Papua New Guinea
Forest Authority

CAPACITY DEVELOPMENT PROJECT FOR OPERATIONALIZATION OF PNG FOREST RESOURCE INFORMATION MANAGEMENT SYSTEM FOR ADDRESSING CLIMATE CHANGE

FINAL REPORT
(Annexes, Part III and IV)

September 2019

JAPAN INTERNATIONAL COOPERATION AGENCY

KOKUSAI KOGYO CO., LTD.

GE
JR
19-044

Part III

Discussion Materials

Annex 13

Dividing Plain Forest (P) and Hill Forest (H)

in Western Province

Dividing plain forest (P) and hill forest (H) in the Western Province

In the previous project, it was known that the distribution pattern in Low Altitude Forest on Plains and Fans (P) and Low Altitude Forest on Uplands (H) in existing Forest Inventory Mapping System (FIMS) and the new Forest Base Map were totally different. In this Project, the specifications of these forest types were extracted and the threshold of the classification between P and H was clarified at first.

As a result of analysis, it was revealed that the distribution pattern in P and H were different especially in the four forest zones[1] located around the Western province. The large parts of these zones were classified as P in the Forest Base Map and as H in the FIMS map (Figure 1). The tree species composition in these four forest zones was similar to that in H forest in the other area in PNG (Table 1).

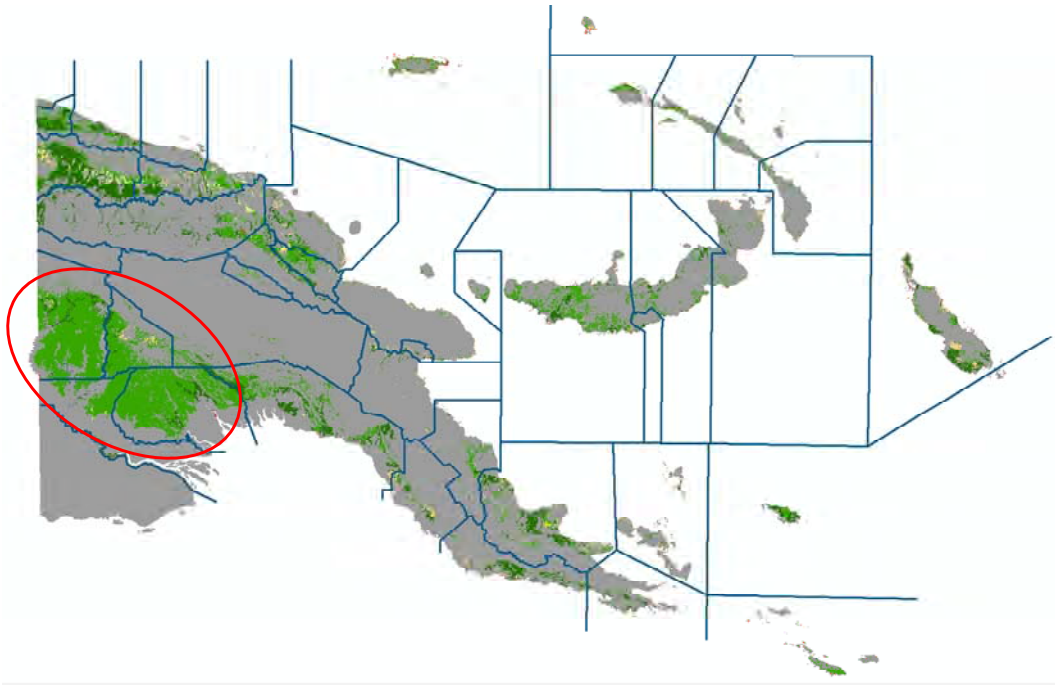


Figure 1. Comparison between distribution pattern in P forest in the Forest Base Map and that in various forest types in FIMS map

The colored part in the map is the area where P forest is distributed in the Forest Base Map. The dark green part is P forest both in the Forest Base Map and FIMS map and the light green part is P forest in the Forest Base Map and H forest in FIMS map. The blue lines indicate the boundaries of each forest zones. Discrepancy between the Forest Base Map and FIMS map is obvious in the

[1] Forty-two "Forest zones", which are divided considering difference in tree species composition, timber volume, etc. due to difference in the climates, etc., are in PNG.

four forest zones circled by a red line

Table 1. Difference in tree composition in P forest and H forest

	P	H
Common species	***Anisoptera***	***Anisoptera***
	Homalium	*Homalium*
	Hopea	***Hopea***
	Intsia	*Intsia*
	Pometia	***Pometia***
	Terminalia	*Terminalia*
	Celtis	***Celtis***
	Canarium	***Canarium***
	Syzygium	***Syzygium***
	Buchanania	***Buchanania***
	Campnosperma	***Campnosperma***
	Vatica	***Vatica***
Non-common species	*Octomeles*	*Calophyllum*
	Alstonia	***Palaquium***
	Endospermum	***Nothofagus***
	Planchonella	***Castanopsis***
	Pterocarpus	***Elmerrillia***
	Pterocymbium	***Flindersia***
	Vitex	***Lithocarpus***

Bold letter indicate the species distributed in the four forest zones.

When the existing FIMS was made, P and H were distinguished from tree composition using airborne pictures in whole nation of PNG and ground survey data. In the previous project, the Forest Base Map was developed from satellite imagery and it was not possible to distinguish tree composition of the forests using the imagery. Comparing the distribution pattern in P and H in FIMS and the steepness of the polygons in the developing Forest Base Map, the fact P forest in FIMS was mainly distributed in the area which slope was less than 6º was ascertained. The project team decided to define low altitude forest which is located on slopes more graduate than 6º as P and the opposite as H.

However, the four forest zone around the Western province has so lower slope (Figure 2 left) that most of the low altitude forests were classified as P (Figure 2 right). On the other hand, the lowland and hill land in that area is clearly separated (Figure 3 left) and typical tree compositions in P and H were found in those places, respectively (Figure 3 right). Namely, the relationship between slopes of the forests and tree composition in this region was different from that in the others and this can be the main reason why distribution in P and H are different between the Forest Base Map and FIMS map in this region.

The short- term expert team raised the following two options to PNGFA as policies to update the Forest Base Map:

1. The definition of P and H in the Forest Base Map would be not changed (use 6º as the threshold)
2. Change P in the four forest zones around the Western province to H if the area was H in FIMS map

The team recommend to choose option 1 if PNGFA consider the slope information was more important than the tree composition information otherwise choose option 2.

Mr. Constin, a leader of Inventory Mapping branch, PNGFA, which is one of the main C/P in this Project, and most of the other staffs, believed slope information was more useful than tree composition information even though there might be relationship between tree composition information and flood plain distribution, which can be important information for logging operation. Besides, they recognized that the current distribution pattern of each tree species in the zones was actually not clear because most of the forests in the zones were disturbed after FIMS map development. As a result, the staffs chose option 1 as their collective opinion.

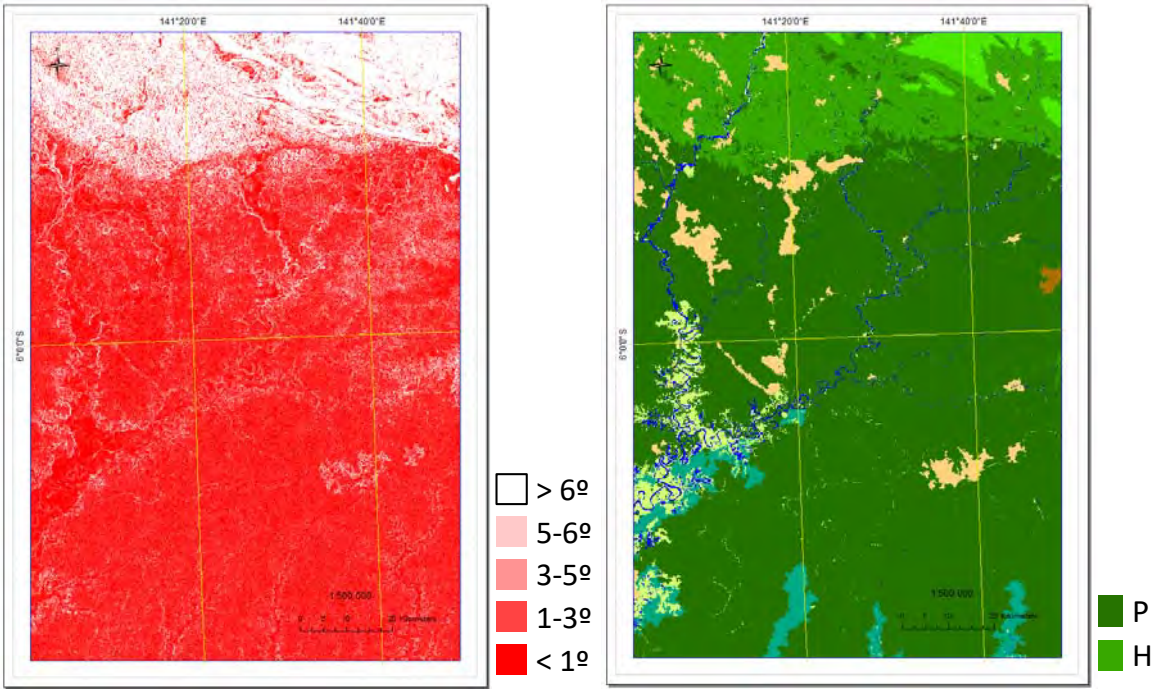


Figure 2. Slope map in some area in Western province (left) and Forest Base Map (right)

H is distributed in areas > 6º

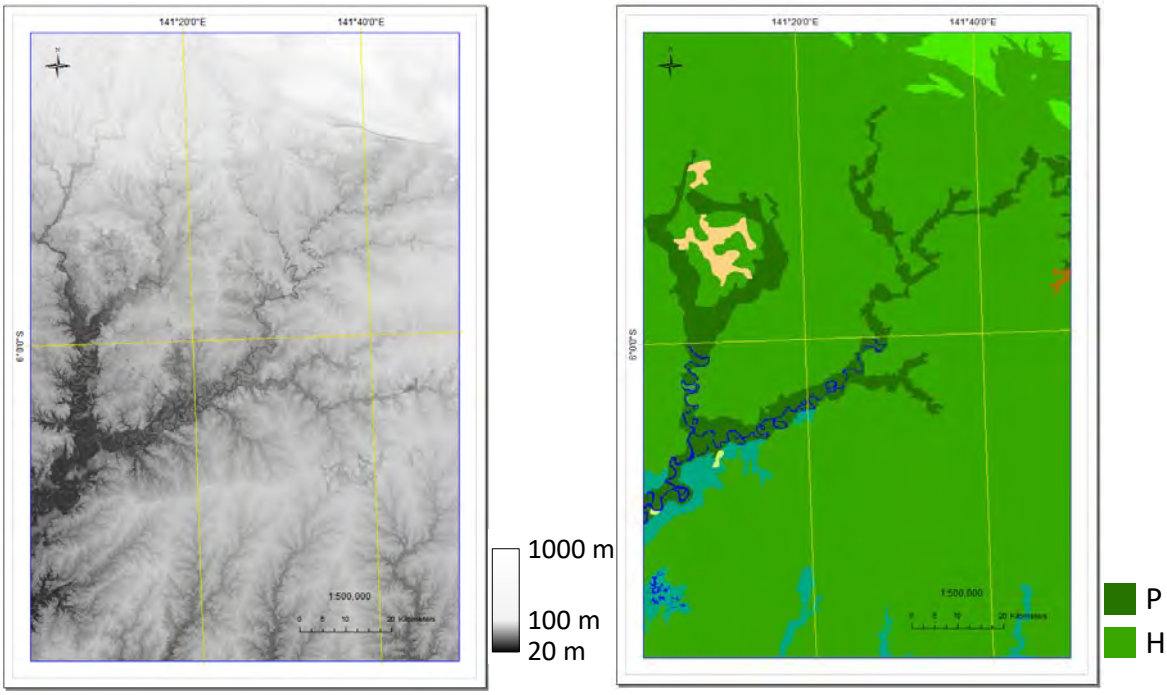


Figure 3. Digital Elevation Model (left) and FIMS map (right)

Distribution in P and low altitude area are corresponding.

On the other hand, Dr. Turia, the leader of Forest Policy & Planning, the superstructure of Inventory & Mapping branch, maintained cautious stance to choose option which greatly change the distribution pattern of the vegetation types and, conversely, was anxious whether updating the Forest Base Map would change the estimated total forest carbon amount in PNG which had been reported to FRA 2015. She asked the short- term expert team to calculate ratios of P forest in the Forest Base Map which was also P forest in FIMS map to total P forest in the Forest Base Map (correspondence ratio) of each option to estimate change in carbon storage amount. The team gave the above two options and the third option;

3. Change all P in PNG to H if the area was H in FIMS map

and report the correspondence ratios were 27.8%, 48.7% and 76.3%, respectively. The team indicated that there would be no inconsistency in the carbon storage whichever options PNGFA chose because the forest carbon storage per area in P forest and in H forest assumed as same in the FRA 2015 report (Table 2) although the correspondence ratio would increase if some part of P forest in the Forest Base Map was turned into H forest. Additionally, the team suggested choosing an option which is merely useful to use as a map because past information would be kept in the database. Dr. Turia finally agreed to choose the first option respecting the choice of the other officers.

The advantage of this choice is that the slope of the site in low altitude forest is obviously known from the vegetation code and easy to identify vegetation code of forest polygons in low altitude

area from slope if those were changed from current non-forest polygons in the future. On the other hand, tree species expected the existence in the site from the vegetation code may not be there actually.

