelines and regulations
- Issues and Challenges identified included:
  (i) Logistics and Budget
  (ii) Technical Knowledge
  (iii) Risk Management
- The presentation was concluded by mentioning the amount of progress impacted by the JICA-PNGFA Project and states further development of already established activities by PNGFA

2.2.3 Drone application for forest inspection in PNGFA by Mr. Steven Saki

- Mr. Saki presented on the drone applications for Forest Inspection and how it assists PNGFA field officers in the field during monitoring.
- There were three priority areas stated:
  (i) Natural Forest Monitoring
  (ii) Forest Plantations Monitoring
  (iii) Forest Research

- Workshops and trainings were conducted to train and build the capacity of the officers in drone operation in inspection and monitoring
- Also discussed were the limitations with regard to drone operation and the drone specifications (environmental conditions, location, law and regulation, etc…)
- The presentation was concluded by stating the need for further training and the procurement of additional drone equipment by PNGFA

2.3 Output 3: Prepared/Identified Forest Information for addressing/contributing to REDD+

2.3.1 Potentials of using logging data for carbon estimation by Ms. Elizabeth Kaidong

- Ms. Kaidong presented on the potential in PNG to estimate carbon emissions from forest degradation caused by logging based on field methods.
- Its importance is based on the fact that, even though timber production is one of PNG's major economic sector, it is also a main source of forest degradation.
- A balance must be maintained by sustaining forest resources, addressing the impacts of the forestry sector on degradation and attracting sustainable investments which will promote REDD+ in PNG.
- Addressing forest degradation is possible with the JICA-PNGFA Project's capacity building and the development of the PNG-FRIMS which will provide the necessary information for integration with the Volume Method (Developed by Pearson et al.)
- The main constraints cited include:
  (i) the volume method's inability to cover post-logging and degradation
  (ii) capacity and availability of technical experts for developing Emission Factors
  (iii) limited scientific publications on logging emission sources
- To improve, certain steps highlighted were:
  (i) review of guidelines and Forest Reference Level (FRL) to integrate regrowth and degradation with the volume method.
  (ii) develop technical support by promoting Forest Research to develop logging emission factors (EF)
  (iii) further development of monitoring methods
  (iv) rapid operationalization of DSS to improve management of actual harvested volume.

3. <u>Closing</u>

3.1 General overview of the project and way forward by Dr. Ruth Turia

- Dr. Turia provided an overview of the project and also the future scenarios intended to further develop the JICA-PNGFA Project by:
  (i) maintenance and upkeep of PNG-FRIMS and information
  (ii) refining the ACC calculation and its role in forest planning and decision-making in PNG
  (iii) possible use for Volume Method and the development of logging EF
  (iv) the application of the knowledge, capacity and tools gained throughout the JICA-PNGFA Project, and its further development and upscaling.

3.2 Q&A/Discussion (*See attached*)

3.3 Speech by Solomon Islands Representative (see attached)

3.4 Speech by the Chief Representative of the JICA-PNG Office - Mr. Masato Koinuma (*see attached*)

3.5 Closing remarks by Dr. Ruth Turia

- Acknowledgment to all participants and general announcements

PAPUA NEW GUINEA

SPEECH BY HON. SOLAN MIRISIM, MP
MINISTER FOR FORESTS

ON THE OCCASION OF THE PROJECT FINAL SEMINAR ON " CAPACITY DEVELOPMENT FOR OPERATIONALIZATION OF PNG FOREST RESOURCES INFORMATION MANAGEMENT SYSTEM (PNG FRIMS)FOR ADDRESSING CLIMATE CHANGE".

Date : 18th, July, 2019
Venue : Hilton, Hotel

Salutations:

Mr. Takashi Toyama- Country Representative -JICA PNG

Mr. Mistugu Yachidate – First Secretary to the Ambassador of Japan

Mr. Tunou Sabuin, Managing Director of the PNG Forest Authority

Mr. Daisuke Kadawaki – Chief Technical Advisor – JICA/PNGFA Project

Mirzodhaydar Isoev- Chief Technical Advisor FCPF

Dr. Vaeno Vigulu (Permanent Secretary , Minister of Forestry and Research and his delegation of the Solomon Islands' Government

Management and Staff of the PNG Forest Authority

Dr. Abe Hitofumi -Chief Technical Advisor, National Forest Inventory Project.

Other Agency representatives

Management and Staff of the PNG Forest Authority.

Distinguished Guests, Ladies and Gentlemen

It is with great pleasure that I am here today on this occasion for the Final Seminar on the JICA project entitled " **Capacity Development for Operationalization of PNG Forest Resources Information System for Addressing Climate Change".**

This is my first time to participate in an official capacity since my appointment as the Minister for Forests in May this year under the Marape/ Davis Government. I thank the Managing Director and the project Management Team for extending this invitation to me for the final project Seminar.

I was raised in a rural village in my home District in Telefomin, Sandaun province, a province closely linked to Forest and I who benefited greatly from the forestry sector.

Forest and its related resources have contributed significantly to the lives and livelihood of our people for many generations and will continue to do so for many more to come. The traditional use of forest and environment management and utilization in Papua New Guinea may vary across the country, due to our vast culture diversity and the 800 plus language we have, however the principle remains the same and are inherited from one generation to another. It therefore has a strong emphasis for conservation and sustainable development.

Economically and socially, forest resources have contributed significantly to the development of PNG over many years. Unlike our neighbouring countries, PNG has a large land mass with a relatively low population where the majority of our people continue to live in rural communities such as villages and in hamlets, therefore, the development of forestry as a strategic resource provides for the needed tangible development such as infrastructural and monetary benefits to our rural population. The government generates income from the development of forest resources through export tax and corporate tax to the tune of about 700 Million Kina a year. The forestry sector also provides a significant percentage of the total work force in the country.

Given the significance of forestry, as a renewable resource, the government is taking a renewed policy directive and interest in the sector in terms of ;

1. Banning of Round Log Export
2. Maximizing onshore log processing in PNG.
3. Increasing Forest plantation development, and;
4. Meaningful participation by landowners.

The implementation of these policy directives will certainly contribute towards ensuring sustainable benefits from this sector.

Distinguished Guests, Ladies and Gentlemen

At this juncture, I would like to express my sincere gratitude to the Government and people of Japan and its development agency (Japanese International Cooperation Agency (JICA) for their continued support to the forestry sector of Papua New Guinea. I have been advised that the last two projects which include this project has provided considerable knowledge and capacity to the PNGFA Officers in the areas of remote Sensing and Geographical Information System (GIS) and forest management. It will undoubtedly go a long way in enabling PNGFA to ensure that PNG's forests are sustainably managed now and into the future. This is a worthwhile support that the Japanese government through JICA has provided to the PNG Forest Authority and Papua New Guinea as a country.

I would also like to thank the other development partners particularly the European Union (EU) and the Food & Agriculture Organization of the United Nations (FAO) who are currently assisting in the Multi-purpose National Forest Inventory work undertaken by the PNGFA. Thank you also to the United Nations Development Program (UNDP) and the Australian Government and other development partners for their support to the forestry sector of PNG. Many of these development partners complement each other's work. The collaboration of international development partners in enabling wise utilization of the forest resources and addressing climate change demonstrates a vibrant connectivity that exist within the international community and a strong desire to assisting developing countries like Papua New Guinea in her development aspirations.

Distinguish Guests, Ladies and Gentlemen

To this end, let me remind you all that as PNG is almost 80% covered by forest and is natural and renewable resource; it can have strategic long-term positive effects on the economy of PNG. The policy initiatives I have mentioned and the outcome of projects initiated by development partners will contribute towards a brighter future for forestry and the economy of PNG moving forward.

I look forward to a continuation of partnership between JICA and the PNG -Forestry Sector, and of course, the other development partners

I wish you all the best in your deliberation at this important Seminar.

Thank you and God bless you all.

Hon. Solan Misirim, MP
Minister for Forests

Speech by Japanese Ambassador – Mr. Yachidate Mitsugu

(*Transcribed from video from PNGFA Public Relations archives*)

"Good Morning to you all,

As a representative of the Embassy of Japan, I would like to express my congratulations on a successful seminar for the technical cooperation project between JICA and PNGFA. The success of this project is a testament to the relationship between JICA and PNGFA. I am honoured to have the opportunity to speak to you today and would like to acknowledge the presence of the minister for Forests, Hon. Solan Mirisim, the Managing Director, Mr. Tunou Sabuin, and the Project Director, Dr. Ruth Turia, and all participants that are here today.

The implementation of sustainable forest management in PNG is an essential factor, in not only the economic growth of the nation, but also for addressing broader international concerns, such as Climate Change, and Timber Legality Standards. During the course of pursuing sustainable forest management, it would be a welcoming situation, if JICA would have contributed to achieving results in this area of concern.

PNGFA and JICA embarked on this technical cooperation project in 2011, proceeding in the second phase in 2014. One of the achievements of this technical cooperation was the development of the PNG Forest Resource Information System (PNG-FRIMS), which is situated as a core system to manage forest resource information in PNG. In the current project, I believe PNG-FRIMS has been enhanced even more and utilized in practical activities such as, forest inspection and monitoring in the field and addressing climate change.

I also expect that through this seminar, those two outcomes, based on mutual cooperation between JICA and PNGFA in the Forestry Sector, will be shared with a wide range of affiliates and further utilized in the Sector's future endeavours tenfold.

Thank you."

Q&A Discussions

2.1.1 Enhanced Information in Forest Base/Cover Map by Mr. Perry Malan

- Comment by Mr. Goodwill Amos:
  It is important have Watershed and Catchment data, as this will be beneficial in planning roads, bridges and other infrastructure. And also, disaster management in terms of flooding, and landslides.

2.1.2 Capability and Potential of PNG-FRIMS (with demo) by Mr. Patrick La'a

- Dr. Turia explained the Decision Support System (DSS) developed by PNGFA to capture operational information from all directorates in PNGFA, which can be used in conjunction with PNG-FRIMS.

2.2.1 Contributions to National Forest Plan (AAC/PFP) by Ms. Margaret Tongo

- Comments by Ms. Margeret Tongo and Dr. Turia:
  Clarifying the AAC calculation as not taking into account FCA projects, as FCA projects are clear felling and do not have any regrowth, thus cannot be used in AAC calculations. Also, as the OLD calculation did not account for the regrowth, the NEW AAC formula was developed to cater for the regrowth volume. The regrowth volume recovers by 3% every year, leading to a total of 36 years, for an area to be fully regrown.

- Comment by Mr. Jim Silu:
  FCA projects need to updated within PNGFA to give an accurate represent of the current situation in the provinces. This will help provincial offices to gather all information when formulating their provincial plans.