Table 2. Correspondence of forest classification reported for FRA 2015 and Global Ecological Zone (FAO)

Forest Base Map 2012 (PNGFA/JICA)				Global Ecological Zone (FAO)			IPCC ABG (t/ha)
	Forest types	Annual Rainfall	PNGRIS Volume	Forest types		Descriptions	
P	Low altitude forest on plains and fans	High	High				
H	Low altitude forest on uplands	High	High	TAr	Tropical rain forest	Wet: 0 – 3 months dry. When dry period, during winter	300
Fri	Seral forest	High	High				
Fsw	Swamp forest	High	High				
D	Dry seasonal forest	Low-Middle	Middle	TAwa	Tropical moist deciduous forest	Wet/dry: 3 – 5 months dry, during winter	180
B	Littoral forest	-	-				
W	Woodland	Low-High	Low-Middle	TAwb	Tropical dry forest	Dry/wet: 5 – 8 months dry, during winter	130
Sa	Savanna	Low	Low	TBsh	Tropical shrubland	Semi-Arid: Evaporation > Precipitation	70
Sc	Scrub	Low	Low				
L	Lower montane forest	High	High	TM	Tropical mountain systems	Approximate > 1000 m altitude (local variations)	140
Mo	Montane forest	High	-				
M	Mangrove	-	-				192

Annex 14

Error Matrix Tables of the Forest Base Map and

NFI Pre-Inventory

Error Matrix (Forest/Non-forest, PNG)

Accuracy evaluation of land cover category in PNG (Forest, Non-forest)

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

O.A.	87%

Accuracy evaluation of land cover category in PNG (Forest, Non-forest)

*Other wooded land (Woodland, Savanna, Scrub) are included in Non-forest

		NFI			
		Forest	Non-forest	Total	**U.A.**
Map	Forest	16142	1645	17787	91%
	Non-forest	2386	4923	7309	67%
	Total	18528	6568	25096	
	P.A.	87%	75%		

O.A.	84%

Accuracy evaluation of land cover category in PNG (Forest, Non-forest)

*Savanna and Scrub are included in Non-forest

		NFI			
		Forest	Non-forest	Total	**U.A.**
Map	Forest	17606	1743	19349	91%
	Non-forest	1739	4008	5747	70%
	Total	19345	5751	25096	
	P.A.	91%	70%		

O.A.	86%

Error Matrix (6 categories, PNG)

Accuracy evaluation of land cover category in PNG (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	18333	323	719	415	6	82	19878	92%
	Non-forest	Grassland	491	802	179	303	7	20	1802	45%
		Cropland	1063	273	1541	47	2	174	3100	50%
		Wetlands	53	19	2	209		2	285	73%
		Other land	5	4		3	2	1	15	13%
		Settlements		1	1			14	16	88%
		Total	19945	1422	2442	977	17	293	25096	
		P.A.	92%	56%	63%	21%	12%	5%		

O.A.	83%

Error Matrix (6 categories, Province)

Accuracy evaluation of land cover category in Central (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1223	23	45	18	1	5	1315	93%
	Non-forest	Grassland	40	52	12	14	1		119	44%
		Cropland	34	16	21	5		1	77	27%
		Wetlands	3		1	4			8	50%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	1300	91	79	41	2	6	1519	
		P.A.	94%	57%	27%	10%	0%	0%		

O.A.	86%

Accuracy evaluation of land cover category in National Capital District (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1					5	6	17%
	Non-forest	Grassland						1	1	0%
		Cropland						1	1	0%
		Wetlands								#DIV/0!
		Other land								#DIV/0!
		Settlements						7	7	100%
		Total	1					14	15	
		P.A.	100%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	50%		

O.A.	53%

Accuracy evaluation of land cover category in Oro (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	895	13	47	20			975	92%
	Non-forest	Grassland	23	31	13	8	1		76	41%
		Cropland	30	9	65				104	63%
		Wetlands	5	1		4			10	40%
		Other land	1						1	0%
		Settlements						1	1	100%
		Total	954	54	125	32	1	1	1167	
		P.A.	94%	57%	52%	13%	0%	100%		

O.A.	85%

Accuracy evaluation of land cover category in Milne Bay (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	454	14	48			4	520	87%
	Non-forest	Grassland	5	42	8				55	76%
		Cropland	58	20	57			1	136	42%
		Wetlands	1	1				1	3	0%
		Other land								#DIV/0!
		Settlements						1	1	100%
		Total	518	77	113			7	715	
		P.A.	88%	55%	50%	#DIV/0!	#DIV/0!	14%		

O.A.	77%

Accuracy evaluation of land cover category in Gulf (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1403	16	6	188		4	1617	87%
	Non-forest	Grassland	12	6		24	1		43	14%
		Cropland	31	4	11	4		3	53	21%
		Wetlands	5			18			23	78%
		Other land								#DIV/0!
		Settlements						1	1	100%
		Total	1451	26	17	234	1	8	1737	
		P.A.	97%	23%	65%	8%	0%	13%		

O.A.	83%

Accuracy evaluation of land cover category in Western (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	4032	102	17	78	1	4	4234	95%
	Non-forest	Grassland	230	163	3	126	1	1	524	31%
		Cropland	68	7	10	1		4	90	11%
		Wetlands	14	12		98		1	125	78%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	4344	284	30	303	2	10	4973	
		P.A.	93%	57%	33%	32%	0%	0%		

O.A.	87%

Accuracy evaluation of land cover category in Morobe (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1158	23	93	4	1	7	1286	90%
	Non-forest	Grassland	21	96	31	4	1	3	156	62%
		Cropland	88	39	112	3	1	11	254	44%
		Wetlands	5	1	1	10			17	59%
		Other land		2		2			4	0%
		Settlements		1	1			2	4	50%
		Total	1272	162	238	23	3	23	1721	
		P.A.	91%	59%	47%	43%	0%	9%		

O.A.	80%

Accuracy evaluation of land cover category in Madang (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	966	11	58	13		3	1051	92%
	Non-forest	Grassland	25	48	6	7			86	56%
		Cropland	145	17	112	3		23	300	37%
		Wetlands	5	1		11			17	65%
		Other land				1	1		2	50%
		Settlements								#DIV/0!
		Total	1141	77	176	35	1	26	1456	
		P.A.	85%	62%	64%	31%	100%	0%		

O.A.	78%

Accuracy evaluation of land cover category in East Sepik (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1460	25	48	48		7	1588	92%
	Non-forest	Grassland	54	171	2	103		2	332	52%
		Cropland	138	10	67	15		26	256	26%
		Wetlands	1	3		45			49	92%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	1653	209	117	211		35	2225	
		P.A.	88%	82%	57%	21%	#DIV/0!	0%		

O.A.	78%

Accuracy evaluation of land cover category in West Sepik (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	1601	4	20	13		8	1646	97%
	Non-forest	Grassland	24	25	5	8			62	40%
		Cropland	56	3	6	1		8	74	8%
		Wetlands	3			5			8	63%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	1684	32	31	27		16	1790	
		P.A.	95%	78%	19%	19%	#DIV/0!	0%		

O.A.	91%

Accuracy evaluation of land cover category in Chimbu (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	194	2	20	1		1	218	89%
	Non-forest	Grassland	5	10	8				23	43%
		Cropland	13	3	38			12	66	58%
		Wetlands				4			4	100%
		Other land								#DIV/0!
		Settlements						1	1	100%
		Total	212	15	66	5		14	312	
		P.A.	92%	67%	58%	80%	#DIV/0!	7%		

O.A.	79%

Accuracy evaluation of land cover category in Enga (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	384	4	13				401	96%
	Non-forest	Grassland	8	22	3	2		1	36	61%
		Cropland	38	14	103	2		7	164	63%
		Wetlands	1			2			3	67%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	431	40	119	6		8	604	
		P.A.	89%	55%	87%	33%	#DIV/0!	0%		

O.A.	85%

Accuracy evaluation of land cover category in Eastern Hilands (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	308	15	19			4	346	89%
	Non-forest	Grassland	14	63	24			3	104	61%
		Cropland	24	35	50			11	120	42%
		Wetlands	1			1			2	50%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	347	113	93	1		18	572	
		P.A.	89%	56%	54%	100%	#DIV/0!	0%		

O.A.	74%

Accuracy evaluation of land cover category in Southern Hilands (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	589	10	21	12		2	634	93%
	Non-forest	Grassland	3	16	9			1	29	55%
		Cropland	23	33	44	2		8	110	40%
		Wetlands	1						1	0%
		Other land						1	1	0%
		Settlements								#DIV/0!
		Total	616	59	74	14		12	775	
		P.A.	96%	27%	59%	0%	#DIV/0!	0%		

O.A.	84%

Accuracy evaluation of land cover category in Hela (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	376	14	15	1		1	407	92%
	Non-forest	Grassland	5	15	5	1			26	58%
		Cropland	16	10	66	1		1	94	70%
		Wetlands	3			1			4	25%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	400	39	86	4		2	531	
		P.A.	94%	38%	77%	25%	#DIV/0!	0%		

O.A.	86%

Accuracy evaluation of land cover category in Western Highlands (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	326	11	21	1	1		360	91%
	Non-forest	Grassland	4	22	20	1			47	47%
		Cropland	69	30	336	8		25	468	72%
		Wetlands				1			1	100%
		Other land	2						2	0%
		Settlements								#DIV/0!
		Total	401	63	377	11	1	25	878	
		P.A.	81%	35%	89%	9%	0%	0%		

O.A.	78%

Accuracy evaluation of land cover category in Jiwaka (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	547	22	33	2		1	605	90%
	Non-forest	Grassland	7	10	9			2	28	36%
		Cropland	95	16	214	1	1	10	337	64%
		Wetlands	2			1			3	33%
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	651	48	256	4	1	13	973	
		P.A.	84%	21%	84%	25%	0%	0%		

O.A.	79%

Accuracy evaluation of land cover category in West New Britain (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	836		24	3		1	864	97%
	Non-forest	Grassland	4	1	5	1		1	12	8%
		Cropland	50	2	90	1		8	151	60%
		Wetlands				3			3	100%
		Other land					1		1	100%
		Settlements								#DIV/0!
		Total	890	3	119	8	1	10	1031	
		P.A.	94%	33%	76%	38%	100%	0%		

O.A.	90%

Accuracy evaluation of land cover category in East New Britain (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	615	4	18	2	1	1	641	96%
	Non-forest	Grassland	1	1	2			1	5	20%
		Cropland	49	4	72			4	129	56%
		Wetlands	2						2	0%
		Other land								#DIV/0!
		Settlements						1	1	100%
		Total	667	9	92	2	1	7	778	
		P.A.	92%	11%	78%	0%	0%	14%		

O.A.	89%

Accuracy evaluation of land cover category in Manus (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	308	5	28	4		7	352	88%
	Non-forest	Grassland	3	2	2	2		1	10	20%
		Cropland	11		5				16	31%
		Wetlands								#DIV/0!
		Other land	1						1	0%
		Settlements								#DIV/0!
		Total	323	7	35	6		8	379	
		P.A.	95%	29%	14%	0%	#DIV/0!	0%		

O.A.	83%

Accuracy evaluation of land cover category in New Ireland (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	368	5	35			1	409	90%
	Non-forest	Grassland	2	2	2	2	1		9	22%
		Cropland	18	1	26			8	53	49%
		Wetlands								#DIV/0!
		Other land								#DIV/0!
		Settlements								#DIV/0!
		Total	388	8	63	2	1	9	471	
		P.A.	95%	25%	41%	0%	0%	0%		

O.A.	84%

Accuracy evaluation of land cover category in Autonomous Region of Bougainville (6 categories)

			NFI							
			Forest	Non-forest						
			Forest	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	289		90	7	1	16	403	72%
	Non-forest	Grassland	1	4	10		1	3	19	21%
		Cropland	9		36			2	47	77%
		Wetlands	1			1			2	50%
		Other land	1	2					3	0%
		Settlements								#DIV/0!
		Total	301	6	136	8	2	21	474	
		P.A.	96%	67%	26%	13%	0%	0%		

O.A.	70%

Error Matrix (7 categories, PNG)

Accuracy evaluation of land cover category in PNG (7 categories)

			NFI								
			Forest		Grassland	Cropland	Wetlands	Other land	Settlements		
			Forest	and/Savanna/	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	16142	363	237	666	300	5	74	17787	91%
		Woodland/Sa	995	833	86	53	115	1	8	2091	40%
	Grassland	Grassland	331	160	802	179	303	7	20	1802	45%
	Cropland	Cropland	1007	56	273	1541	47	2	174	3100	50%
	Wetlands	Wetlands	49	4	19	2	209		2	285	73%
	Other land	Other land	4	1	4		3	2	1	15	13%
	Settlements	Settlements			1	1			14	16	88%
		Total	18528	1417	1422	2442	977	17	293	25096	
		P.A.	87%	59%	56%	63%	21%	12%	5%		
		O.A.	78%								

Error Matrix (8 categories, PNG)

Accuracy evaluation of land cover category in PNG (8 categories)

			NFI									
			Forest			Grassland	Cropland	Wetlands	Other land	Settlements		
			Forest	Woodland	avanna/Scru	Grassland	Cropland	Wetlands	Other land	Settlements	Total	**U.A.**
Map	Forest	Forest	16142	255	108	237	666	300	5	74	17787	91%
		Woodland	902	307	155	51	41	104		2	1562	20%
		Savanna/Scr	93	135	236	35	12	11	1	6	529	45%
	Grassland	Grassland	331	98	62	802	179	303	7	20	1802	45%
	Cropland	Cropland	1007	21	35	273	1541	47	2	174	3100	50%
	Wetlands	Wetlands	49	1	3	19	2	209		2	285	73%
	Other land	Other land	4		1	4		3	2	1	15	13%
	Settlements	Settlements				1	1			14	16	88%
		Total	18528	817	600	1422	2442	977	17	293	25096	
		P.A.	87%	38%	39%	56%	63%	21%	12%	5%		

O.A.	77%

Error Matrix (vegetation classes, PNG)

Accuracy evaluation of forest base map in PNG

					NFI																						
					Forest											Grassland		Cropland		Wetla	Other	Settle		
					Forest								Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle	Total	**U.A.**
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	2446	1138	4		40	21	70	309	31	16	65	9	18	41		184	26	80		31	4529	54%
			H	Low Altitude Forest on Up	1122	4820	109			9	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	1	5	47			65	3	3	13				7			480	43%
			B	Littoral Forest	8					6		3	1		7			1			1				27	22%
			Fri	Seral Forest	17	18	11			1	4	11	1		5			3		2	3	6			82	5%
			Fsw	Swamp Forest	297	38			48	6	22	314	11		90	15	11	33		13	1	116		6	1021	31%
			M	Mangrove	17				2	11	2	34	104		5	2		1		3	2	62		2	247	42%
			Qf	Forest Plantation	3	3	1			1				7	1		2	1	1	11	2				33	21%
		Woodland	W	Woodland	267	33	1		326	5	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	Grassland	G	Grassland and Herbland	83	44	45		53	3	7	72	4	1	98	24	36	689	20	162	15	303	7	19	1685	41%
			Ga/G	Alpine grassland/Subalpin			7	12									2	23	70	2				1	117	60%
	Cropland	Cropland	O	Agricultural Land Use	225	299	363	4	7	12	16	45	6	7	21	9	24	233	30	1211	132	47	2	165	2858	42%
			Qa	Plantation other than fore	13	6				1		1		2			2	10		66	132			9	242	55%
	Wetlands	Wetlands	E	Lakes and larger rivers	13	18	3		2		4	6	3		1	2	1	19		2		209		2	285	73%
	Other land	Other land	Z	Bare areas	2	1	1										1	4				3	2	1	15	13%
	Settlements	Settlements	U	Larger urban centres														1		1				14	16	88%
	Total				4641	6486	4774	277	752	77	193	1118	171	39	817	402	198	1257	165	2095	347	977	17	293	25096	
	P.A.				53%	74%	88%	67%	28%	8%	2%	28%	61%	18%	38%	33%	6%	55%	42%	58%	38%	21%	12%	5%		