- Comment by Ms. Ms. Magdalene Maihua:
  FCA projects are need to regulated as most of the forest areas under Potential Forest Development areas are being allowed to become FCAs, and are being clear-felled with no restraint. Having an Annual Allowable Cut for each province is important as it will control the amount of FCA projects (clear-felling) in the country.

2.2.3 Drone application for forest inspection in PNGFA by Mr. Steven Saki

- Question Mr Gewa Gamoga:
  On the use of drones, how can we collect whatever information with regards to forests, efficiently and effectively?

- Answer by Mr Jehu Antiko:
  That depends on the purpose of information that is to be captured and the equipment that is available. Currently, the available drones in PNGFA can only be operated for 20 minutes,

which can be used to cover just one set-up. To maximise the potential, the drones can be used in conjunction with GPS and ground visual inspection, and proper planning to cover areas that are larger.

- Further Comments by Mr Jim Silu:
  We need to look for a way forward to develop a better monitoring system, in which, we have drones with better flight time and more power. Also, there are limited staff in Field Services, therefore, drones with better flight time are needed to for an officer to effectively cover a wide area.

- Further Comments by Mr Gewa Gamoga:
  There should be a strategy or plan, that takes into account the current capabilities of the available equipment, and capacities of PNGFA.

- Further Comments by Mr Goodwill Amos:
  There are other drones, of which some can go up to about 4000 meters, and travel a radius of 2 km and with a robust flight time.

- Further Comments by Dr Ruth Turia:
  The challenge is for PNGFA to acquire drones will have more capabilities (longer battery life, flight time) and for further trainings to be conducted to fully train other PNGFA officers.

- Further comments made by Ms. Ms. Magdalene Maihua:
  The use of drones to be used as a complimentary tool along with GPS Handheld Devices

- Further comments by Mr. Jehu Antiko:
  Identify applicable areas and purposes to aid in planning and cost-benefit analysis for utilizing drones, GPS, and GIS systems.

3.1 General overview of the project and way forward by Dr. Ruth Turia

- Comments by Dr. Turia:

  - As the project is focused on sustainable forest management, FCAs are not sustainable forestry projects, hence, information regarding FCA is PNG-FRIMS is not complete
  - West New Britain Provincial Government have been consulted to come up with their provincial forest plan, and once they have finalized, it will be used as a guideline for all other provinces to develop their provincial plans. This is to allow better insight when PNGFA is developing the National Forest Plan.
  - Output 3 (Forest Information for addressing REDD+), specifically, the volume method is a new method as presented by Ms. Kaidong. Acknowledgement to JICA, FAO, UNREDD, LEAF/TNC, USAID, AUSAID, and GIZ for helping to develop this method.
  - The challenge is for PNGFA to fully utilize PNG-FRIMS

- PNGFA's interest is that logged-over forests can be harvested again in the next 35 years, and also to improve the yield of the regrowth
- One of the challenges is to be able to retain the maximum yield of the forest after it has been regrown. In year 36, or year 1 of the next cycle. At this time, there is also no guidelines as governing whether the logging company responsible for harvesting the forest area, and the volume they harvested, will also be allowed to harvest, after the forest has regrown.
- PNG is a leading country in REDD+, even though the country has not received any Result Based Payment. The country, however, have benefitted from projects by donor agencies.
- For those who have benefitted in the trainings and workshops to share their knowledge.
- Use DSS to track volume of logs being exported
- Providing information and data to logging companies to prepare their own Annual Working Plans (ALPs) following PNGFA guidelines and standards, or
  For PNGFA to develop the ALPs for the logging companies
- EU, FAO, CCDA, CEPA, and other partners and projects to maintain and update information on REDD+ and to update FRL for the country
- "JICA is interested to know what will happen at the end of the project…"

- Comment by Ms. Magdalene Maihua (regarding "*For PNGFA to develop the ALPs for the logging companies*")

    - For this to be possible, PNGFA needs a lot manpower and funds

- Comment by Mr. Perry Malan

    - There must be a Memorandum of Understanding regarding the sharing of PNGFA data with other stakeholders, partners and government departments (currently being developed by Mr. Samuel Gibson)

- Comment by Mr. Gewa Gamoga

    - For PNGFA Drone experts to develop a strategy on using the limited capacity and equipment that is consistent, in which the same strategy will be used in all operations.
    - With regard to *"For PNGFA to develop the ALPs for the logging companies",* this should be done in phases; For example; instead of going straight ahead with producing the ALPs, PNGFA should start small, by first providing only road data and produce road information. Once, the process is successful, it can move on to the next phase, which is to work on the ALPs.

- Further Comments by Dr. Ruth Turia

    - For PNGFA to build capacity in drone usage, particularly the provinces, so each of the provincial offices can be able to have their own drone equipment.

Speech by Solomon Islands Government Delegation Representative

(*Transcribed from video from PNGFA Public Relations archives*)

"Thank you for giving us the opportunity on behalf of the Solomon Islands Government Delegation to share our reasons for being here, and also, what we learned in this meeting.

First of all, Dr Ruth, we thank you very much for the invitation, and accepting our offer to come here. Your invitation is very much appreciated and our government is very happy with that.

Secondly, thank you JICA for making this trip successful for us in being able to attend this very important JICA-PNGFA Project Closing meeting. PNGFA and JICA has a 10-year collaboration, and our interest is to learn from you, the outcome of the collaboration and the project.

On this note, I thank the presenters for sharing your information, outcomes, and experiences you have gained during this project period. We are so happy to learn from your experience, and we also have information to bring home and share with our colleagues and the government of Solomon Islands.

For your information, the Solomon Islands Government, through our Ministry of Forest and Research, just had similar collaboration with JICA. Our purpose for bring here, as I have said, is to learn from your experience, the outcome, the constraints, the challenges, the achievements and also the steps to going forward. The outcomes and the experience that we learn from the meetings and your 10-year collaboration with JICA, may or will have suggestions to change our current policies, regulations or some parts of our current legislation.

Finally, having said that, again, on behalf of the Solomon Islands Government, I thank you again PNGFA and JICA, for allowing us to attend this very important meeting and I can learn from what you have experienced and your achievements. It is very interesting to listen to the questions and answers. All of you are very experienced in this field; Forestry. And as Solomon Islands and PNG, we entirely depend to support out national economy on the forest resource that we have.

Although, Solomon Islands has a lesser land mass, compared to Papua New Guinea, we are also running after Papua New Guinea in exporting round logs to China. At the moment, our country is actually harvesting our forest resources at an unsustainable rate. The Government of Solomon Islands understand that. We are trying to reduce the round log export, and this year, it is going to be going down. Last year, we produced around 2.7 million cubic meters, which is really high. This year, we plan to go down to 1.9 million cubic meters, the year after that, 1.3 million cubic meters, the year after that, 1 million cubic meters, and in 2023, we plan to export 700 000 cubic meters per annum; 300 000 cubic meters from plantations, and 400 000 cubic meters from natural forests. That will be our sustainable rate for the country. Going forward, that will be our contribution to the national economy.

Coming back to this meeting, for us is very important. You have 10 years' experience; we just have 2 years. We have this meeting as a bonus, going forward, for JICA to assist us, as they have assisted you, in the last 10 years.

Thank you very much."

PNGFA-JICA FRIMS Project Wrap-up Seminar

Closing Remarks by Masato Koinuma
JICA Senior Representative

- First of all, I would like give my thanks to Papua New Guinea's Forest Authority (PNGFA) for organizing this wrap-up seminar. As we all know, the Capacity Development Project for Operationalization of the PNG Forest Resource Information Management System for Addressing Climate Change – also known as the PNGFA-JICA FRIMS Project -- is approaching its end in August 2019.

- JICA PNG appreciates the PNGFA and FRIMS project's efforts to establish a robust and reliable national forest resource monitoring system to tackle ongoing deforestation and forest degradation in the country.

- At this final stage of the project, we are well aware that the project has made many achievements. Today, at this seminar, we would like to share the fruits of the hard work done during the five-year project period with all stakeholders.
  Due to the tireless efforts of the project team, following expected outputs were achieved:
  - ✓ PNG-FRIMS was expanded and enhanced.
  - ✓ The national forest plan, provincial forest plans, forest management plans and their monitoring system were improved through steady operation of PNG-FRIMS.
  - ✓ Forest information for addressing REDD+ was prepared.

- Although the project will end in one month, we strongly hope that the PNGFA will utilize the good practices of FRIMS Two for policy development and the expansion of REDD+ activities.

- In order for the PNGFA to fully utilize the assets of the FRIMS project after August 2019, it is vital that the PNGFA make the following arrangements to mainstream PNG-FRIMS under the framework of the PNGFA:

1. Secure the necessary funding for the continuation of project activities. These include the continued updating and expansion of FRIMS, as well as the expansion of drone training exercises to other provincial centers.

2. Assign the daily tasks and updating activities of FRIMS to permanent staff members of the PNGFA.

3. Include FRIMS activities in the Corporate Plan of the PNGFA.

- PNG contains some of the largest areas of tropical rainforest in the Pacific region. The tropical rainforest plays important roles in many aspects, contributing to the national economy through timber exports, rich biodiversity and mitigation of climate change.

- Even after the end of the project, JICA wishes to work closely with the PNGFA to support them in scaling up PNG-FRIMS nationwide. We look forward to working together to continue to ensure that the forest resources in PNG are conserved and managed in a sustainable manner.

Thank you

添付資料 50

PNGFA-JICA プロジェクトワークショップの概要

Summary of the PNGFA/JICA Project Workshop

1. Date: 1st of August, 2017 (9:30 – 16:20)

2. Venue: PNGFA Board Room

3. Background
PNGFA/JICA Project is aiming to improve the monitoring system of forest management plans through steady operation of PNG-FRIMS. To date, the Project conducted several trainings on GPS, GIS and PNG-FRIMS LAN Map (LAN Map) to improve the monitoring system in HQ, Area Offices and pilot provinces. Additionally, the Project has also provided support to manage forest plantations and register Incorporated Landowner Group (ILG) by providing necessary trainings and data from PNG-FRIMS.
This workshop has been held according to Project Activities 2.6[*1] in the Project Design Matrix.

4. Workshop Objectives and Outcomes
(1) To present the progress of Project activities
(2) To exchange views on the Project activities

5. Workshop Outcomes
(1) Deeper understanding of the Project outline and the progress have been gained within relevant officers and stakeholders.
(2) Mutual better understanding between PNGFA and developers has been promoted.

6. Presentations

(1) Title: Overall progress report and the objectives of the Work Shop

Presenter:	Mr Masaya Nishimura, JICA Expert
Contents:	a) Explanations of objectives of the workshop b) Progress report c) Explanations of program of the workshop
Questions (Q) and Answers (A):	Q: What is the progress of the improvement of National Forest Plan? A: Currently, we have been conducting a trial calculation for Annual Allowable Cut volume and considering which forest type should be included in Production Forest.

[1] Activity 2.6: Prepare and disseminate information on the Project outputs, taking the opportunities such as the training workshops.

(2) Title: Introduction of newly available information and tool on LAN Map

Presenter:	Mr Patrick Laa, Cartographer, I&M Branch, FPPD
Contents:	a) Explanations of LAN Map (purpose, concept, contents and interface) b) Achievements
Current progress:	a) Updating Web Application Service - Add New Imagery – Landsat 8 2014 AGP - Add Updated Constraints (e.g. 50m Contour) b) Enhancing Web Application Functions - Printing Tool - Sketch Tool - Feedback Tool (Remarks)
Questions (Q) and Answers (A)	Q: Do you have any plans to publish the contents of LAN Map? This is because the information such as satellite imageries can be good tools to make realistic logging plans for developers A: several spatial information such as Landsat Annual Greenest Pixel (AGP) and Forest Basemap have been published in PNG REDD+ Monitoring Web-portal (www.nfms-png.org). A: PNGFA management can consider exchanging data with developers apart from JICA Project pilot sites.

(3) Title: Enhancement of monitoring system of forest management plans (introduction of case study in pilot sites)
a) Validation for encroachment case

Presenter:	Mr John Orabi, Coordinator – Field Mobile Surveillance, FSD
Contents:	a) FSD Structure & Objective b) Concession Areas c) Field Monitoring d) Case Study on encroachment issue e) Demonstration on ArcGIS Explorer
Current progress:	An encroachment case survey has been conducted with GPS and GIS in West Sepik Province making use of JICA Training.
Challenges:	More training needed to utilize the ArcGIS Explorer and LAN Map.
Opinions:	a) Geo-reference system of maps should be fitted in advance when validating encroachment cases. b) Consistency of information is absolutely necessary. c) PNGFA needs to be able to verify encroachment cases with enhanced skill and technologies. d) GPS and GIS can support to mediate landowner issues.

b) Five year forest working plans

Presenter:	Ms Esther Beni, Acting Projects Officer – Southern, Projects Branch, PAD
Contents:	a) FWP Approval Procedure b) Components of an FWP Application c) Demonstration of LAN Map d) Conclusion e) Recommendations
Current progress:	LAN Map exercise has been conducted for officers in Projects Branch and LAN Map has been utilized for evaluation of 5YFWP in Project pilot sites.
Challenges:	Currently, FWP and ALP of JICA Project Pilot sites are published on LAN Map, however other projects also needs to be published for better planning and monitoring.

c) Annual Logging plans

Presenter:	Mr Peter Lat, Inventory and Mapping Officer, Area Office – West, FSD
Contents:	a) Monitoring and Evaluation Process of an ALP b) Purpose/Responsibility of Evaluating of ALP c) Existing Monitoring/Evaluation System of ALP d) Enhanced Monitoring/Evaluation System of ALP e) Making an Adequacy/Evaluation Report f) Usefulness of Monitoring/Evaluation Reports g) Recommendation
Current progress:	A GPS/GIS training has been conducted for officers in Area Office - West and monitoring reports have been made and used for ensuring transparency of projects.
Challenges:	a) The standardization of monitoring reports is necessary. b) Project officers need a little more training on the operation of ArcGIS Explorer and making monitoring reports c) Email system within PNGFA (including field offices) needs to be established for timely updating and sharing the situations in the field.
Opinions:	Monitoring reports can support decision makings.
Questions (Q) and Answers (A):	Q: Developers use 40m pitch contour maps. If PNGFA provides us finer contour maps, we can make more realistic plans. A: PNGFA can create finer contour maps as we use contour maps originated from 5m Digital Elevation Map (DEM).

d) Set up plans

Selective logging projects (FMA, TRP and LFA)	
Presenter:	Ms Rahab Ponoluh, Monitoring Officer - Gasmata, Area Office – West, FSD
Contents:	a) Process of Set-up Approval b) Use of GPS/ArcGIS in Aspects of Set-up Monitoring (Pre-Logging Inspection, Monitoring During Logging and Post-Logging Inspection) c) Comparison of Improved Monitoring System d) Conclusion e) Recommendation
Current progress:	A GPS/GIS training has been conducted for officers in Area Office - West and monitoring reports have been made and used for better monitoring.
Challenges:	Providing GPS and laptop with GIS is necessary as it can promote efficient field work.
FCA Projects	
Presenter:	Mr Steven Saki, Project Supervisor, Sandaun Provincial Forest Office, FSD
Contents:	a) Monitoring method for FCA b) Procedure to make monitoring reports c) Possible uses of monitoring reports other than monitoring logging operations d) Importance and Usefulness of Monitoring Reports
Current progress:	A GPS/GIS training has been conducted for officers in Sandaun Provincial Forest Office and monitoring reports have been made and used for upgrading officers reporting system.
Opinions:	Improvement of skill has been observed, but how we apply enhanced skill and tools to our tasks is more important.

(5) Title: Example of utilization of PNG-FRIMS other than monitoring of forest management plans

a) Management of Forest plantations

Presenter:	Mr David Bogen, BFP2 Supervisor, Bulolo Plantations, FDD and Mr Winnie Tindipa, Plantations Officer – Kuriva, FDD
Contents:	a) Introduction of Bulolo Wau Plantations b) Data Management in Bulolo Plantations c) Current Maps Produced by GIS d) Challenges e) Future approach f) Demonstration of LAN Map
Current progress:	A GPS/GIS training has been conducted for officers in Bulolo Plantations.
Future Plan:	A follow up training will be conducted once Bulolo Plantations purchase necessary items such as license of ArcGIS, GPS, GIS and etc.
Challenges:	a) Lack of IT support. b) Old version Mapping Software (Map info version 7) and Equipment hamper the good management of data. c) More training needed to utilize the LAN Map.

b) ILG demarcation with LAN Map/Arc GIS

Presenter:	Mr Cedric Tumba, ILG/FMA Officer, Acquisition Branch, FPPD
Contents:	a) Introduction of tasks in Acquisition Branch b) Importance of acquisition c) Introduction of Acquisition Branch Training d) Utilization of LAN Map/ArcGIS e) Demonstration of LAN Map
Current progress:	a) A GPS/GIS training has been conducted for officers in Acquisition Branch. b) Clan sketch tool has been added on LAN Map
Future plan:	An actual ILG boundary demarcation will be conducted in Morobe Province.
Challenges:	Out dated Topographic map hampers to grasp an actual field situation
Opinions:	a) ILG boundary demarcation is regarded as very important. GPS/GIS and LAN Map can support to demarcate ILG boundaries and mediate landowner issues under dispute. b) 3D image map can be good reference to Landowners to demarcate their land easily. c) 3D image is available on “ArcGIS Pro” and “Hillshade image” can be good reference to capture the topographic feature.

(7) Title: Improvement of National Forest Plan (especially on calculation of Annual Allowable Cut Volume)

Presenter:	Ms Margaret Tongo, Forest Plans Officer, I&M Branch, FPPD
Contents:	a) Outline of the National Forest Plan b) Importance's of Annual Allowable Cut c) Issues identified in the calculation of the Allowable Annual Cut (AAC) d) Actions taken to address the issue of re-growth calculation e) Calculation method of “Re-growth volume” f) Management of FCA and TA g) Management for logged-over area (Digitizing work) h) Future tasks i) Tools to assist PFMC on decision making (Land use planning)
Current progress:	The concept of re-growth model has been considered within project team a trial calculation has been implemented by JICA experts.
Future plan:	Digitizing maps of FWP and ALP will be continued by a casual staff hired by JICA Project.
Challenges:	a) Much workload is needed for digitizing maps b) Unorganized document management hampers smooth digitizing
Opinions:	First of all, it is necessary to organise the documents in the strong room in order to grasp how many maps we need to digitize.
Questions (Q) and Answers (A):	Q: When new NFP will be submitted to NFB A: Depending on progress of work. Currently, JICA experts are making the tables to calculate AAC volume, however re-growth calculation model has not been completed yet.

(8) Title: Necessary information for revision of Forest Cover Map

Presenter:	Mr Jehu Antiko, Cartographer, I&M Branch, FPPD
Contents:	a) Issues faced with Forest Basemap V1 b) Resource/Reference Material c) Primary Results of FBM V1 Mismatch Correction d) Primary Result of Past Forest Cover/ Landuse maps e) Future Work
Current progress:	Past year Forest Cover Maps in pilot provinces have been completed.
Future plan:	Forest Cover Map 2015 will be completed in near future.
Challenges:	Internet connection speed in PNGFA is too slow to download LANDSAT imageries. This problem makes it difficult to revise the Forest Basemap.
Opinions:	a) This task is very important since Forest cover map needs to be compared with the Collect Earth data. b) The land use type analysis during the revision needs to be consistent with its definition. c) Internet connection in NFI is quite fast, but not smooth due to the intermittent connection.

(9) Title: Future plan for Project activities, including: importance of data exchange with developers; and security and integrity of logging data.

Presenter:	Mr Masaya Nishimura, JICA Expert
Contents:	a) Future plan - Monitoring of logging - ILG demarcation - Forest Plantation Management - Improvement of National Forest Plan b) Proposing data exchange with developers
Opinions:	GPS and laptop with GIS can enhance the performance of field work. Deployment of the tools for field officers needs to be considered. Officers who took the training should teach other officers in their respective offices. Improvement of internet connection is necessary as field officers normally use private G-mail account for work. Regarding to the exchange of data with developers, PNGFA needs to provide useful information for developers such as fine contour map. PNGFA management will consider procuring GPS and laptops for field officers.