O.A.	60%

Error Matrix (vegetation classes, Province)

Accuracy evaluation of forest base map in Central

					NFI																						
					Forest											Grassland		Cropland		Wetla	Other	Settle		
					Forest								Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle	Total	**U.A.**
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	92	7				1	7	6		1	12	9		1		10	2	6		1	155	59%
			H	Low Altitude Forest on Up	82	449	13			1	6	1			5	6	1	5		7	1	1		2	580	77%
			L	Lower Montane Forest		2	329	6										2	4	8					351	94%
			Mo	Montane Forest			2	16											3						21	76%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest	2							2			1			1							6	0%
			Fri	Seral Forest		3																			3	0%
			Fsw	Swamp Forest	1						3				1										5	0%
			M	Mangrove							2	3	17		1			1				3			27	63%
			Qf	Forest Plantation		1								3	1					3	1				9	33%
		Woodland	W	Woodland	25	7					4	8	1		21	16		3		4		5			94	22%
		Savanna /Scrub	Sa	Savanna	3	1									8	29	3	3		8		2	1	2	60	48%
			Sc	Scrub				1							1					1		1			4	0%
	Grassland	Grassland	G	Grassland and Herbland	2	3	3					2	2		11	14	1	39	1	12		14	1		105	37%
			Ga/G	Alpine grassland/Subalpin			1	1										4	8						14	57%
	Cropland	Cropland	O	Agricultural Land Use	10	6	7			2	1			1		6	1	15		17	2	5		1	74	23%
			Qa	Plantation other than fore														1		1	1				3	33%
	Wetlands	Wetlands	E	Lakes and larger rivers		1					1		1							1		4			8	50%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total				217	480	355	24		4	24	22	21	5	62	80	6	75	16	72	7	41	2	6	1519	
	P.A.				42%	94%	93%	67%	####	0%	0%	0%	81%	60%	34%	36%	0%	52%	50%	24%	14%	10%	0%	0%		

O.A.	67%

Accuracy evaluation of forest base map in National Capital District

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle		
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle	Total	**U.A.**
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl																						#####
			H	Low Altitude Forest on Up																						#####
			L	Lower Montane Forest																						#####
			Mo	Montane Forest																						#####
			D	Dry Seasonal Forest																						#####
			B	Littoral Forest																						#####
			Fri	Seral Forest																						#####
			Fsw	Swamp Forest																						#####
			M	Mangrove																						#####
			Qf	Forest Plantation																						#####
		Woodland	W	Woodland																				1	1	0%
		Savanna /Scrub	Sa	Savanna												1								4	5	20%
			Sc	Scrub																						#####
	Grassland	Grassland	G	Grassland and Herbland																				1	1	0%
			Ga/G	Alpine grassland/Subalpin																						#####
	Cropland	Cropland	O	Agricultural Land Use																				1	1	0%
			Qa	Plantation other than fore																						#####
	Wetlands	Wetlands	E	Lakes and larger rivers																						#####
	Other land	Other land	Z	Bare areas																						#####
	Settlements	Settlements	U	Larger urban centres																				7	7	100%
			Total													1								14	15	
			P.A.		#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	100%	#####	#####	#####	#####	#####	#####	#####	50%		

O.A.	53%

Accuracy evaluation of forest base map in Oro

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle		
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle	Total	**U.A.**
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	91	42				1	5	12			4		3	3		20	2	9			192	47%
			H	Low Altitude Forest on Up	56	284	12								8		5	3		15					383	74%
			L	Lower Montane Forest		6	237	3										1		2					249	95%
			Mo	Montane Forest			1	13											1						15	87%
			D	Dry Seasonal Forest																						#####
			B	Littoral Forest											1										1	0%
			Fri	Seral Forest	4	3	2								4							1			14	0%
			Fsw	Swamp Forest	5	1						3			1			3		1					14	21%
			M	Mangrove									8												8	100%
			Qf	Forest Plantation																						#####
		Woodland	W	Woodland	32	1					1	18			20					5	1	10			88	23%
		Savanna /Scrub	Sa	Savanna	1		1								2	3		2		1					10	30%
			Sc	Scrub											1										1	0%
	Grassland	Grassland	G	Grassland and Herbland	5	6	1				1	3			4		1	26	1	11	2	8	1		70	37%
			Ga/G	Alpine grassland/Subalpin			1	1										2	2						6	33%
	Cropland	Cropland	O	Agricultural Land Use	1	15						1			1		2	9		37					66	56%
			Qa	Plantation other than fore	6	4														15	13				38	34%
	Wetlands	Wetlands	E	Lakes and larger rivers	2	2						1						1				4			10	40%
	Other land	Other land	Z	Bare areas	1																				1	0%
	Settlements	Settlements	U	Larger urban centres																				1	1	100%
			Total		204	364	255	17		1	7	38	8		46	3	11	50	4	107	18	32	1	1	1167	
			P.A.		45%	78%	93%	76%	#####	0%	0%	8%	100%	#####	43%	100%	0%	52%	50%	35%	72%	13%	0%	100%		

O.A.	64%

Accuracy evaluation of forest base map in Milne Bay

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle		
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle	Total	**U.A.**
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	62	11				6		1		2			1	3		19	3			1	109	57%
			H	Low Altitude Forest on Up	74	197	1			1					1		1	7		22	2			3	309	64%
			L	Lower Montane Forest			64										1	1							66	97%
			Mo	Montane Forest													1								1	0%
			D	Dry Seasonal Forest																						#####
			B	Littoral Forest																	1				1	0%
			Fri	Seral Forest																						#####
			Fsw	Swamp Forest														1							1	0%
			M	Mangrove	7					3			13							1					24	54%
			Qf	Forest Plantation										1											1	100%
		Woodland	W	Woodland	3					1			1					1							6	0%
		Savanna /Scrub	Sa	Savanna																						#####
			Sc	Scrub	1													1							2	0%
	Grassland	Grassland	G	Grassland and Herbland		4											1	41		8					54	76%
			Ga/G	Alpine grassland/Subalpin														1							1	0%
	Cropland	Cropland	O	Agricultural Land Use	20	21	10			4		1	1				1	20		43	6			1	128	34%
			Qa	Plantation other than fore																1	7				8	88%
	Wetlands	Wetlands	E	Lakes and larger rivers									1					1						1	3	0%
	Other land	Other land	Z	Bare areas																						#####
	Settlements	Settlements	U	Larger urban centres																				1	1	100%
			Total		167	233	75			15		2	16	3	1		6	77		94	19			7	715	
			P.A.		37%	85%	85%	#####	#####	0%	#####	0%	81%	33%	0%	#####	0%	53%	#####	46%	37%	#####	#####	14%		

O.A.	60%

Accuracy evaluation of forest base map in Gulf

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	298	138					7	48	10		3			1		1		24			530	56%
			H	Low Altitude Forest on Up	177	367	7				18	3			1					3		13		2	591	62%
			L	Lower Montane Forest		4	76	1										3						1	85	89%
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest									1												1	0%
			Fri	Seral Forest																						####
			Fsw	Swamp Forest	46	1					2	79	7		11							72		1	219	36%
			M	Mangrove	2							20	25			2				1		55			105	24%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	14	4					1	26	2		2			7				23			79	3%
		Savanna /Scrub	Sa	Savanna														5		1		1			7	0%
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	5	1						2	1		1	2		6				24	1		43	14%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	6	11	10				1		1			1		4		11		4		3	52	21%
			Qa	Plantation other than fore	1																				1	0%
	Wetlands	Wetlands	E	Lakes and larger rivers	2	1					1	1										18			23	78%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																				1	1	100%
	Total				551	527	93	1			30	179	47		18	5		26		17		234	1	8	1737	
	P.A.				54%	70%	82%	0%	####	####	0%	44%	53%	####	11%	0%	####	23%	####	65%	####	8%	0%	13%		

O.A.	51%

Accuracy evaluation of forest base map in Western

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	957	500			40		8	71		13	19		2	8		9		17		1	1645	58%
			H	Low Altitude Forest on Up	48	250	3							1				2		2				1	307	81%
			L	Lower Montane Forest		1	137											2		2			1		143	96%
			Mo	Montane Forest				3											1						4	75%
			D	Dry Seasonal Forest	121	8			207	1	5	47			65	3	3	13				7			480	43%
			B	Littoral Forest	5					5					5										15	33%
			Fri	Seral Forest	1				1		1	2						2				2			8	13%
			Fsw	Swamp Forest	43	8			48	4	11	112	3		53	15	4	23		1		26			351	32%
			M	Mangrove	5				2	5		10	17		3							1		2	45	38%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	46	8			326	2	3	53	1		210	99	5	27		2		18			800	26%
		Savanna /Scrub	Sa	Savanna	1				34			8	3		67	99	5	17		1		6			241	41%
			Sc	Scrub	1				33			3			56	85	9	7				1			195	5%
	Grassland	Grassland	G	Grassland and Herbland	33	9	1		53	3	3	50		1	69	8		163		3		126	1	1	524	31%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	9	27	4		7	2		4		6	6	2	1	7		10		1		4	90	11%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers	4				2		1	4			1	2		12				98		1	125	78%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total				1274	811	145	3	752	22	32	364	24	21	554	313	29	283	1	30		303	2	10	4973	
	P.A.				75%	31%	94%	100%	28%	23%	3%	31%	71%	0%	38%	32%	31%	58%	0%	33%	####	32%	0%	0%		

O.A.	46%

Accuracy evaluation of forest base map in Morobe

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	17	6					4	1			2		1	4		11	1	1		2	50	34%
			H	Low Altitude Forest on Up	58	301	9			1	5						3	10		43	1		1	3	435	69%
			L	Lower Montane Forest		8	659	18						1			3	4	2	30	1			2	728	91%
			Mo	Montane Forest			1	19									2		3						25	76%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																		1			1	0%
			Fsw	Swamp Forest	6	2						1									1	1			11	9%
			M	Mangrove						1			1												2	50%
			Qf	Forest Plantation		1								2			2			3					8	25%
		Woodland	W	Woodland	6	5						8			2		2				2	1			26	8%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	1	6	7										5	80	6	31		4	1	3	144	56%
			Ga/G	Alpine grassland/Subalpin				2											10						12	83%
	Cropland	Cropland	O	Agricultural Land Use	6	34	43					1					4	31	2	97	1	3	1	11	234	41%
			Qa	Plantation other than fore														6		11	3				20	15%
	Wetlands	Wetlands	E	Lakes and larger rivers	1	3											1	1		1		10			17	59%
	Other land	Other land	Z	Bare areas														2				2			4	0%
	Settlements	Settlements	U	Larger urban centres														1		1				2	4	50%
	Total				95	366	719	39		2	9	11	1	3	4		23	139	23	228	10	23	3	23	1721	
	P.A.				18%	82%	92%	49%	####	0%	0%	9%	100%	67%	50%	####	0%	58%	43%	43%	30%	43%	0%	9%		

O.A.	70%

Accuracy evaluation of forest base map in Madang

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	158	22					14	12			2		3	1		17	1	2			232	68%
			H	Low Altitude Forest on Up	92	328	7				6						2	4		28				3	470	70%
			L	Lower Montane Forest		7	214	4									4	1	1	4					235	91%
			Mo	Montane Forest				10											1						11	91%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest		1															1				2	0%
			Fsw	Swamp Forest	26						3	14			1		1	3				2			50	28%
			M	Mangrove																						####
			Qf	Forest Plantation										1											1	100%
		Woodland	W	Woodland	11						4	10			6		3			7		9			50	12%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	10	5	4				1	1			2		1	46		5	1	7			83	55%
			Ga/G	Alpine grassland/Subalpin													1		2						3	67%
	Cropland	Cropland	O	Agricultural Land Use	46	45	31			3	6	6			6		1	17		97	5	3		23	289	34%
			Qa	Plantation other than fore	1															4	6				11	55%
	Wetlands	Wetlands	E	Lakes and larger rivers	1	4												1				11			17	65%
	Other land	Other land	Z	Bare areas																		1	1		2	50%
	Settlements	Settlements	U	Larger urban centres																						####
	Total				345	412	256	14		3	34	43		1	17		16	73	4	162	14	35	1	26	1456	
	P.A.				46%	80%	84%	71%	####	0%	0%	33%	####	100%	35%	####	0%	63%	50%	60%	43%	31%	100%	0%		

O.A.	61%

Accuracy evaluation of forest base map in East Sepik

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	174	22				2	4	78	1		15		4	9		15		6		4	334	52%
			H	Low Altitude Forest on Up	86	409	3					7			1					11		1		2	520	79%
			L	Lower Montane Forest		3	113	1												1					118	96%
			Mo	Montane Forest				2																	2	100%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest						1															1	100%
			Fri	Seral Forest	2						1	8						1				2			14	7%
			Fsw	Swamp Forest	115	15				1	2	74			17		5	3		6		6		1	245	30%
			M	Mangrove									6		1					1		3			11	55%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	109	6					3	101			41		27	12		13	1	30			343	12%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	10		1				2	7	1		11		22	171		2		103		2	332	52%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	55	35	4				6	27			6		4	10		67		15		26	255	26%
			Qa	Plantation other than fore													1								1	0%
	Wetlands	Wetlands	E	Lakes and larger rivers									1					3				45			49	92%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total				551	490	121	3		4	18	302	9		92		63	209		116	1	211		35	2225	
	P.A.				32%	83%	93%	67%	####	25%	6%	25%	67%	####	45%	####	0%	82%	####	58%	0%	21%	####	0%		