7. Participation list

No.	Name	Title	Organisation
1	Mr Tunou Sabuin	Managing Director	PNGFA
2	Dr Ruth Turia	Director - FPPD	PNGFA
3	Mr Karokaro Mau	Director - FSD	PNGFA
4	Ms Fay Duega	Public Relations Officer	PNGFA
5	Mr Rabbie Lalo	Planning Analyst	PNGFA
6	Mr Constin Bigol	Manager - I&M	PNGFA
7	Ms Margaret Tongo	Forest Plans Officer	PNGFA
8	Mr Perry Malan	Senior Cartographer	PNGFA
9	Mr Patrick La'a	Cartographer	PNGFA
10	Mr Jehu Antiko	Cartographer	PNGFA
11	Mr Joseph Badi	Manager - Acquisition	PNGFA
12	Mr Charles Rawali	Supervisor LLO	PNGFA
13	Mr Cedric Tumba	ILG/FMA Officer	PNGFA
14	Mr Dambis Kaip	Manager - P&AC	PNGFA
15	Mr Goodwill Amos	Manager - REDD+ and CC	PNGFA
16	Mr Gewa Gamoga	Officer - Climate Change	PNGFA
17	Ms Esther Beni	A/Project Officer - Southern	PNGFA
18	Mr John Orabi	Coordinator FMS	PNGFA
19	Mr Jason Sigamata	Desktop Network Technician	PNGFA
20	Mr Mark Betuels	Area Manager - Southern	Area Office - Southern
21	Mr Jim Menge	Supervisor Technical	Area Office – Southern
22	Mr Inchu Yambutau	A/ Supervisor Inspection	Area Office – Southern
23	Mr Peter Lat	Inventory Officer	Area Office - West
24	Ms Rahab Ponoluh	Monitoring Officer - Gasmata	Area Office – West
25	Mr Steven Saki	Project Supervisor - FCA/LFA	PFO – Sandaun
26	Mr David Bogen	BFP2 Supervisor	Bulolo Plantation, FDD
27	Mr Winnie Tindipa	Plantations Officer - Kuriva	Kuriva Plantation, FDD
28	Mr Simon Peter	Manager	Rimbunan Hijau (PNG)
29	Mr Rey Lambo	General Manager	Cakara Alam
30	Mr Joseph Manlisis	Planning Manager	Cakara Alam
31	Mr David Ling	General Manager	Amanab Forest Products Limited
32	Mr Henry Huang	Manager	Amanab Forest Products Limited
33	Mr Desmond Lau	General Manager - A&M	BOPPL
34	Mr Masatake Harada	Assistant Representative	JICA
35	Ms Margaret George	Senior Programme Officer	JICA
36	Mr Daisuke Kadowaki	Expert	JICA
37	Ms Ayako Ochi	Expert	JICA
38	Mr Yasuyuki Okada	Expert	JICA
39	Dr Takahiro Koide	Expert	JICA
40	Ms Everlyn P Mel	GIS Officer	JICA
41	Mr Masaya Nishimura	Expert	JICA

8. Program

Facilitator: Dr Ruth Turia – Project Director and Director - FPPD, PNGFA

Tame	Activity	Lead person
9:30	Opening Remarks	Mr Tunou Sabuin
9:35	Overall progress report and the objectives of the Work Shop	Masaya Nishimura
9:45	Introduction of newly available information and tool on LAN Map	Mr Patrick La'a
10:00	Enhancement of monitoring system of forest management plans	
	Validation for encroachment case	Mr John Orabi
	Five year Forest Working Plans	Ms Esther Beni
	Annual Logging Plans	Mr Peter Lat
	Set-up plans	Ms Rahab Ponoluh Mr Steven Saki
11:20 – 11:35	Coffee Break	
11:35	Example of utilization of PNG-FRIMS other than monitoring of forest management plans	
	Management of Forest plantations	Mr Winnie Tindipa Mr David Bogen
	ILG demarcation with LAN Map/ArcGIS	Mr Cedric Tumba
12:15 – 13:15	Lunch Break	
13:15	Improvement of National Forest Plan	Ms Margaret Tongo
13:35	Necessary information for revision of Forest Cover Map	Mr Jehu Antiko
13:50 – 14:05	Coffee Break	
14:05	Future plan for Project activities	Masaya Nishimura
14:15	Exchange of views	Participants
15:00	Concluding remarks	Dr Ruth Turia

添付資料51

ドローンを用いた森林モニタリング実務研修の概要

Wrap up
Drone Utilization to Field Monitoring Training

Trip Duration: 23rd-28th Oct '18

Participants

Sandaun office(8 person);
- Jimu Silu (PFO Sandaun [Initial & wrap up meeting)]
- kalan(Supervisor/Amanab 1-4 FMA)
- Jackelyn(Acting Supervisor/Amanab 5&6)
- Brenda(Monitoring Officer/Amanab 5&6)
- Steven Saki(Supervisor/Bewani FCA)
- Conrad(Monitoring Officer/Bewani FCA)
- Erick tin won(Supervisor/Vanimo TRP)
- Paul (silviculture officer)

HO(2 person):Patrick Laa and Jehu antiko

JICA Experts(3 person): Kadowaki, Koyama, Takahashi

Observer

Amanab Forest Products: Two survey officers

Main Purpose of the training

- Discussing drone use for field monitoring
- Learning basic Drone flying control
- Capturing aerial photo using drone in order to make up one whole set-up.

Set-up Information

Area: 150ha

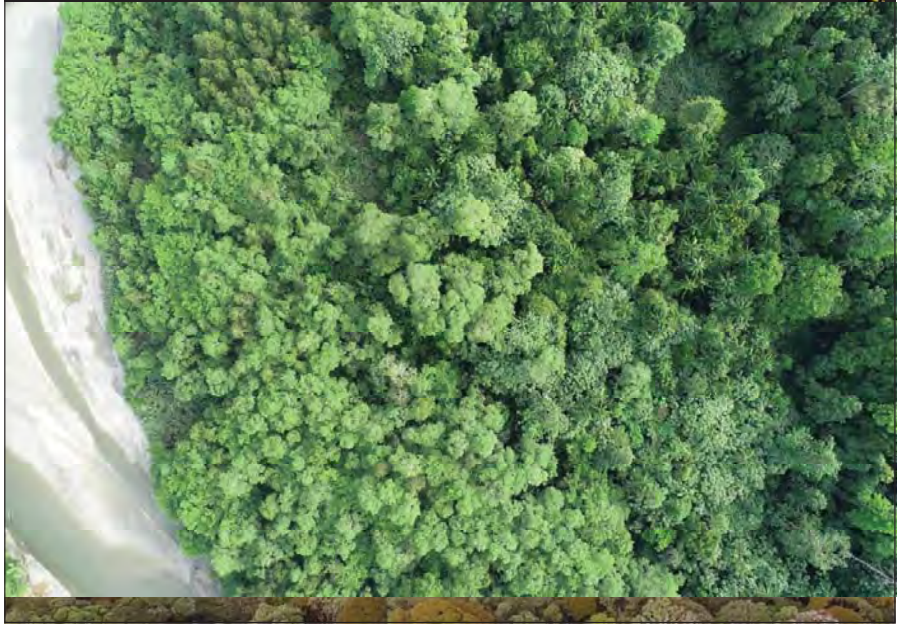
Status: Waiting for Set up clearance evaluation by the supervisor

Training Contents: Basic flying technic
Auto pilot flying to shooting photos and videos

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

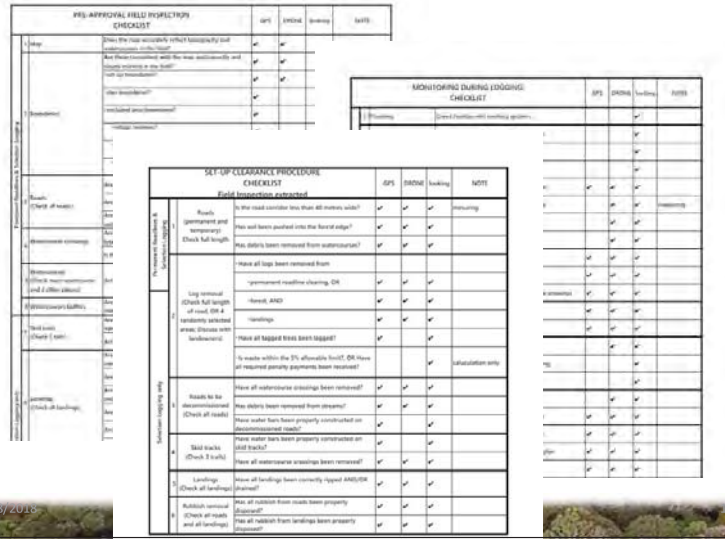
Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change



Video

Use GPS/DRONE for Check list items per LCoP



Probability of Application of the Drone for Inspections LCoP

Plan Approval

- Does the map accurately reflect topography and watercourses in the field?
- Are set-up boundaries consisitent with the map and correctly and clearly marked in the field?

Probability of Application of the Drone for Inspections LCoP

Set-up Clearance Procedure

- Is the road corridor less than 40 metres wide?
- Has soil been pushed into the forest edge?
- Has debris been removed from watercourses?
- Have all logs been removed from
  - permanent roadline clearing, OR
  - forest, AND
  - landings
- Have all watercourse crossings been removed?
- Has debris been removed from streams?
- Have all watercourse crossings been removed?
- Have all landings been correctly ripped AND/OR drained?
- Has all rubbish from roads been properly disposed?
- Has all rubbish from landings been properly disposed?

Probability of Application of the Drone for Inspections LCoP

Monitoring During Logging

- Roads follow approved surveyed roadlines
- Roads corridor is less than 40 metres wide
- Streams are free of soil
- Roads are properly drained
- Bridges are properly constructed
- Culverts are properly constructed
- Roads are properly drained at watercourse crossings
- Excluded areas free of soil
- Streams free of soil
- Trees are felled into gaps
- No felling into excluded areas
- No machine disturbance in excluded area
- Watercourse crossing located as per plan
- Watercourse crossing constructed as per plan
- No soil in stream
- Landings located as marked out in the field

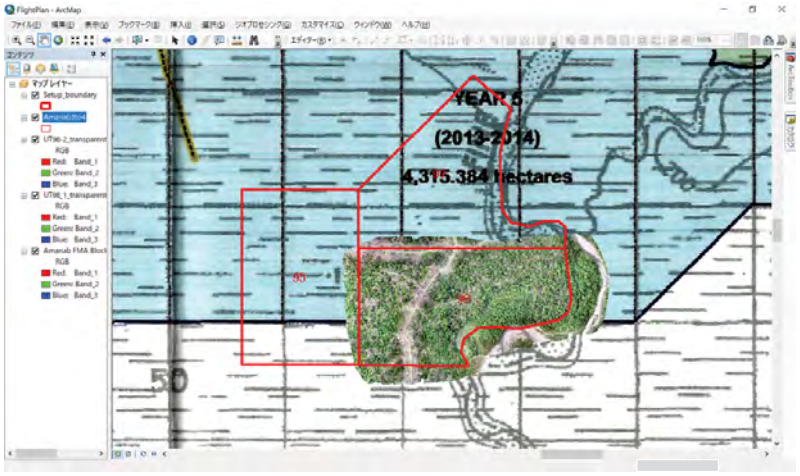
Further Application

Probability of Application of the Drone for Inspections by ortho images

Flight Plan Outline
CoverArea: 187.56ha
Flightlength: 35,336m
FlightTime: 130min
Overlaps: 90% 70%
Photos: 1194
Batteries: 7 packs
Altitude: 200m
Speed: 7.7m/s
Maximum Distance around 1000m