O.A.	50%

Accuracy evaluation of forest base map in West Sepik

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	272	130					14	51	3		3		1	2		7		9		7	499	55%
			H	Low Altitude Forest on Up	72	624	14								1		1	1		7		1			721	87%
			L	Lower Montane Forest		5	297	3									1			5					311	95%
			Mo	Montane Forest			2	3									1		1						7	43%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest	2																				2	0%
			Fsw	Swamp Forest	38	4					1	24			5					1		2			75	32%
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	14	1						10			3		1					1		1	31	10%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	9	2	5					6					2	22	1	5		8			60	37%
			Ga/G	Alpine grassland/Subalpin															2						2	100%
	Cropland	Cropland	O	Agricultural Land Use	12	33	4					3			2		2	2	1	6		1		8	74	8%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers	2						1											5			8	63%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total				421	799	322	6			16	94	3		14		9	27	5	31		27		16	1790	
	P.A.				65%	78%	92%	50%	####	####	0%	26%	0%	####	21%	####	0%	81%	40%	19%	####	19%	####	0%		

O.A.	70%

Accuracy evaluation of forest base map in Chimbu

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	2	1																		3	67%
			H	Low Altitude Forest on Up	51	1														5		1			58	2%
			L	Lower Montane Forest	2	130	1										2	2		15				1	153	1%
			Mo	Montane Forest			4																		4	0%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	1	2												7		7					17	41%
			Ga/G	Alpine grassland/Subalpin		1	1												3	1					6	50%
	Cropland	Cropland	O	Agricultural Land Use	3	10												3		37	1			12	66	56%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers																		4			4	100%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																				1	1	100%
	Total				59	145	6										2	12	3	65	1	5		14	312	
	P.A.				3%	1%	17%	####	####	####	####	####	####	####	####	####	0%	58%	100%	57%	0%	80%	####	7%		

O.A.	18%

Accuracy evaluation of forest base map in Enga

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl		1																		1	0%
			H	Low Altitude Forest on Up		26	7										1	1		1				36	72%
			L	Lower Montane Forest			279	10									1		2	9	3			304	92%
			Mo	Montane Forest			3	56											1					60	93%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	1		3											4		2		2			12	33%
			Ga/G	Alpine grassland/Subalpin			2	1									1	7	11	1				1	24	46%
	Cropland	Cropland	O	Agricultural Land Use		2	35										1	8	6	101	2	2		7	164	62%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers		1																2			3	67%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total				1	30	329	67									4	20	20	114	5	6		8	604	
	P.A.				0%	87%	85%	84%	####	####	####	####	####	####	####	####	0%	20%	55%	89%	0%	33%	####	0%		

O.A.	79%

Accuracy evaluation of forest base map in Eastern Hilands

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl											1		1	1						3	0%
			H	Low Altitude Forest on Up		30	1																	31	97%
			L	Lower Montane Forest			262	2									1	11	2	18			4	300	87%
			Mo	Montane Forest			1	8																9	89%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation			1												1	1				3	0%
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		1	10										3	51	11	24			3	103	50%
			Ga/G	Alpine grassland/Subalpin															1					1	100%
	Cropland	Cropland	O	Agricultural Land Use			24											22	13	46	2		11	118	39%
			Qa	Plantation other than fore																1	1			2	50%
	Wetlands	Wetlands	E	Lakes and larger rivers			1															1		2	50%
	Other land	Other land	Z	Bare areas																					####
	Settlements	Settlements	U	Larger urban centres																					####
	Total					31	300	10							1		5	85	28	90	3	1		18	572	
	P.A.				####	97%	87%	80%	####	####	####	####	####	####	0%	####	0%	60%	4%	51%	33%	100%	####	0%		

O.A.	70%

Accuracy evaluation of forest base map in Southern Hilands

					NFI																					
					Forest											Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest								Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	14	59	3				3									1		1			81	17%
			H	Low Altitude Forest on Up	11	200	10													2		2			225	89%
			L	Lower Montane Forest		6	264	1						1				9	1	18		3		2	305	87%
			Mo	Montane Forest				7																	7	100%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest		7																2			9	0%
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland								2					1					4			7	0%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		1	2											8		9				1	21	38%
			Ga/G	Alpine grassland/Subalpin															8						8	100%
	Cropland	Cropland	O	Agricultural Land Use	1	1	21											30	3	43	1	2		8	110	39%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers		1																			1	0%
	Other land	Other land	Z	Bare areas																			1		1	0%
	Settlements	Settlements	U	Larger urban centres																						####
	Total				26	275	300	8			3	2		1			1	47	12	73	1	14		12	775	
	P.A.				54%	73%	88%	88%	####	####	0%	0%	####	0%	####	####	0%	17%	67%	59%	0%	0%	####	0%		

O.A.	70%

Accuracy evaluation of forest base map in Hela

					NFI																					
					Forest											Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest								Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl		9																		9	0%
			H	Low Altitude Forest on Up		45	4											3							52	87%
			L	Lower Montane Forest		4	300	3										11		15		1		1	335	90%
			Mo	Montane Forest			3	7																	10	70%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland			1																		1	0%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		1	2											5		5		1			14	36%
			Ga/G	Alpine grassland/Subalpin			2											7	3						12	25%
	Cropland	Cropland	O	Agricultural Land Use		1	15											9	1	66		1		1	94	70%
			Qa	Plantation other than fore																						####
	Wetlands	Wetlands	E	Lakes and larger rivers		2	1															1			4	25%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
	Total					62	328	10										35	4	86		4		2	531	
	P.A.				####	73%	91%	70%	####	####	####	####	####	####	####	####	####	14%	75%	77%	####	25%	####	0%		

O.A.	80%

Accuracy evaluation of forest base map in Western Highlands

					NFI																					
					Forest											Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest								Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	8	7						3						1		3		1			23	35%
			H	Low Altitude Forest on Up	3	29	2					1								1			1		37	78%
			L	Lower Montane Forest			247	5									1	3		12	1				269	92%
			Mo	Montane Forest			1	17									2	2	5						27	63%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation																3	1				4	0%
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		1												4		17	3	1			26	15%
			Ga/G	Alpine grassland/Subalpin				3										1	17						21	81%
	Cropland	Cropland	O	Agricultural Land Use		2	62	1									4	25	4	282	39	8		23	450	63%
			Qa	Plantation other than fore														1		6	9			2	18	50%
	Wetlands	Wetlands	E	Lakes and larger rivers																		1			1	100%
	Other land	Other land	Z	Bare areas		1	1																1		2	0%
	Settlements	Settlements	U	Larger urban centres																						####
	Total				11	40	313	26				4					7	37	26	324	53	11	1	25	878	
	P.A.				73%	73%	79%	65%	####	####	####	0%	####	####	####	####	0%	11%	65%	87%	17%	9%	0%	0%		

O.A.	70%

Accuracy evaluation of forest base map in Jiwaka

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	2	12														1					15	13%
			H	Low Altitude Forest on Up		142	3													6					151	94%
			L	Lower Montane Forest			346	16										6	6	24	2	2		1	403	86%
			Mo	Montane Forest			5	21											10						36	58%
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove																						####
			Qf	Forest Plantation																						####
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		1	3											6		8	1			2	21	29%
			Ga/G	Alpine grassland/Subalpin				3										1	3						7	43%
	Cropland	Cropland	O	Agricultural Land Use		11	79	3									2	16		163	37	1	1	10	323	50%
			Qa	Plantation other than fore																7	7				14	50%
	Wetlands	Wetlands	E	Lakes and larger rivers		1	1															1			3	33%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
			Total		2	167	437	43									2	29	19	209	47	4	1	13	973	
			P.A.		100%	85%	79%	49%	####	####	####	####	####	####	####	####	0%	21%	16%	78%	15%	25%	0%	0%		

O.A.	71%

Accuracy evaluation of forest base map in West New Britain

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	138	94				6		5	6							5	4				258	53%
			H	Low Altitude Forest on Up	128	388	4			1							2			2	9	2		1	537	72%
			L	Lower Montane Forest		1	28																		29	97%
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest	1	4						1									2				8	0%
			Fsw	Swamp Forest	7					1		3										1			12	25%
			M	Mangrove						1			4								1				6	67%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	4	1				1		3	2		1		1				1				14	7%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland		2	1					1						1			5	1		1	12	8%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	20	18					1	1	3					2		13	8	1		3	70	19%
			Qa	Plantation other than fore	3	2				1							1			1	68			5	81	84%
	Wetlands	Wetlands	E	Lakes and larger rivers																		3			3	100%
	Other land	Other land	Z	Bare areas																			1		1	100%
	Settlements	Settlements	U	Larger urban centres																						####
			Total		301	510	33			11	1	14	15		1		4	3		21	98	8	1	10	1031	
			P.A.		46%	76%	85%	####	####	0%	0%	21%	27%	####	100%	####	0%	33%	####	62%	69%	38%	100%	0%		

O.A.	63%

Accuracy evaluation of forest base map in East New Britain

					NFI																					
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	32	22				1	1	2								2	3				63	51%
			H	Low Altitude Forest on Up	89	291	2			1	8	1		2				3		6	5	1	1	1	411	71%
			L	Lower Montane Forest		6	138																		144	96%
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest								1													1	0%
			Fri	Seral Forest	2	5					1														8	13%
			Fsw	Swamp Forest																						####
			M	Mangrove	2								2								1				5	40%
			Qf	Forest Plantation	3	1				1								1		1					7	0%
		Woodland	W	Woodland																		1			1	0%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub													1								1	100%
	Grassland	Grassland	G	Grassland and Herbland	1													1		1	1			1	5	20%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	22	21	4				1							2		42	21			4	117	36%
			Qa	Plantation other than fore										1				2		4	5				12	42%
	Wetlands	Wetlands	E	Lakes and larger rivers	1	1																			2	0%
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																				1	1	100%
			Total		152	347	144			3	11	4	2	3			1	9		56	36	2	1	7	778	
			P.A.		21%	84%	96%	####	####	0%	9%	0%	100%	0%	####	####	100%	11%	####	75%	14%	0%	0%	14%		

O.A.	66%

Accuracy evaluation of forest base map in Manus

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	52	26				2	1	13	5		4			4		16	1	3		5	132	39%
			H	Low Altitude Forest on Up	96	100					2	3						1		11		1		2	216	46%
			L	Lower Montane Forest																						####
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest																						####
			Fsw	Swamp Forest																						####
			M	Mangrove	1								3											4	75%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland																						####
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	3													2		2		2		1	10	20%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	6	4														3	1				14	21%
			Qa	Plantation other than fore	1																1				2	50%
	Wetlands	Wetlands	E	Lakes and larger rivers																						####
	Other land	Other land	Z	Bare areas	1																				1	0%
	Settlements	Settlements	U	Larger urban centres																						####
			Total		160	130				2	3	16	8		4			7		32	3	6		8	379	
			P.A.		33%	77%	####	####	####	0%	0%	0%	38%	####	0%	####	####	29%	####	9%	33%	0%	####	0%		

O.A.	42%

Accuracy evaluation of forest base map in New Ireland

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	32	20				1	2	1	4					3		9	2			1	75	43%
			H	Low Altitude Forest on Up	38	188	5			3	2	2		1				1		19					259	73%
			L	Lower Montane Forest		3	50																		53	94%
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest																						####
			Fri	Seral Forest	3															1					4	0%
			Fsw	Swamp Forest																						####
			M	Mangrove						1		1	7												9	78%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	2					1		1						1		4					9	0%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub																						####
	Grassland	Grassland	G	Grassland and Herbland	2													2		2		2	1		9	22%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	8	4				1		1	1					1		19	1			7	43	44%
			Qa	Plantation other than fore	1							1		1						1	5			1	10	50%
	Wetlands	Wetlands	E	Lakes and larger rivers																						####
	Other land	Other land	Z	Bare areas																						####
	Settlements	Settlements	U	Larger urban centres																						####
			Total		86	215	55			7	4	7	12	2				8		55	8	2	1	9	471	
			P.A.		37%	87%	91%	####	####	0%	0%	0%	58%	0%	####	####	####	25%	####	35%	63%	0%	0%	0%		

O.A.	64%

Accuracy evaluation of forest base map in Autonomous Region of Bougainville

					NFI																						
					Forest												Grassland		Cropland		Wetla	Other	Settle	Total	U.A.
					Forest									Wood	Savanna/S		Grassland		Cropland		Wetla	Other	Settle		
					P	H	L	Mo	D	B	Fri	Fsw	M	Qf	W	Sa	Sc	G	Ga/G	O	Qa	E	Z	U		
Map	Forest	Forest	P	Low Altitude Forest on Pl	47	8				1		5	2				2			38	7	1		9	120	39%
			H	Low Altitude Forest on Up	12	121	1			1							1			34	3		1	2	176	69%
			L	Lower Montane Forest			38										2			2				1	43	88%
			Mo	Montane Forest																						####
			D	Dry Seasonal Forest																						####
			B	Littoral Forest	1																				1	0%
			Fri	Seral Forest	2	2	9			1	1		1		1					1					18	6%
			Fsw	Swamp Forest	10							4	1		1		1			4		4		4	29	14%
			M	Mangrove									1												1	100%
			Qf	Forest Plantation																						####
		Woodland	W	Woodland	1							7			1					1		2			12	8%
		Savanna /Scrub	Sa	Savanna																						####
			Sc	Scrub		1	1										1								3	33%
	Grassland	Grassland	G	Grassland and Herbland	1													4		8	2		1	3	19	21%
			Ga/G	Alpine grassland/Subalpin																						####
	Cropland	Cropland	O	Agricultural Land Use	3	5											1			11	5			1	26	42%
			Qa	Plantation other than fore																14	6			1	21	29%
	Wetlands	Wetlands	E	Lakes and larger rivers		1																1			2	50%
	Other land	Other land	Z	Bare areas													1	2							3	0%
	Settlements	Settlements	U	Larger urban centres																						####
			Total		77	138	49			3	1	16	5		3		9	6		113	23	8	2	21	474	
			P.A.		61%	88%	78%	####	####	0%	100%	25%	20%	####	33%	####	11%	67%	####	10%	26%	13%	0%	0%		

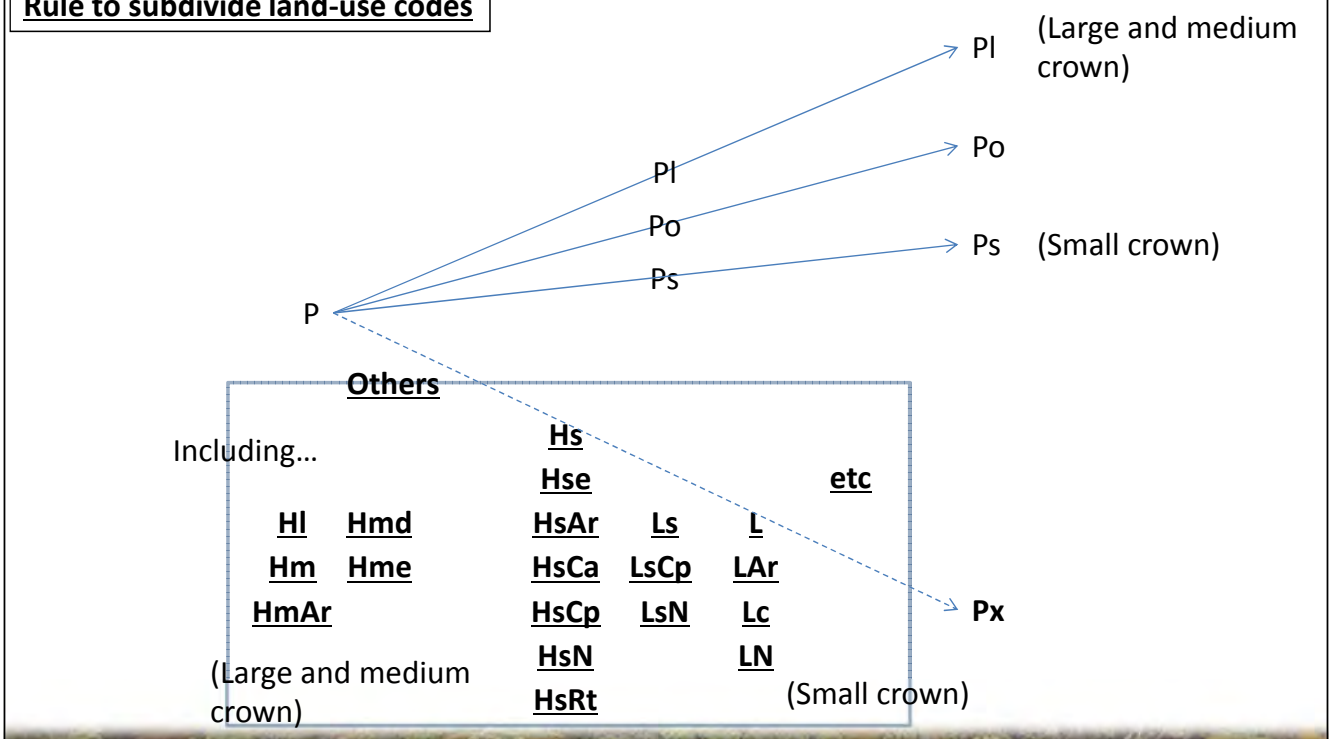
O.A.	50%

Annex 15

Rules for Subdividing Codes of Land Cover

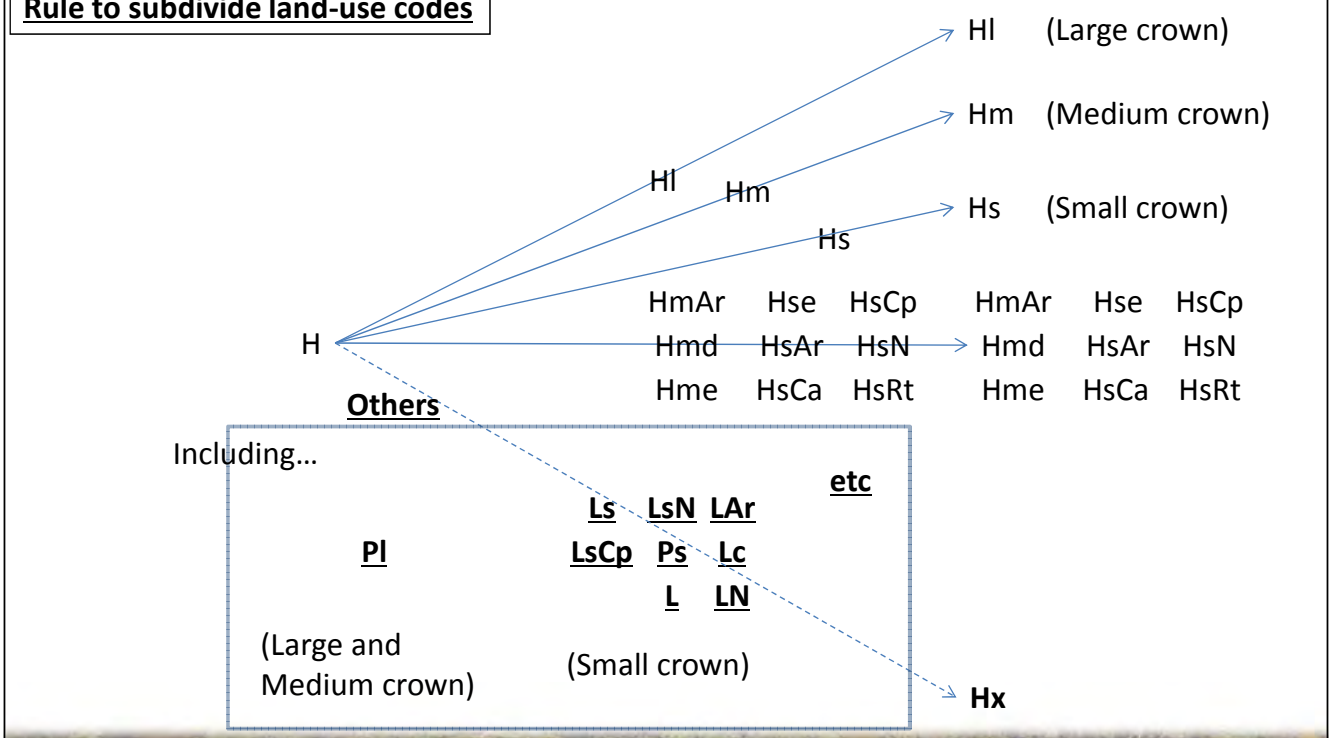
Base Map (V1) | **Existing FIMS** | **Base Map (V1.1)**

Rule to subdivide land-use codes



Base Map (V1) | **Existing FIMS** | **Base Map (V1.1)**

Rule to subdivide land-use codes



Base Map (V1) | **Existing FIMS** | **Base Map (V1.1)**

Rule to subdivide land-use codes

L

L
Ls
LAr
Lc
LN
LsCp
LsN

L
Ls
LAr
Lc
LN
LsCp
LsN

Others

Lx

Base Map (V1) | **Existing FIMS** | **Base Map (V1.1)**

Rule to subdivide land-use codes

B

BCe
BMl
B

BCe
BMl
B

Others

Bx

Fri

FriCg
FriK
FriTb
Fv
Fri

FriCg
FriK
FriTb
Fv
Fri

Others

Frix

Fsw

FswC
FswMl
FswTb
Fsw

FswC
FswMl
FswTb
Fsw

Others

Fswx

Same in W, Sa, Sc, G

Rule to subdivide land-use codes

Base Map (V1)	Base Map (V1.1)
Mo	Mo
D	D
Ga	Ga
Gi	Gi
M	M
O	O
E	E
Z	Z
U	U
O	O
Qa	Qa
Qf	Qf

Annex 16

Treatment of Small Islands in the Forest Base Map

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

The Forest Base Map

How to Deal with Small Islands

KOKUSAI KOGYO CO., LTD.

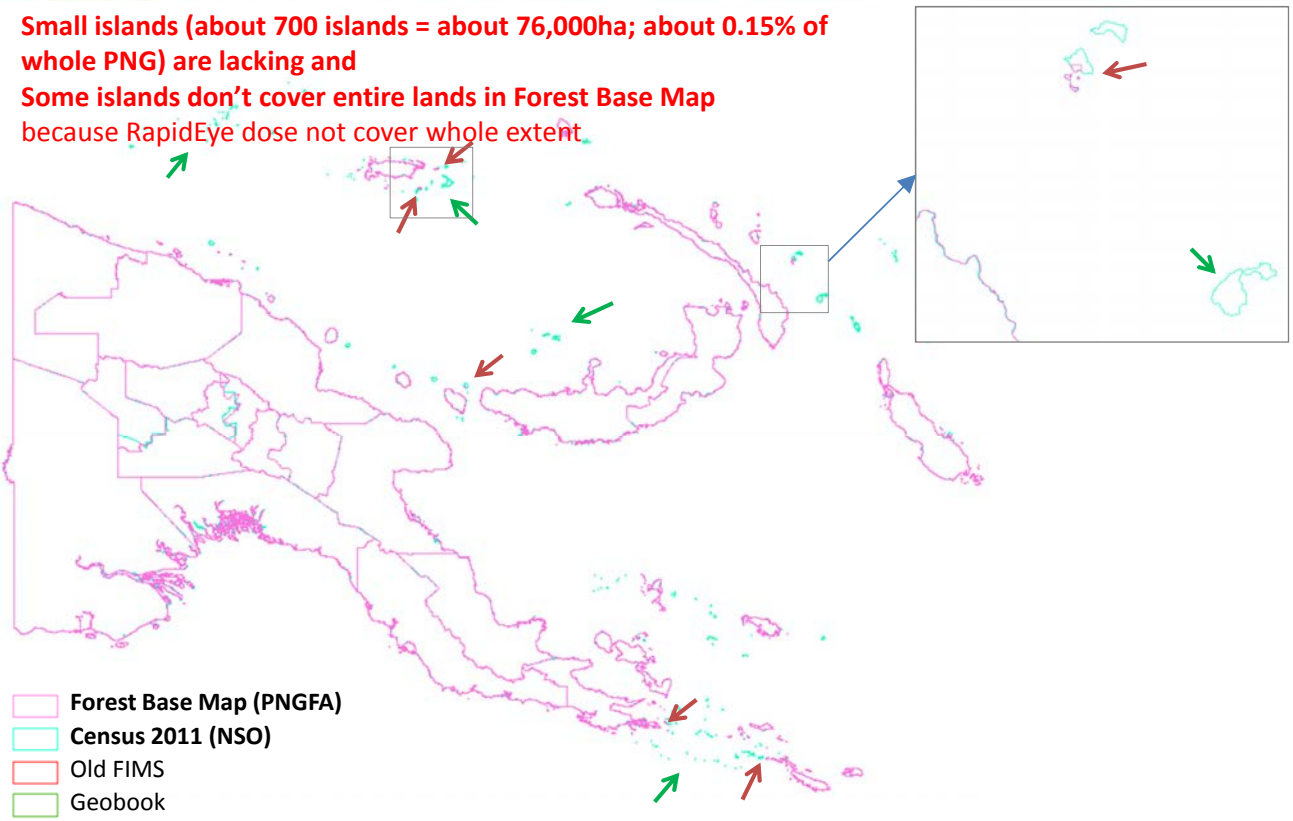
Feb 19 2016

The Forest Base Map: Small islands issue

- How to deal with small islands
  - There is some difference in small islands (boundary) between data source
  - The Forest Base Map was created from RapidEye imagery, so the Map covers RapidEye imagery extent, which does not cover all small islands.
  - As compared with other boundaries: Census 2011 (NSO), old FIMS, and Geobook …

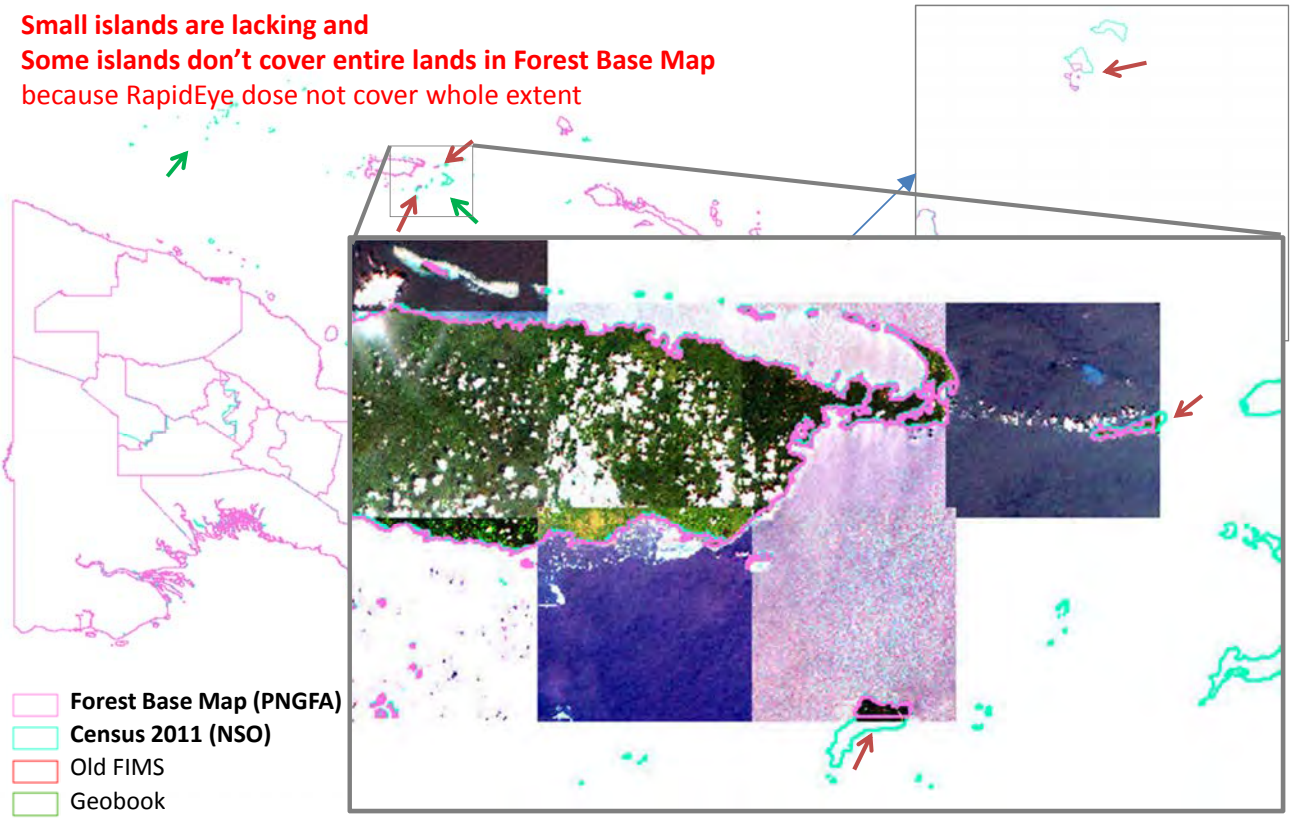
The Forest Base Map: comparison with other boundaries

Small islands (about 700 islands = about 76,000ha; about 0.15% of whole PNG) are lacking and
Some islands don't cover entire lands in Forest Base Map
because RapidEye dose not cover whole extent