Probability of Application of the Drone for Inspections by ortho images

Probability of Application of the Drone for Inspections by ortho images



Other Findings

- Procurement (drone, laptop PC, software, training)
- 7 batteries at least needed for one survey at this time.
- 3 hours needed for shooting one set-up (including time for change battery. Net flying duration 130min.)
- 1000 photos taken for the set-up. (in case of altitude 200m)
- 1 night needed to process ortho-photo with a Laptop PC.
- Around 1,000m is limit distance for the drone to send live image to its controller

The way forward

Feb 2019:
Drone workshop at HO

Apr-May 2019:
(Plan)Trial evaluation Set-up clearance with Drone in WNB and WSP

添付資料 52

MRV-TWG 発表資料

PNGFA/JICA Project (2014-2019)

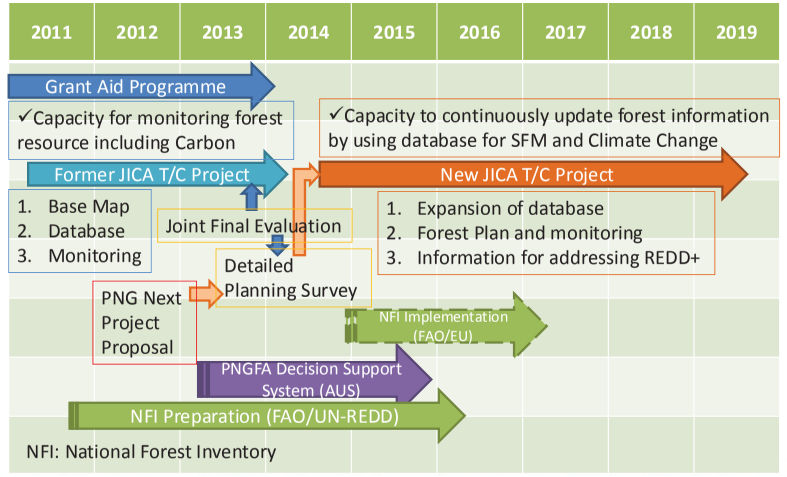
Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change
– PNG-FRIMS –

Progress of 2014

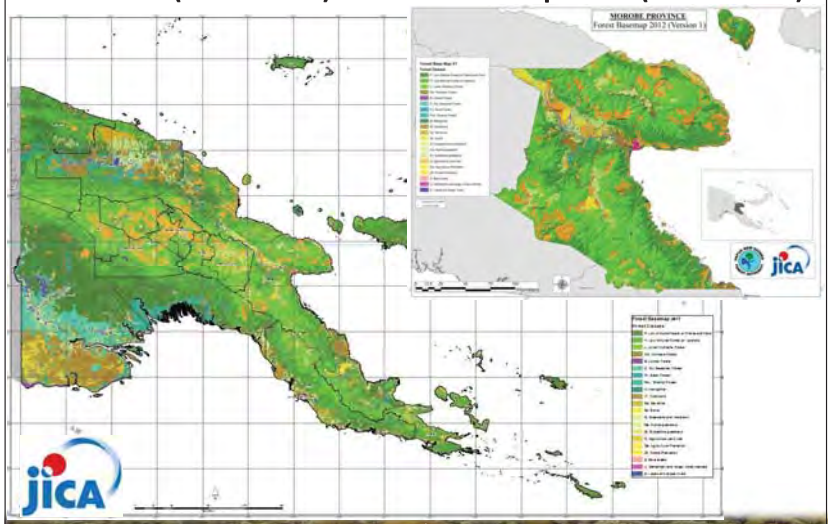
March 17th, 2015
Masamichi HARAGUCHI
Kokusai Kogyo
Consultant for PNGFA/JICA

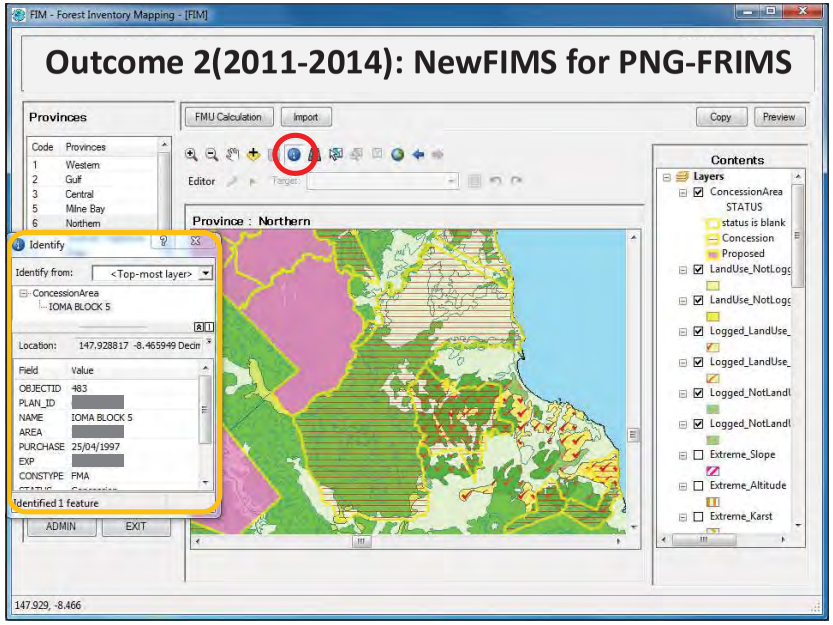
Table of Contents

Timeframe of Forestry Cooperation Projects from 2011-2019

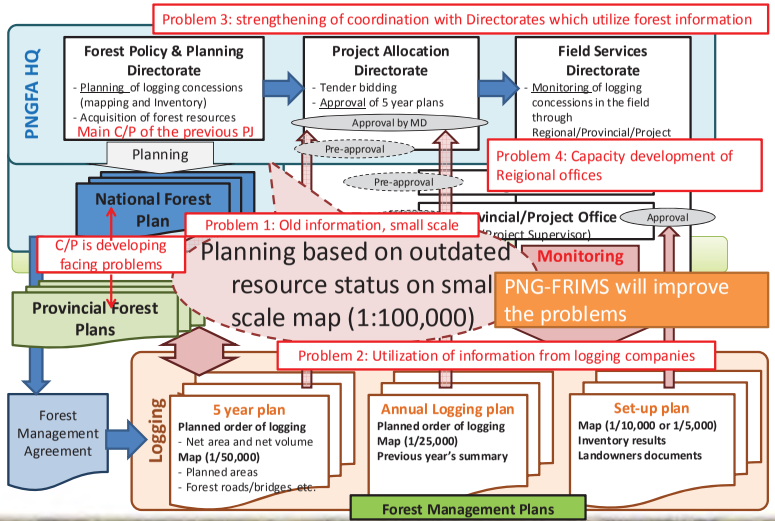


Outcome 1(2011-2014): Forest Basemap 2012 (version 1.0)

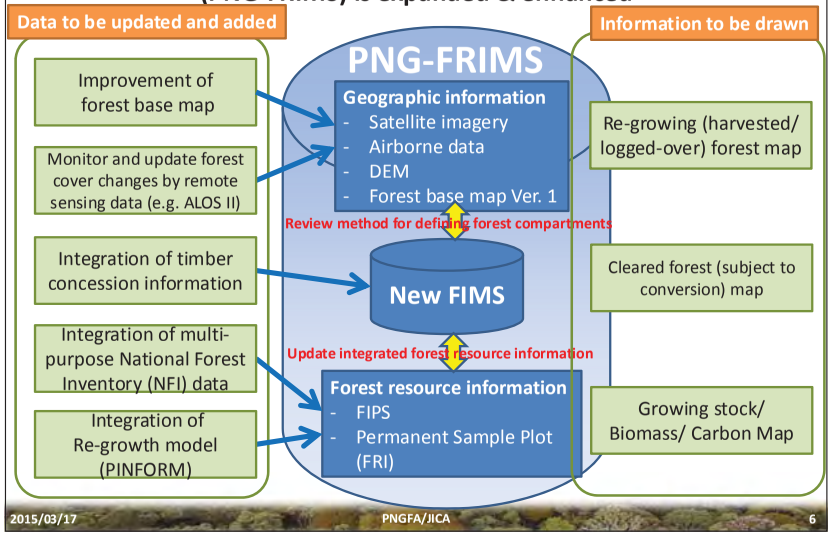




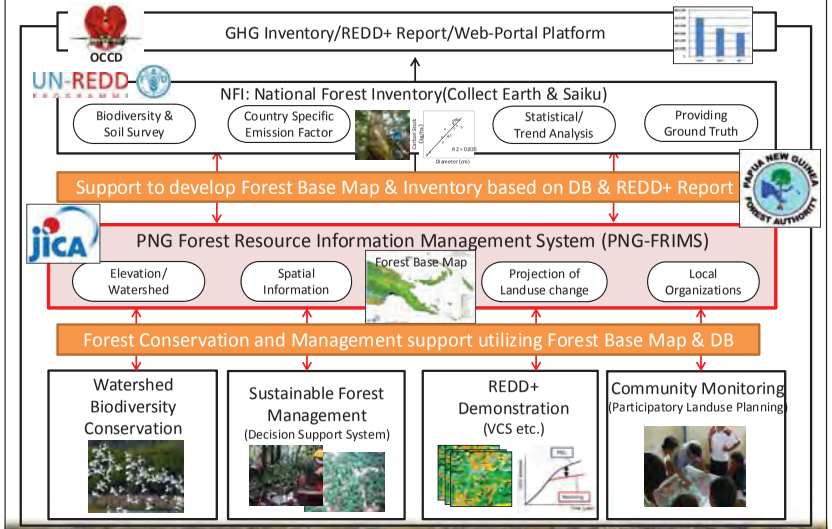
Output 2: Forest Management Plans (National & Provincial) are improved



Output 1: PNG Forest Resource Information Management System (PNG-FRIMS) is expanded & enhanced



Output3: Forest Information for addressing REDD+ is prepared



Basic Design Applications of PNG-FRIMS (Draft)

PNG-FRIMS

Dedicated system

FIMS

■Summary of FIMS
Editing and managing **forest map data** such as vegetation, concession area, logged over area, etc., estimating timber volume, outputting reports.