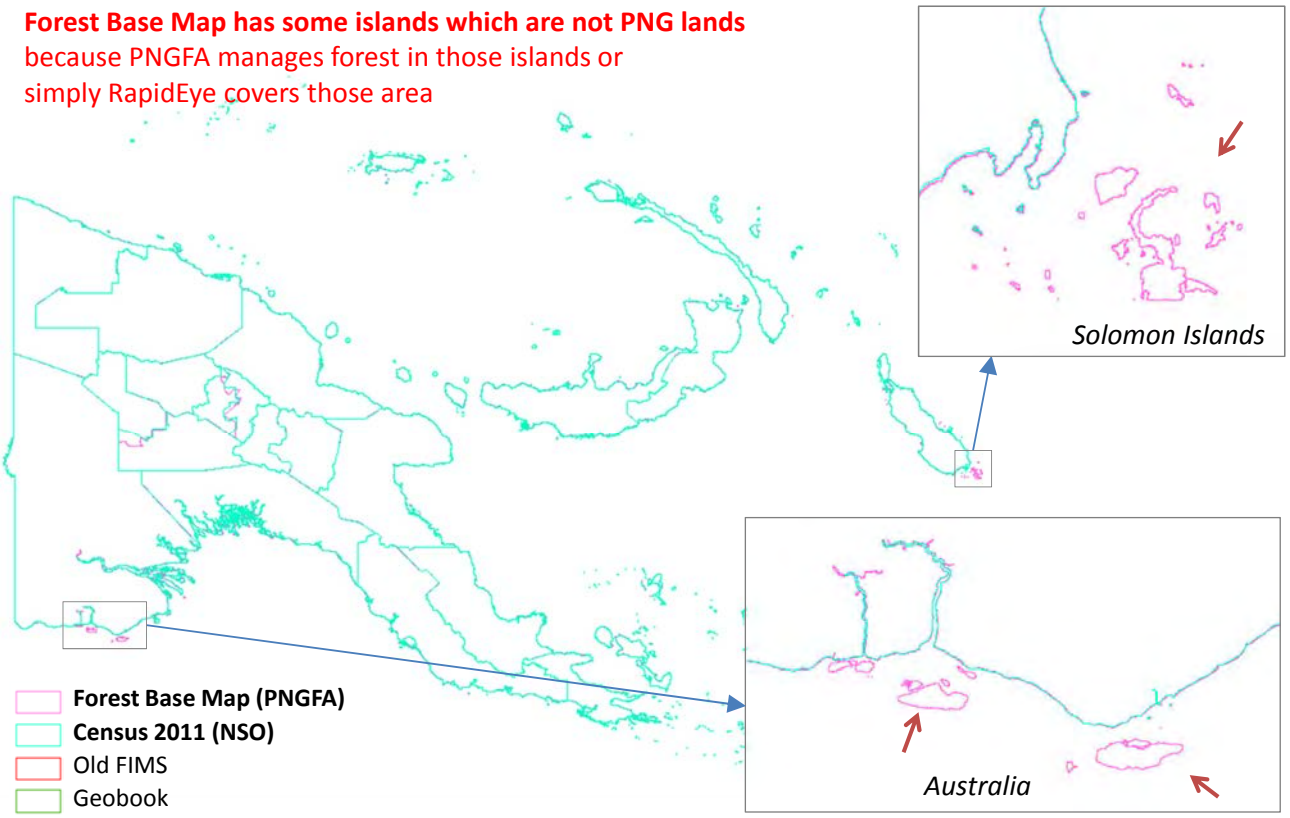
The Forest Base Map: comparison with other boundaries

Small islands are lacking and
Some islands don't cover entire lands in Forest Base Map
because RapidEye dose not cover whole extent



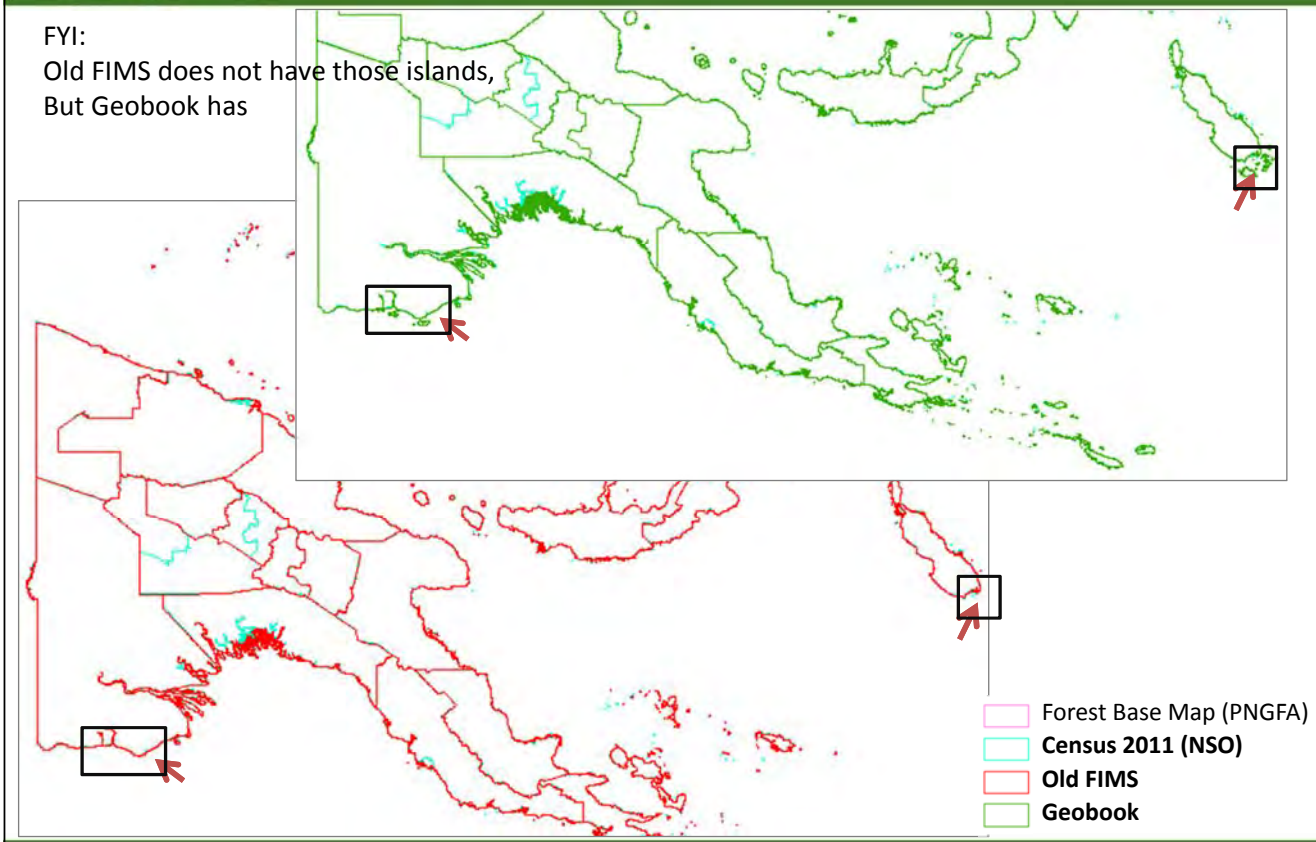
The Forest Base Map: comparison with other boundaries

Forest Base Map has some islands which are not PNG lands
because PNGFA manages forest in those islands or
simply RapidEye covers those area



The Forest Base Map: comparison with other boundaries

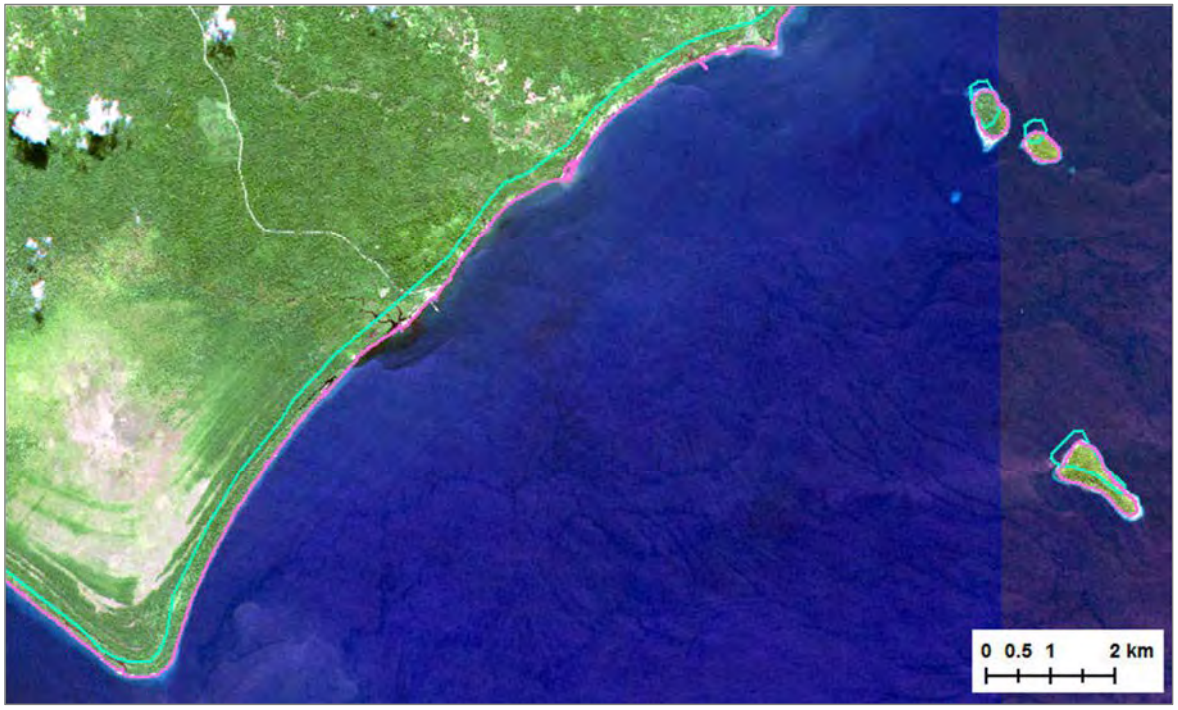
FYI:
Old FIMS does not have those islands,
But Geobook has



The Forest Base Map: comparison with other boundaries

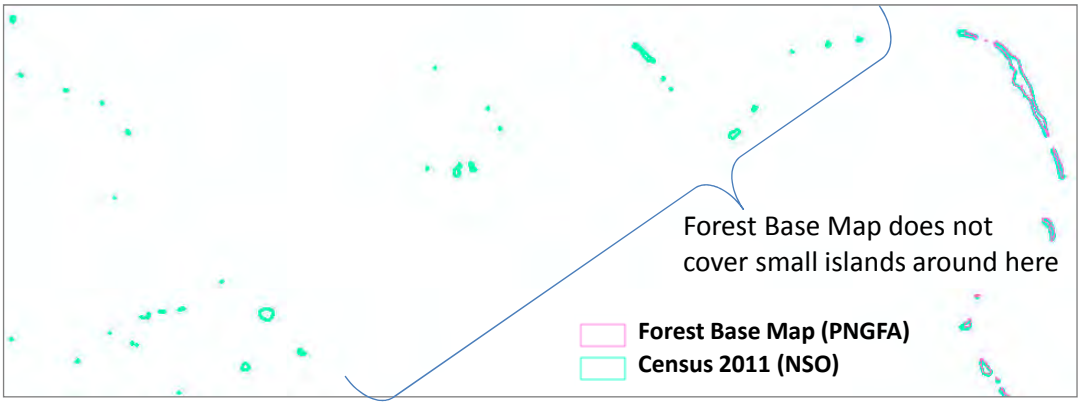
FYI:
Forest Base Map is better fitting to Satellite imagery than Census 2011

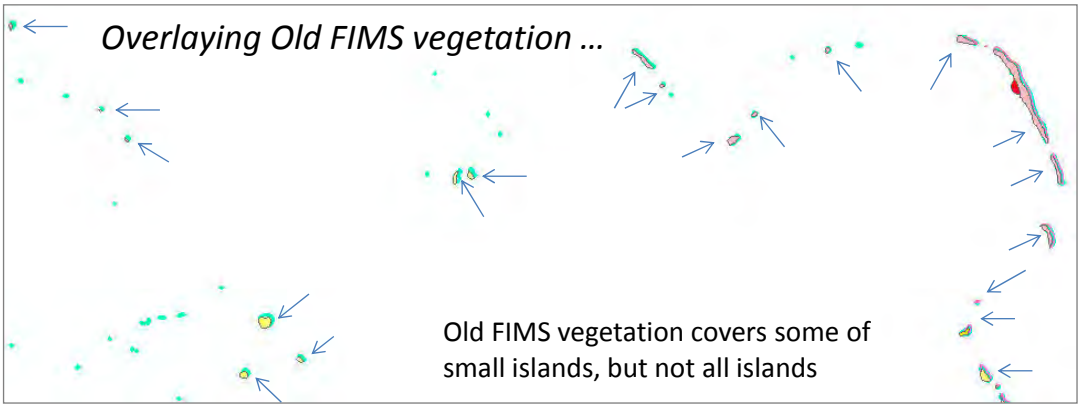
Forest Base Map (PNGFA)
Census 2011 (NSO)



The Forest Base Map: comparison with other boundaries

FYI:





The Forest Base Map: How to deal with islands

Data situations
Options to deal with
Notes
Proposed handling

A. Islands which are non-existent in NSO, and existent in FBM (those islands are not PNG territory)
   a. Islands under PNGFA management? (Australia)
   b. Islands not under PNGFA management (Solomon Islands)
      i. No any change
      ii. No change in shape, and change of province code attribute in province field (blank, country name, "-", "outside PNG" or etc.)
      iii. Delete

ii; No change in shape, and change of province code to "outsidePNG" in province field

Approved

B. Islands which are existent in NSO, and not-existent in FBM
   a. Islands cut by outlines of RapidEye imagery (about 5 islands)
   b. Islands except above (about 700 islands)
      i. No any change
      ii. Create the islands by using NSO data or LANDSAT imagery without forest type (just blank in the forest type field)
         * NSO boundary is not fit to satellite imagery well
         * It is difficult to decide forest type from LANDSAT imagery
      iii. Create the some islands by copying old FIMS vegetation
         * Old FIMS vegetation is not fit to satellite imagery well
         * Old FIMS vegetation does not cover all islands, and does not represent land cover in 2011

i; No change in the Forest Base Map 2012, and add some explanations about the Map in metadata

Next forest cover map will cover small islands

Sub joinder: In the meeting, we concluded that the map would be managed according to the proposed handling (pink letters))

Annex 17

Decision / Agreement on Elements that Will be the Basis for the Future Work of Analysis of Deforestation and Forest Degradation Processes

Last updated on 18th August 2016

Working Document

Decision/agreement on elements that will be the basis for the future work of analysis of deforestation and degradation processes
Work Plan and Tentative Conclusion

Introduction

To progress analysis work on identifying and quantifying deforestation and forest degradation (DD) processes, we need some preliminary agreements on different points. The discussion for this work was originally planned up to the end of November 2015. The work would be to address the points under the three parallel tracks through propositions and subsequent discussions, clarification of data sources, involvement of relevant agencies, and responsibility sharing among stakeholders.

After almost one year of discussion, this paper is prepared for presenting tentative conclusion of the discussion.

1. Track 1: Decisions / agreements on Definitions

Plan:

1) Land Use (LU) classes
   Note: This item was originally planned as 'Land Use and Land Cover (LULC) classes'. The term 'Land Cover' was deleted at early stage of discussion in order to keep consistency with IPCC terminology.
2) Forest Strata (temporal sub-classes)
3) FMU definition and selection criteria
4) Land transition types
5) Deforestation / Forest Degradation drivers

1) Land Use (LU) classes

An interpretation of IPCC six LU classes on Forest Base Map 2012 is understood as in the following table 1.

Table 1. IPCC Six Land Use and Forest Base Map 2012 Categories

No	IPCC Land Use	Referred in the Forest Base Map as:
1	Forestland	All forest types (P, H, L, Mo…) including forest plantation, woodland, savanna, and scrub
2	Cropland	Agricultural land and plantation other than forest plantation
3	Grassland	Grassland and herbland

4	Wetlands	Lakes and larger rivers
5	Settlements	Larger urban centres
6	Other land	Bare soils and waterbodies

2) Strata (= temporal sub-classes)

Forest strata (or temporal sub-classes) are necessary for appropriate forest monitoring for its management purposes. For the purpose of the carbon calculation, we may need further sub-classes that reflect carbon stock contents. The sub-classes in the table 2 are conceived for serving two objectives (forest monitoring and carbon calculation) simultaneously.

Table 2. Possible temporal sub-classes for forest monitoring and carbon calculation

LU classes	No	LU Strata (temporal sub-classes)
Forest land (for each forest type)	1	Primary forest
	2	Logged over forest
	3	Non-logged degraded forest (from driver other than formally planned logging. Ex.: fuelwood collection, gardening, small scale logging for mobile sawmills)
Forest land	1	Forest plantation - Open-canopy plantation (young stage or after cut)
	2	Forest plantation – Close-canopy plantation (mature)
Cropland	1	Annual crops (herbaceous)
	2	Perennial plantations (ligneous)
Grassland	1	Shrub (This category is not defined in Forest Base Map)
	2	Grassland
Settlements	1	Infrastructure (other than roads)
	2	Road

3) FMU

New ‘FMU’ was conceived as a unit (minimum polygon) of forest at ‘not too small’ scale for replacing legacy ‘FMU (Forest Mapping Unit) on PNGRIS and Forest Inventory Mapping (FIM) system. The legacy FMU is ‘too large’ in relation to current available technology. The new FMU is supposed to be used for monitoring and recording changes of forests on new FRIMS.

+ The following name is decided: Forest Monitoring Unit on the Forest Base Map 2012 in the FRIMS

+ Criteria used to delineate FMUs:
  - Boundaries: province, forest zone, catchment (+ soil when data available)
  - LU class, forest type including crown size

+ Applicability and application of Strata (or temporal sub-classes) will be further studied in JICA Project activities.

4) Land transition

+ Deforestation: Forest land => Another land use class.

+ Degradation:

1- Forest land - Primary forest => Logged over forest

2- Forest land - Primary forest => Non-logged degraded forest

3- Forest Land - Forest plantation - Close-canopy plantation
=> Open-canopy plantation

+ Regeneration

1- Forest land - Logged over forest => Primary forest

2- Forest land - Non-logged degraded forest => Primary forest

3- Forest Land - Forest plantation / Open-canopy plantation
=> Close-canopy plantation

+ Reforestation:

Grassland or Cropland => Forest land

5) Definitions of drivers of Deforestation and Degradation (DD)

A list of possible drivers of deforestation and degradation are tentatively set as illustrated in tables 3 and 4. The working definition of them are provided in a set of land use and strata combinations. Usefulness or effectiveness of them are tested in upcoming JICA Project activities. The set of typology and definitions takes into consideration technical limitations associated to Remote Sensing analysis. Some of definitions are deliberately simplified to facilitate analyses.

Particular caution is needed on communication with National Forest Inventory team about these table 3 and 4. The placement (either in deforestation or degradation) and handling (to what extent and how) of gardening, shifting-cultivation, and fallow between Collect Earth Analysis and FRIMS output must be carefully coordinated so as to be mutually comparable and thus verifiable.

Table 3. Deforestation drivers

Driver	**Initial LU class/ strata**	**Final LU class/ strata**

Subsistence agriculture	Forest land/ whichever strata	Cropland/ annual crops Grassland/ shrub Grassland/ grassland
Commercial agriculture		Cropland/ perennial plantations
Large fire		Grassland/ grassland
Mineral extraction		Settlements/ infrastructure
Road construction		Settlements/ road
City expansion and settlements		Settlements/ infrastructure

Note: Grazing was originally listed in this Deforestation drivers table. According to the discussion in Track 3 (Table 8), grazing usually happens in Grassland and is very unlikely a driver for deforestation. Therefore, the Grazing is moved to Table 4 (Degradation drivers).

Table 4. Degradation drivers

Driver	**Initial Forestland strata**	**Final Forestland strata**
Authorized selective logging	Primary forest	Logged over forest
Wood collection (non-authorized logging + fuel wood collection)	Primary forest	Non-logged degraded forest
Gardening through slash and/or burn (so small fires are included here)	Primary forest	Non-logged degraded forest
Logging in forest plantations	Forest plantation/ Close -canopy plantation	Forest plantation/ open-canopy plantation
Grazing	Usually happens in Grassland though may have a potential of forest degradation	Grassland/ shrub Grassland/ grassland

2. Track 2: Data availability and sources

Plan:

1) Disturbance types in the logging concessions
2) Regeneration types
3) Information on Plantations, SABLs, and Settlements

Note: Item 3) was originally planned three items for each activity though aggregated as a matter of presentation.

1) Disturbance within and outside logging concessions

We propose to consider 5 categories of disturbance inside logging concession areas:

1. Disturbance from felling
2. Fire
3. Illegal logging
4. Road construction
5. Forest clearance for gardening
6. Landslip & flooding
7. Non -renewable resources development eg mining, oil & gas etc

2) Regeneration

We propose 2 categories of regeneration:

	Regeneration type	**Area type**
1	Assisted regeneration	Planted by PNGFA programme in logging concessions
2	Natural regeneration	Not in concessions

3) Information on Plantations, SABLs, and Settlements

Table 5. Factors to define plantations, SABL, and settlements projects

	Plantations	SABL when different than plantations	Settlements
1. Boundary	x	x	x
2. Crop type	x		
3. Land use purpose		x	
4. Initial land-use (before development)	x	x	x
5. Company	x	x	x
6. Year of lease attribution	x	x	x
7. Year(s) of clear cutting and successive plantings	x	x (if applicable)	
8. Year of clear cutting			x (if applicable)
9. Management regimes	x		
10. Meant land use		x	

For further information on forest plantations, study of data in PNGFA Forest

Development Directorate (Forest Plantations Branch) is necessary.
The topic on other information sources for SABL (when different than plantations) and Settlements project will be revisited when necessity arises for JICA Project activities.

3. Track 3: Human activities on focus and their characteristics

Plan:

1) Illegal logging characteristics
2) Hansen-loss analysis scale
3) Subsistence agriculture particularities

1) Illegal Logging characteristics

a) Tentative definition

Harvesting, purchasing and transporting logs and forest products in violation of national law

b) Types of illegal logging

- Logging and harvesting operations conducted without proper Timber Permit
- Logging and harvesting in violation of the timber permit conditions
- Logging outside of Timber Permit Areas
- Logging practices against Planning, Monitoring and Control Procedures (PMCP) or Logging Code of Practice (LCOP)

Note: PMCP and LCOP are regulations based on the relevant law. Thus, we selected above operation is illegal logging that happens, for example in buffer zones, protected areas, village boundaries, or of protected tree species.

c) Means to identify illegal logging

- Report from PNGFA field officers, CEPA officers, NGOs, landowners, Provincial government office and media (News Paper, Radio, TV crews and etc.).
- Satellite imagery, e.g. Landsat AGP

d) Availability of PRA (Participatory Rural Appraisal)

Currently no PRA are conducted as part of PNGFA operations.
The process for incorporating landowners might involve some of similar practices.
Ex.: non-structured interview and consultations involving out-sider facilitators

2) Hansen-loss analysis scale

This sub-section is meant to contribute to the analysis of Hansen-loss data led by Dr Koide, a JICA expert of the Project. The 'threshold' mentioned in this sub-section

is proposed to be applied in an analysis flowchart presented by Dr Koide on 28th August 2015, 'Activities in This Mission and Future Plans'. Table 6 summarizes plausible scale of disturbance events in and out of forests.

Table 6. Assumed scale of events and disturbances for Hansen-loss data analysis

Objects	**Decision**	**Explanation (and further useful information)**
a) Mining / Extractive industry	Usually> 50ha Sometimes>30ha	There are some deforestation due to making the pipeline of oil and gas. Clearance of forest areas for facility constructions which include township with workers compounds, schools, hospitals, administrative centers, recreational areas.
b) Road construction	Normal size is 40 ~ 60ha	Normal width: 40m road line corridor (20m on either sides) Normal distance: 10,000 ~ 15,000m 40x (10,000 ~ 15,000) = 400,000 ~ 600,000m2 per annum
c) Facility construction	Normal size is 2ha	Normal size of schools and logging camps are about 2ha. However schools are constructed in the village, so most of schools might not be detected as Hansen-loss. Facility construction is normally appeared along the road and grassland, namely non-forest lands.
d) Plantation associated with FCA	Usually> 50ha	The most of FCA is more than 50ha. Developer can clear forest to 1,000ha a year.
e) Logging (especially Logging roads)	Normal size is 20 ~ 40ha	Normal width: 40m is only applicable to main logging roads where logging trucks and other vehicles will be using. Spur roads are also considered to be logging roads but not commonly used by vehicles. Normal distance: 5 ~ 10km Average main road construction per annum is 5 ~ 10 km. 40 x (5,000 ~ 10,000) = 200,000 ~ 400,000m2

f) Disaster	Normal size is 5ha	Main disaster in PNG is landslide originated from flood and soil erosion especially along the Highlands Highway or earthquake (in ENB). It could happen in natural forest but hard to identify it.
g) Subsistence agriculture	Normal size is 1ha ~ 5ha 1ha for non-commercial crops 5ha for cash crops	Tentative definition: shifting and permanent agriculture cultivation and gardening. Within **5 ~10km** from CU (Census Unit). Agriculture for non–commercial crops is usually 1ha. Agriculture for cash crops (ex. Cocoa, cacao? Sweet potato? and etc.) is 5ha. The 2010 Census Information is available from National Statistics Office. Some of the information is already stored in FRIMS.
h) Fire	1ha ~ 5ha	Difficult to obtain realistic information from the Natural Disaster Office. Natural fires are rare in PNG. Normally it happens artificially. Major causes of fire: ➢ Preparation for gardening (1ha ~ 5ha) ➢ Hunting fire in grassland (1ha ~ 5ha) to chase animals ➢ Accidental or careless fire (1ha ~ 5ha) by cigarette and cooking, etc.

We selected **<u>20ha</u>** as the threshold for analysis from above results.

Some objects like facility construction, disaster, subsistence agriculture and fire may not be identified. However:

- ✓ Hansen-loss originated from facility construction seems not so common
- ✓ Fire will be identified by Firewatch.
- ✓ Distinction between ‘disaster’ and ‘subsistence agriculture’ may be made by using information and assumptions presented in the following sub-section 3) Subsistence agriculture particularities.

The additional information shown in below table 7 may facilitate identification of remaining Hansen-loss points not mentioned in above paragraphs.

Table 7. Clues to identify other disturbance signs in Hansen-loss data analysis

Object	Information for analysis
a) Plantations	Replanting periods for each species type_ Forest plantations: Kamerere: 20, Teak: 30 ~ 40, Klinkii: 30 ~ 35, Acacia: 8 ~ 10, Pinus spp.: 30 ~ 35 and Hoop: 30 ~ 35 years Plantations other than forest plantations: Cocoa: 20 ~ 30 (upper trees are remaining), Oil palm: 20, Rubber: 30 and Coconuts: 50 years
b) Subsistence agriculture	Normally it is made within 5 ~ 10 km from CU
c) Settlements	Normally built in non-forest area and very unlikely detected as Hansen-loss points

There are forest degradation originated from activities listed in Table 8 below. Other new activities might be identified subject to future discussion and analysis led by conclusions in track 1 and 2.

Table 8. Other activities causing forest degradation and their characteristics

Object	**Information for analysis**
a) Grazing	usually happened in Grassland
b) Wood collection	normally collected from gardening site, dead trees & twigs
c) Logging	It is assumed that the data of logging will be coming from forest working plan and the volume will be subtracted from FIMS. Small logging could be operated with chain saw and portable sawmill.
d) Building materials collection	People cut down and collect living tree for building materials.

3) Subsistence Agriculture particularities

a) Tentative definition: shifting and permanent agriculture cultivation and gardening. Within 5 ~ 10km from Census Unit (CU)

b) Means to identify small agriculture patches

- Hansen-loss larger than the area **1 ~ 5 ha** (as mentioned in sub-section 2) above), that is within BM 'subsistence agriculture' but not in 'characteristic shapes' of

mining, road, other facilities, plantation, nor logging.

- For the analysis and study purpose, a set of expedient criteria for classifying Hansen-loss data is proposed as shown in table 9.

Table 9. Expedient criteria for classifying Hansen-loss data

Distance from CU	Size of Hansen-loss data	Class
Not more than 5 ~ 10km	5 ~ 20 ha	Commercial agriculture
	Up to 1 ~ 5 ha	Small agriculture patches
	Less than 1 ha	Some disturbance

CU: Census Unit

Annex 18

Discussion on Development of Drivers of Deforestation and Forest Degradation on Forest Cover Maps

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

Construction of Deforestation and Degradation Information into Forest Cover Maps

KOKUSAI KOGYO CO., LTD.