Unitary management of forest information

- Vegetation map
- Logging map
- Project map
- Topographic map
- …

SQL Server 2008R2

Web Application

Web Browser Map

■Summary of Web Browser Map
Utilized for **sharing forest information in PNGFA**. Able to browse the forest maps on a web browser without any particular software.

FIPS

■Summary of FIPS
Inputting and managing **results of field survey**, estimating timber volume, outputting reports, etc.

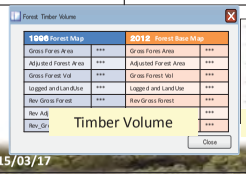
ArcGIS

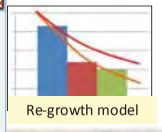
SQLServer

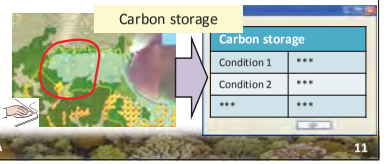
General-purpose Software

Basic Design for Expansion & Enhancement of PNG-FRIMS

Goal	Function	Objectives	Outcomes
To support designs for national and provincial forest plans	Estimates timber volumes utilizing the new Forest Base Map	To estimate timber volume using the new Forest Base Map 2012	This function will make it possible to verify the timber volume estimation using forest base maps in two different times.
		To compare timber volumes based on Forest Base Map 1996 and 2012	
	Estimates timber volumes considering secondary forest	To identify the location of secondary forests	This function will be helpful for seeing the actual situations of secondary forest.
		To estimate the timber volumes utilizing a forest regrowth model	
To grasp the situation of climate change at a point of interest	Estimates carbon storage	To estimate the carbon amount in a selected area	This function will support the planning of REDD+ projects by provision of carbon storage from Forest Base Map and overlapping several layers







Adding Information into PNG-FRIMS (under study)

Forest Base Map (Vegetation)

- Timber volume
- Carbon storage
- Regrowth model
- Change in forest area
- NFI (National Forest Inventory)
- …

Grasp potential for forest resources and carbon emissions by update of the forest base map

Unitary management of forest information

PNG-FRIMS

SQL Server 2008R2

Project Area

- FCA area (Forest Clearance Authority)
- Plantation area
- Wildlife management area
- Mining Operation area
- …

Pay attention to plan new logging / REDD+ projects

Grasp possible deforestation, forest degradation and secondary forest areas by update of logging data timely, accurately

Logging

- Concession Area
- Logged Over Area
- Field Survey
- …

Assess validity of logging / REDD+ project areas

Topography

- Slope/Altitude/Karst/ Inundation/Swamp/ Mangrove/ Contour
- Road/River/Village
- Satellite Image/DEM
- …

Basic Design for Expansion & Enhancement of PNG-FRIMS

Goal	Function	Objectives	Outcomes
To make the procedure of assessment and monitor logging operation plans more efficient	Shares and utilizes the forest information in PNG-FRIMS	- Overlay several forest information - Search location - Sketch map on web browser - Measure distance and extent - Print Maps	This function will help to assess logging plans
			This function will make it easy to find encroachment logging and overlapping of project boundaries by easy access to FRIMS through Web browser

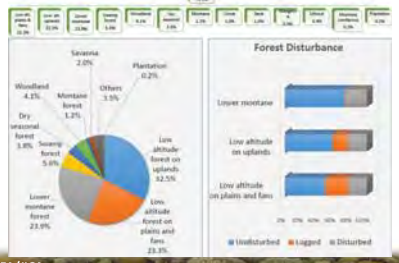
NFI 1st Assessment (by CollectEarth)

UN-REDD PROGRAMME

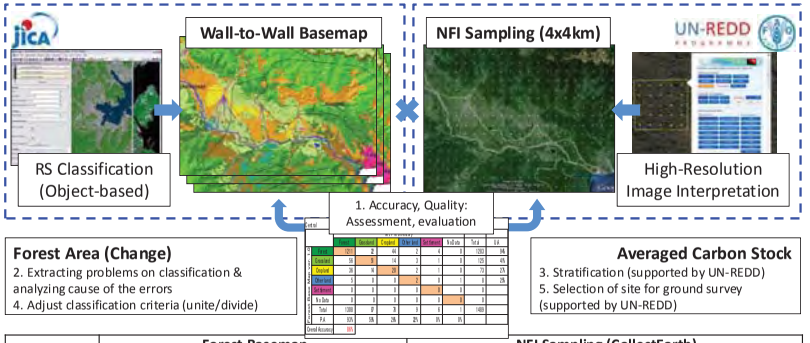
Phase 1
Based on RS data analysis and Collect Earth/Open Foris & Google Earth tool

Phase 2
Based on field plot clusters on a random restricted sampling design

Stratification: PNG Forest Type



Coordinate Forest Basemap & NFI→ Develop consistent GHG Inventory



Forest Area (Change)
2. Extracting problems on classification & analyzing cause of the errors
4. Adjust classification criteria (unite/divide)

Averaged Carbon Stock
3. Stratification (supported by UN-REDD)
5. Selection of site for ground survey (supported by UN-REDD)

	Forest Basemap	NFI Sampling (CollectEarth)
Spatial Coverage	**Wall-to-wall by polygons** Segmentation < 1ha (100x100m)	**Sampling plots** 4x 4km (or 2x2km) 1ha unit with 25 check points
Satellite	Rapid Eye & ALOS/PALSAR (2010-2011)	LANDSAT & Google Earth (High Resolution)
Area Calculation	Geographical	Statistical
Boundary	Yes	No
Statistical Analysis	Limited	Ample

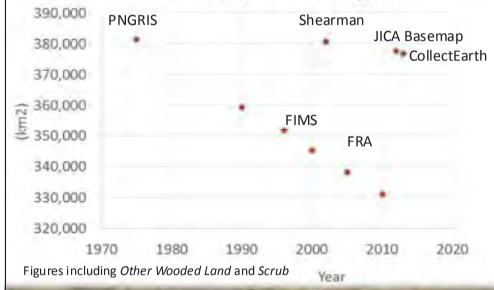
Comparing Results of Forest Basemap and CollectEarth

(km^2)

	1975	1996	2002	1990	2000	2005	2010	2012	2013
	PNGRIS	FIMS	Shearman	FRA	FRA	FRA	FRA	Base map	Collect Earth
Forest (excl. plantations)	336,670	306,980	329,862	314,600	300,500	293,450	**286,400**	377,777	**376,904***
Other wooded land	44,860	44,860		44,740	44,740	44,740	44,740	NA	NA
Scrub			50,793						

*plantations included

PNG forest area in various report



Figures including *Other Wooded Land* and *Scrub*

The 10% increase due to the difference in definition of forest and 8% due to un-appropriate previous estimate.

With Collect Earth, PNGFA now has the capacity to monitor the nation wide forest regularly.

Accuracy Evaluation of Forest Basemap: Forest/Non-Forest

		NFI Pre-inventory			
		Forest	Non-forest	Total	U.A.
Forest Base Map	Forest	18333	1545	19878	92%
	Non-forest	1612	3606	5218	69%
	Total	19945	5151	25096	
	P.A.	92%	70%		

O.A.	87%

P.A. = Producer's Accuracy
U.A. = User's Accuracy
O.A. = Overall Accuracy

Also implement …

Accuracy evaluation by IPCC six categories → O.A. is 83%
Accuracy evaluation in each province → by F/NF, O.A. is >80% in 9 tenths province

The Map can be useful in REDD+ project

Accuracy Evaluation of Land cover Category in PNG

Map				NFI: Forest P	H	L	Mo	D	B	Fri	Fsw	M	Qf	Woodl W	Savanna/Sc Sa	Sc	Grassland G	Ga/G	Cropland O	Qa	Wetl ands E	Othe r Z	Settl emen U	Total	U.A.
Forest	P	Low Altitude Forest on Plain		2446	1138	4		40	2	70	309	31	16	65	9	18	41		184	26	80		31	4529	54%
	H	Low Altitude Forest on Ublar		1122	4820	109				47	18		4	17	6	17	41		225	21	23	4	22	6505	74%
	L	Lower Montane Forest			58	4208	74						2			16	56	18	165	7	6	1	13	4624	91%
	Mo	Montane Forest				19	186									6	2	26						239	78%
	D	Dry Seasonal Forest		121	8			207		5	47			65	3	3	13				7			480	43%
	B	Littoral Forest		3							1	1		1										21	67%
	Fri	Sanal Forest		17	18	11				4	11	1		5			3		2	3	5			82	5%
	Fsw	Swamp Forest		297	38			48		22	314	11		30	15	11	33		13	1	116		6	1021	31%
	M	Mangrove		17				2	1	2	34	104		5	2		1		3	2	92		2	247	42%
	Qf	Forest Plantation		3	3	1							7	1		2	1		11	2				33	21%
Woodland	W	Woodland		267	33	1		26	1	16	247	7		307	115	40	51		36	5	104		2	1562	20%
Savanna /Scrub	Sa	Savanna		5	1	1		34			8	3		77	132	8	27		11		9	1	6	323	41%
	Sc	Scrub		2	1	1	1	33			3			58	85	11	8		1		2			206	5%
Grassland	G	Grassland and Herbland		83	44	45		53		7	72	4	1	98	24	36	689	20	162	15	303	7	19	1685	41%
	Ga/G	Alpine grassland/Subalpine g				7	12									2	23	70	2					117	60%
Cropland	O	Agricultural Land Use		205	299	363	4	7	1	16	45	6	7	21	9	24	233	30	1211	132	47	2	165	2858	42%
	Qa	Plantation other than forest		13	6						1		2			2	10		66	102			9	242	55%
Wetlands	E	Lakes and larger rivers		13	18	3		2		4	6	3		1	2	1	19		2		209		2	285	73%
Other land	Z	Bare areas		2	1	1										1	4					3	2	15	13%
Settlements	U	Larger urban centres															1		1				14	16	88%
		Total		4641	6486	4774	277	752	7	193	1118	171	39	817	402	198	1257	195	2095	347	977	17	923	25096	
		P.A.		53%	74%	88%	67%	28%	86%	0%	28%	61%	18%	38%	33%	6%	55%	42%	58%	38%	21%	12%	5%		

O.A.

P.A. = Producer's Accuracy
U.A. = User's Accuracy
O.A. = Overall Accuracy

60% Map: W ←→ NFI: D

Fri: P.A. 2%, U.A. 5%
Fri usually locates near river which shape is long and thin

Map: Qf, Qa (Plantation) ←→ NFI: O

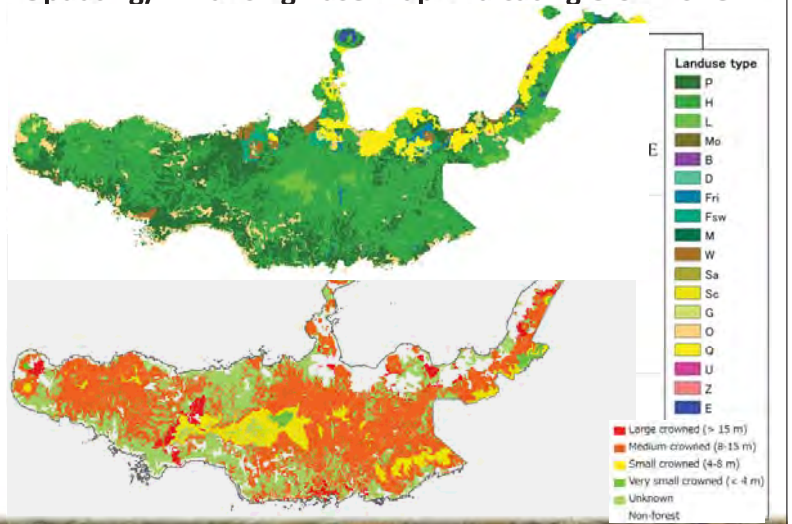
Map: Fsw, W, G ←→ NFI: E
Map: Swamp woodland → W
Swamp grassland, Herbaceous swamp → G

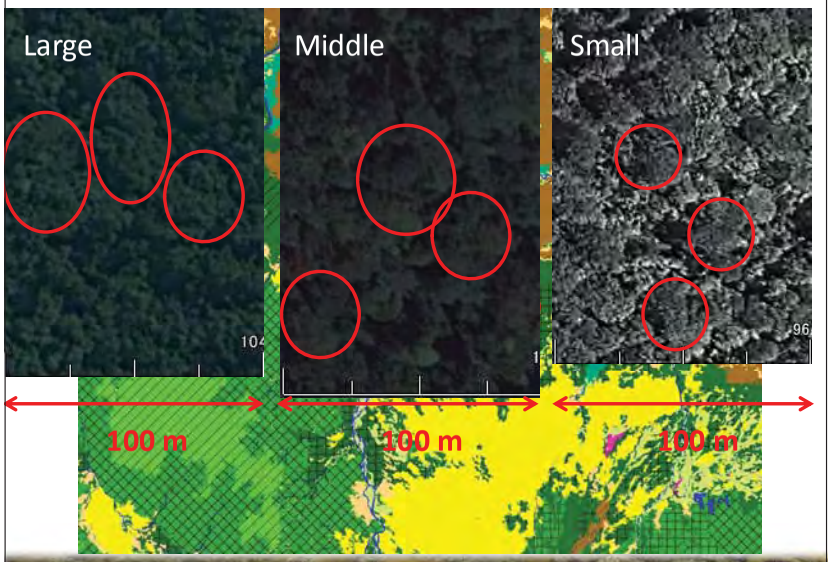
Settlements: P.A. 5%, U.A. 88%
Wetlands: P.A. 21%, U.A. 73%

→ **The Map's features and issues of each class or in each province become clear**

Applicability and points to remember to REDD+ project is clear

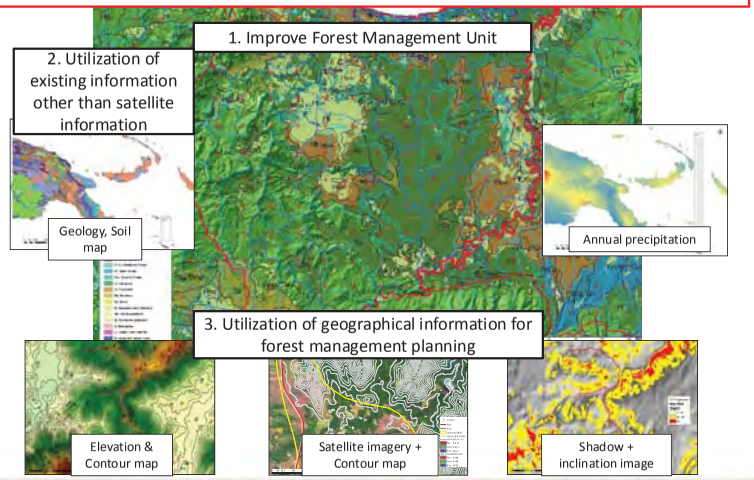
Updating/Enhancing Base Map: Indicating Crown size





Support forest conservation/management/addressing REDD+

Improvement and utilization of the Forest Base Map and DB for planning forest management

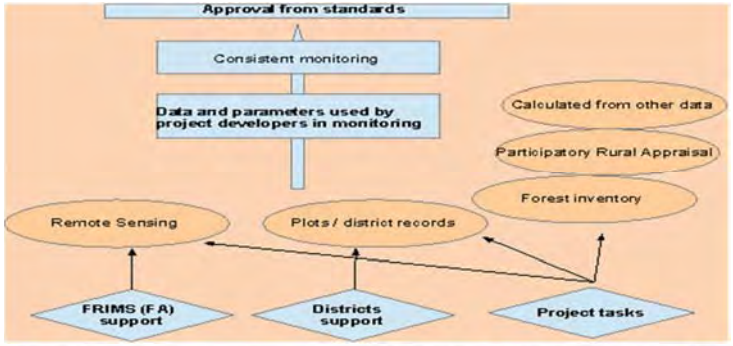


Identifying Methodological Approach in REDD+ Pilot in PNG

I) Standards and methodologies used in PNG REDD+ projects

+ Existing projects: April Salumei (verified and approved) and Central Suau (PDD level)
+ Standards: VCS (Verified Carbon Standards) and CCBS (Carbon, Community, Biodiversity Standards)
+ Methodologies:
  - VM0007 (REDD)
  - VM 0010 (logged forests to protected forests)

II) Sources of data and parameters (required for approbation)



Spatial Data required in REDD+ Voluntary Projects

RS monitoring components	Activity	Frequency	Resources needed
A: Boundary	Detect integrity of project boundary	1 year	ALOS (10m), LANDSAT (30m)
B: Stratification	Land cover classification	1 year	ALOS (10m), LANDSAT (30m), field
C: Land cover changes (deforestation)	Detect and appraise area of deforestation	1 year	Detect: LANDSAT (30m), Appraise area: High Reso (5m)
D: Logging (degradation)	Detect and appraise area of degradation	Continuos	High Resolution (5m)
E: Fire (deforestation)	Detect and appraise area of burning	Continuos	MODIS imagery (250m)
F: Forest Carbon stocks	Species, H, DBH, (emission Factor)	10 years	Field measurements
G: Leakage	New logging or conversion permit in the region	1 year	Detect: LANDSAT (30m), Appraise area: High Reso (5m)

Preparation for Data Sharing (with Local Consultant)

From Phase 1:

- Development and Demarcation of Agriculture and Plantation data through Workshop
- Topology and Geometry Checks of developed/demarcated data layer
- Integration into Basemap V0
- Land Cover Change using visual interpretation methods (PNGFA project sites in PNG) - Pilot

Continuation Work from Phase 1:

1. PNG Provincial Basemap Version 1 Shapefiles (16 GB) Conversions and Compressions

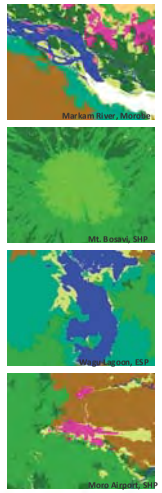
- Shapefile Conversion to ESRI GRID file (600 MB) – Whole country
- ESRI GRID Conversion to TIFF format (1.79 GB) – Whole country
- Data sharing using TIFF based on MDs approval

2. Provincial Forest Planning (PFP)

- Application of Basemap ESRI GRID for PFP Maps
- Apllied basemap to 11 provinces: WHP, SHP, Hela, Jiwaka, Western, EHP, ARB, ENB, Manus, WSP, NIP

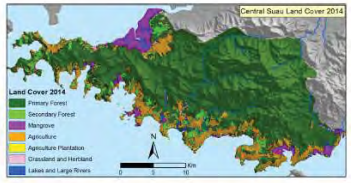
3. Preparation of Logging Constraints layers from PNGRIS 2007

- Counter-part translated Mapinfo tables of PNGRIS 2007 to Shapefiles for all provinces
- Proper filing in progress to prepare for deriving logging constraint's from Inundation, karst limestone layers and maybe other soil properties



Utilization of PNG-FRIMS Data by Other Activities

INTERNATIONAL CLIMATE INITIATIVE
Regional project
Climate Protection through Forest Conservation in Pacific Island Countries

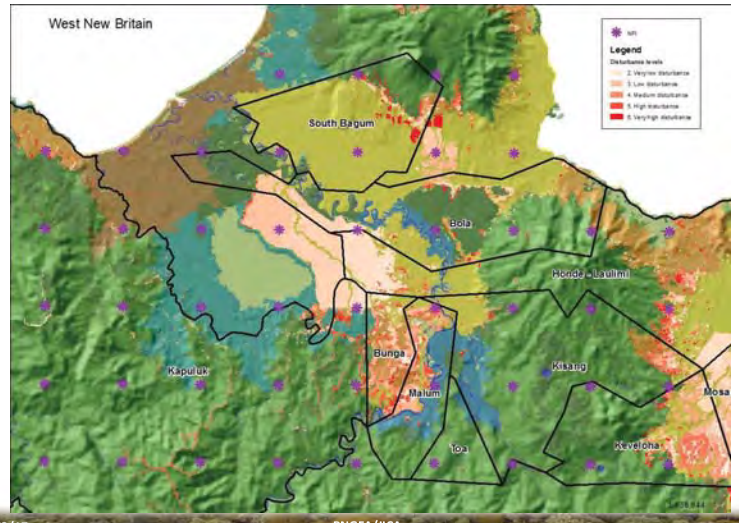


Analysis of Historical Deforestation, Degradation and Land Use in Central Suau / Papua New Guinea

INTERNATIONAL CLIMATE INITIATIVE
Regional project
Climate Protection through Forest Conservation in Pacific Island Countries

Forest Carbon Inventory In
Proposed Central Suau REDD+ Area,
Milne Bay Province,
Papua New Guinea.

Utilization of UMD Hansen data (Secondary/Degradation)



Outcomes of COP19 (Warsaw Framework) & Progress

	Decision in WFR	Progress/Situation
9/CP.19	Work programme on results-based finance for the full implementation of REDD+ activities	
10/CP.19	Coordination of support for the implementation of REDD+ activities, including institutional arrangements	Multilateral(UN-REDD/FAO), bilateral (JICA, GIZ) support and other initiatives (WCS, LEAF) are well coordinated
11/CP.19	Modalities for national forest monitoring systems	Forest Basemap was developed (JICA) NFI pre-assessment using CollectEarth & Monitoring Web Portal (UN-REDD/FAO)
12/CP.19	Timing and the frequency of presentations of the summary of information on how all the REDD+ safeguards are being addressed and respected	Several workshops were held with support of UN-REDD/UNDP. PNGFA also has good experiences on awareness for landowners
13/CP.19	Guidelines and procedures for the technical assessment of forest reference emission levels and/or forest reference levels (FRELs/FRLs)	REL/RL workshop was held in Oct.2014 organized by UN-REDD/FAO, participants from JICA, WCS , LEAF etc.
14/CP.19	Modalities for measuring, reporting and verifying	NFI data can be analyzed and reported by Saiku for GHG inventory (UN-REDD/FAO) . Basemap & CollectEarth was cross checked
15/CP.19	Addressing the drivers of deforestation and forest degradation	Preliminary driver analysis (from 1999 to 2013) was conducted using CollectEarth & Saiku (UN-REDD/FAO)

Publicity of Outcomes at COP20 Side Event @ Lima

①Dec.1st Climate Change Feria (JICA)
Monitoring for Forest Conservation

③Dec.6th DRC Side Event (UN-REDD)
Warsaw Framework & Progress

②Dec.4th Indonesia Pavilion (RESTEC)
Readiness MRV (Carbon&Degradation)

④Dec.8th Indonesia Pavilion (JICA)
Asia Pacific Region: REDD+ Progress

Publicity of Project by News Papers

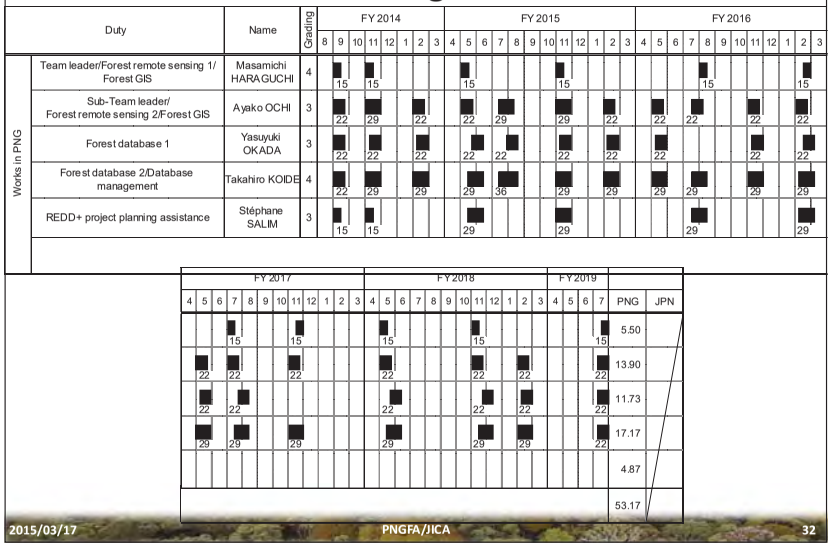
Summary & Way-forward

- Introducing Outcomes of the Project by 2014
  - Basic Design of PNG-FRIMS is being prepared
    - Spatial based forest assessment will be implemented
  - Accuracy Evaluation of Forest BaseMap (ver.1.0)
    - Over 85% Accuracy by F/NF, evaluated by each Province
  - Integration with Existing FIMS/PNGRIS Data/Info
    - Canopy Size are integrated with Forest Basemap
  - Identifying the Requirement for REDD+ Support
    - Requirement are being discussed and explored
  - Preparation for Data Sharing and Enhancement
    - Getting ready and start collaboration (GIZ/LEAF/A.S)
  - Publicity & (International/In-Country)
    - Participation for COP20@Lima and News Paper in PNG
- Summary & Way-forward
  - Integration with FIMS/FIPS & Basemap (update FMU, Timber Volume)
  - Secondary Forest/Degradation (with UMD Hanse-data & CLASlite)
  - Land Change Modeling in Pilot Provinces and Monitoring (LCM)
  - Consideration to Improve Swamp Forest and Wetland (Peat land)
  - Explore the opportunities for Mitigation and Adaptation (GCF etc)

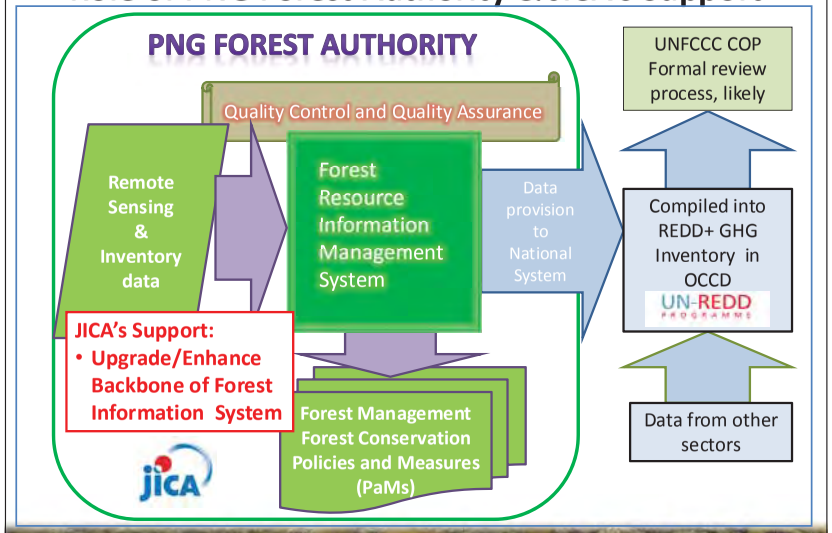
Introduction of Japanese Team

NAME	DUTY
Long Term Experts	
Tatsuya WATANABE	Chief Adviser/Forest Management/Climate Change
Masaya NISHIMURA	Forest Planning/Coordinator
Short Term Experts (KKC Team)	
Masamichi HARAGUCHI	Team Reader/Forest Remote Sensing 1/Forest GIS
Ayako OCHI	Sub-Team Reader/Forest Remote Sensing 2/Forest GIS
Yasuyuki OKADA	Forest Database 1
Takahiro KOIDE	Forest Database 2/Database Management
Stphane SALIM	REDD+ Project Planning Assistance

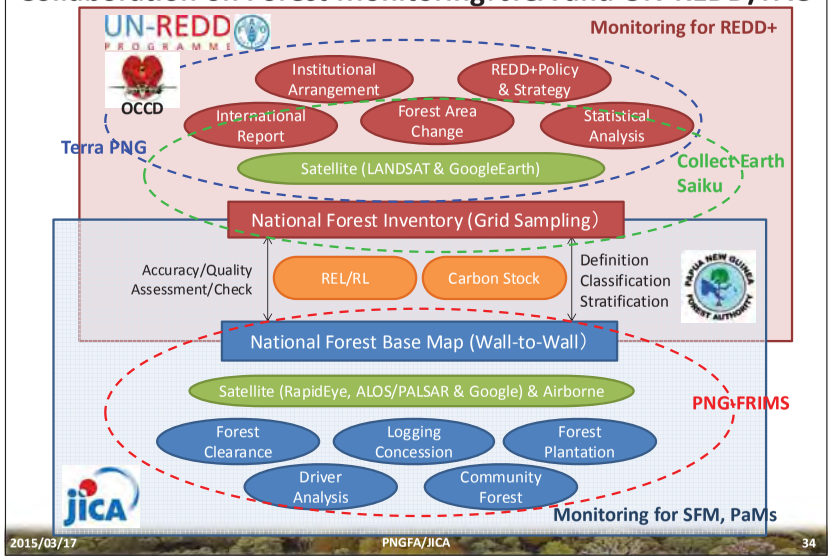
KKC Team Assignment Plan



Role of PNG Forest Authority & JICA's Support



Collaboration on Forest Monitoring: JICA and UN-REDD/FAO



Review of Methodology & Data/Parameters used in Monitoring

Project	Manus	Central Suau	April Salumei
Fund	NGO	Donor	Private
Carbon Methodology	Own	VCS 0010	VCS 0010, VCS 0007
Community/biodiversity	No	Not yet	CCBS (Bd gold)

Data and parameters used in monitoring	Details / conditions	Source
VM OO10 :Improved Forest management: logged to protected forests v1.2		
Illegal logging (PRA)	Whether illegal loggings occur; how deep from roads	PRA
Result of limited illegal logging survey	If enough logging for REDD+	Field survey
$A_{dist,i,t}$	Area disturbed in stratum i at time t	GPS, RS (E)
$A_{DIST\_IL,i}$	Area potentially impacted by illegal logging in stratum i	PRA identify potential logging then GPS and field for delineation
$C_{DIST\_IL,i,t,PRJ}$	Biomass carbon of trees cut and removed through illegal logging in stratum I at time t	Field survey in sample plots
$A_{p,i}$	Total area of illegal logging sample plots in stratum i	Field survey
PMP_i	Merchantable biomass = gross BM DBH>15cm / total ABG BM N.B: PMPi -> forest planning -> legal limit -> extractable volume	Forest inventory

Review of Methodology & Data/Parameters used in Monitoring

Data and parameters used in monitoring	Details / conditions	Source
VM OOO7:REDD methodology modules v 1.3		
Forest cover map	- Forest/Non-forest classification accuracy 90% at least - Monitoring every 5 years at least - Map must be stratified (module X-STR for details)	RS + GPS (B)
Degradation	Forest degradation phenomenon and causes	PRA (participatory rural appraisal)
Result of limited degradation survey	If enough degradation for REDD+	PRA
$A_{def,PA,int}$	Area of recorded deforestation in project area in stratum i converted to land use u at time t	RS (C) Every 5 years
Carbon stocks in above and below ground biomass		
A_{sp}	Area of sample plots	Field survey
N	Number of plots	Field survey
DBH	Diameter at breast height	Field survey
A_{sf}	Area of sampling frame	Field survey
GHG from biomass burning		
$A_{burn,i,t}$	Area burnt in stratum i at time t	RS (E)
$C_{AB,tree,i}$	Carbon stock in above ground biomass in tree t in stratum i	RS (F)
Carbon stocks in the long term wood products pool		
A_i	Total area of the stratum i	GPS, RS (A), parcel records
$V_{ex,i}$	Volume extracted in stratum i, if possible by wood product and species Gross volumes, not net volumes used commercially	RS (F), satellite, aerial, ground or harvest records
Estimation of market effects		
PML_{FT}	Mean merchantable biomass = AGB (DBH>50cm) / total AGB	Calculation