Dec 9th 2016

Contents

- Introduction
- Decision/Agreement on DD Elements (reference)
- DD and Driver Analysis (reference)
- Method of DD Info Construction
- Results
- Plan for Future

Introduction

- Forest resource changes in PNG are believed to be not only changes of Land Use classes but also forest degradation.
- Conditions precedent have been discussed among PNGFA staff and JICA experts for the decision/agreement on elements that will be the basis for the future work of analysis of deforestation and forest degradation (DD) processes.
  - Definitional issues
  - Data availability and sources
  - Human activities on focus and their characteristics
- Study of available data and satellite imagery has been implemented by Dr. Koide to identify and quantify DDs and their drivers.
- Being based on the results of DD assessment above, information about DDs and drivers are constructed into the Forest Base Map and past forest cover maps of pilot provinces.
- This work will be a help to consider forest resource monitoring for the future.

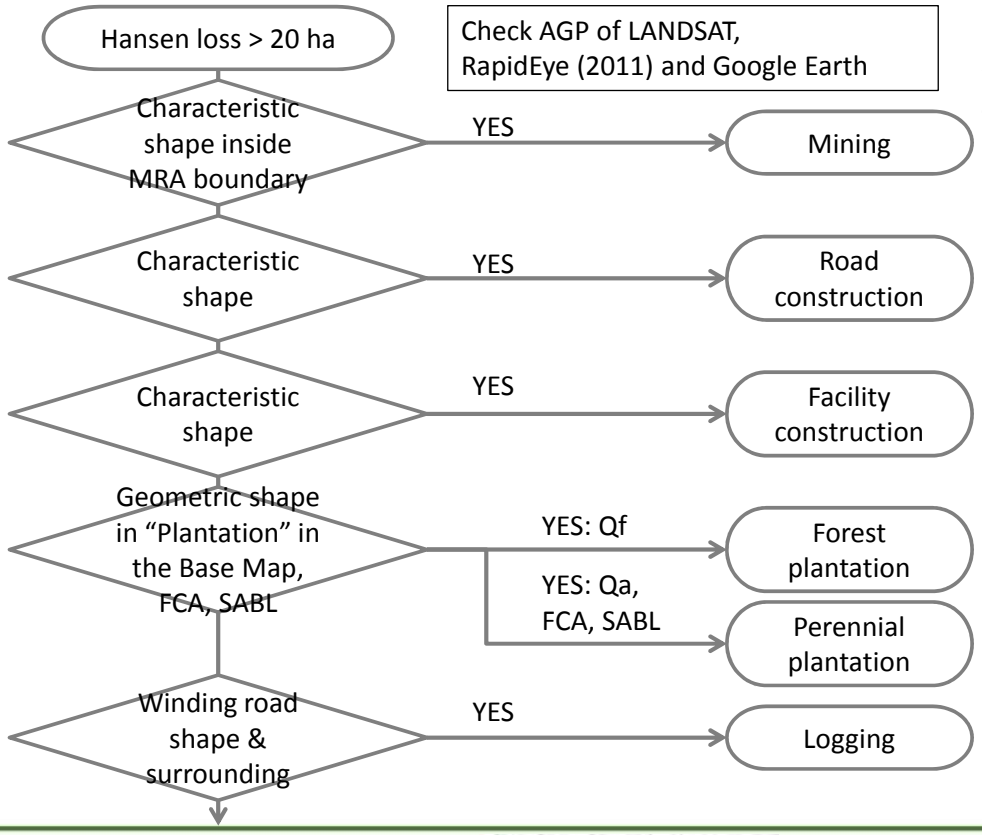
Decision/Agreement on DD Elements

For more information, see the DD discussion report

- Track 1: Definitional issues
  1. Land Use Land Cover (LULC) classes
  2. Forest Strata types (temporal sub-classes)
  3. FMU definition and selection criteria
  4. Land transition types
  5. Deforestation / Forest Degradation drivers
- Track 2: Data availability and sources
  6. Disturbance types in the logging concessions
  7. Regeneration types
  8. Information on Plantations
  9. Information on SABLs
  10. Information on Settlements
- Track 3: Human activities on focus and their characteristics
  11. Illegal logging characteristics
  12. Hansen-loss analysis scale
  13. Subsistence agriculture characteristics

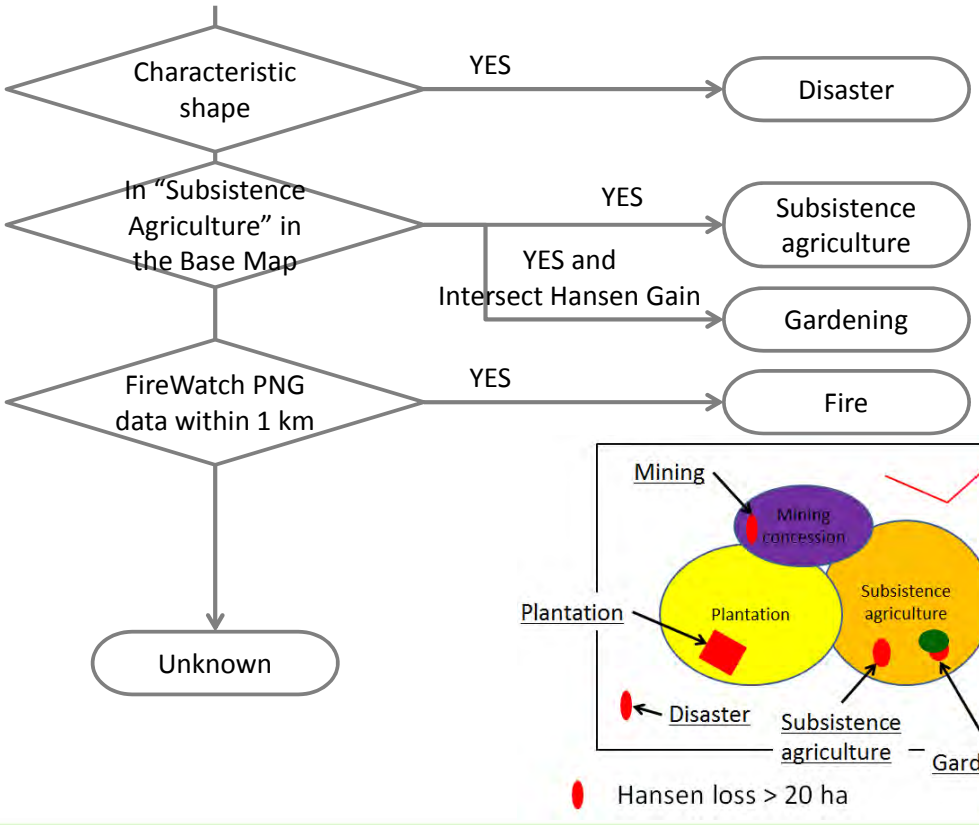
DD and Driver Analysis

Flow revised on the basis of the DD discussion

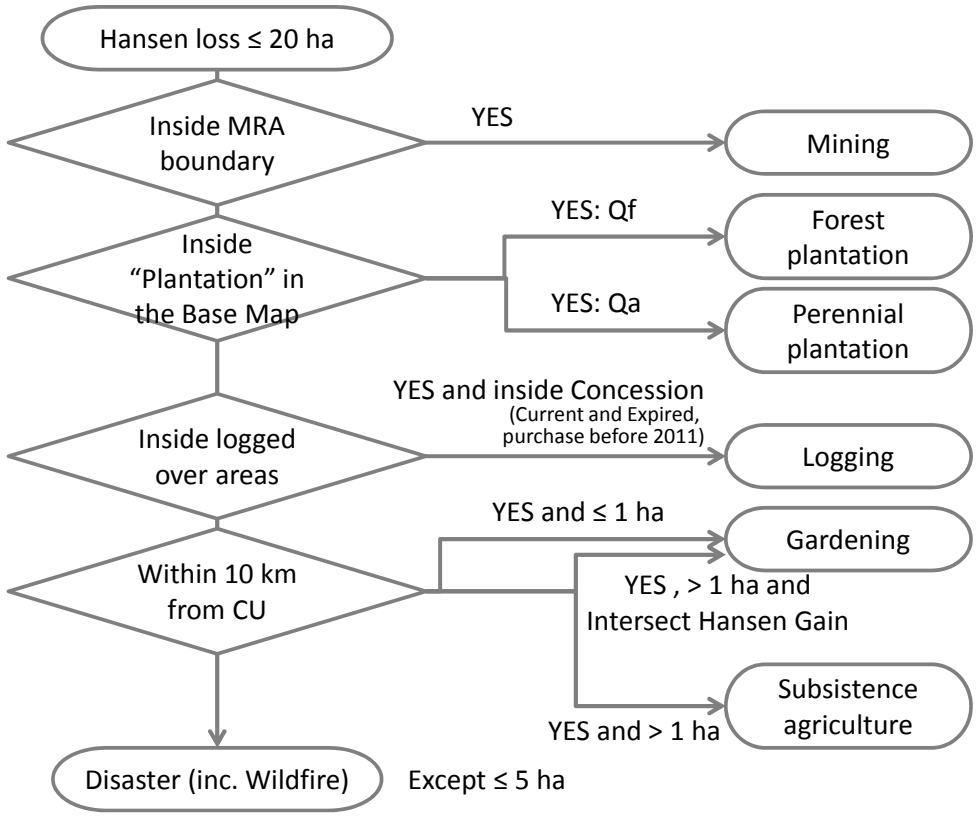


For more information, see the Driver analysis presentation

DD and Driver Analysis (Cont.)

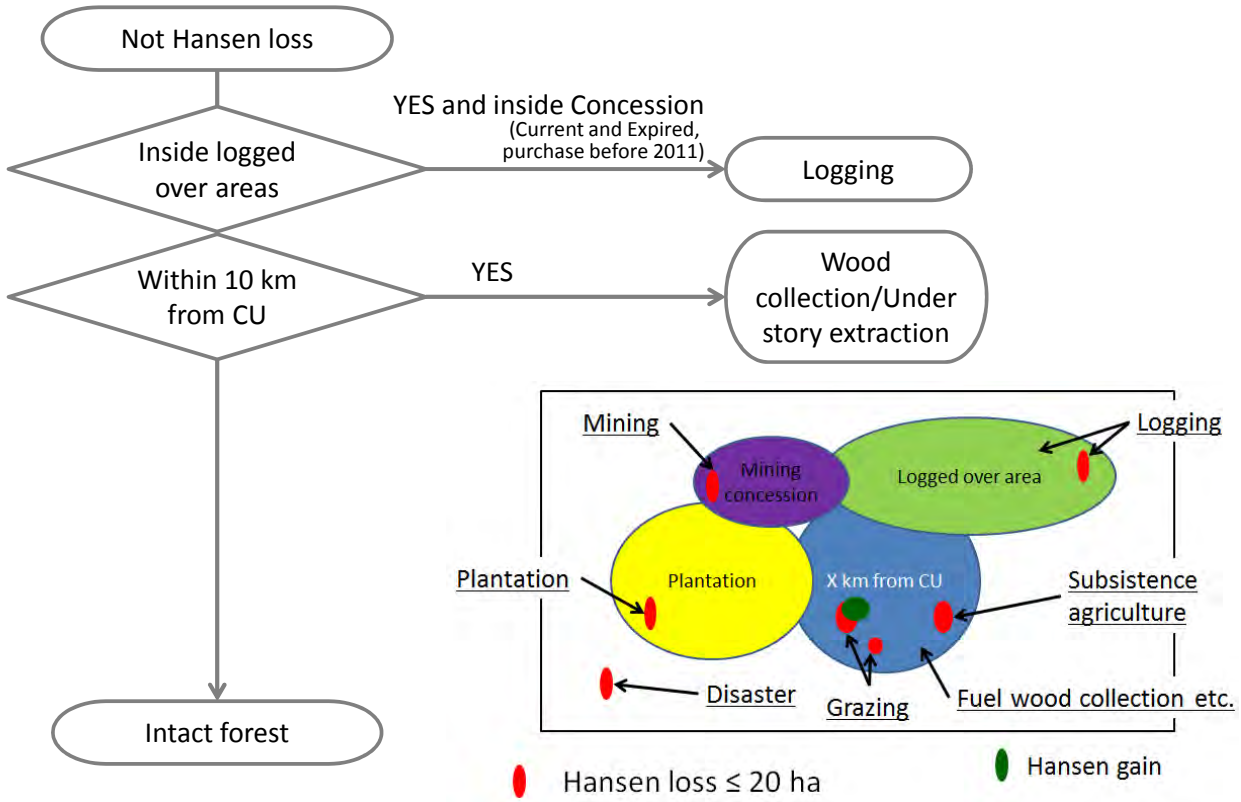


DD and Driver Analysis (Cont.)



Logged over areas: 500 m buffer from logging road

DD and Driver Analysis (Cont.)



Method of DD Info Construction

For The Forest Base Map

1. Prepare satellite imagery: LAMDSAT AGP, RapidEye (2011), Google Earth
2. Prepare data to be used 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)
   - 10km buffer from CU
   - Hansen Lossyear (2001-2010) / Gain
   - FireWatch PNG

Method of DD Info Construction (Cont.)

3. Pick out Hansen Loss (2001-2010) grater than 20ha
4. Identify driver for each Hansen loss polygon on the basis of the flow chart by referring satellite imagery and data below prepared in step.2

Condition		Order	Driver
Characteristic shape inside MRA boundary	→	1	Mining
Characteristic shape	→	2	Road construction
Characteristic shape	→	3	Facility construction
Geometric shape in Forest plantation (Qf) in the Base Map	→	4	Forest plantation
Geometric shape in Agriculture plantation (Qa) in the Base Map	→	5	Perennial plantation
Geometric shape in FCA and SABL	→	6	Perennial plantation 2
Winding road shape & surrounding	→	7	Logging
Characteristic shape	→	8	Disaster (flooding, landslide, volcano, etc.)
In "Subsistence Agriculture (O)" in the Base Map	→	9	Subsistence Agriculture
	→	10	Gardening
FireWatch PNG data within 1 km	→	11	Fire
Unknown	→	12	Unknown

Method of DD Info Construction (Cont.)

5. Pick out Hansen Loss (2001-2010) smaller than 20ha
6. Identify driver for each Hansen loss polygon on the basis of the flow chart by overlaying with data below prepared in step.2

Condition		Order	Driver
Inside MRA boundary	→	13	Mining
Inside Forest plantation (Qf) in the Base Map	→	14	Forest plantation
Inside Forest plantation (Qa) in the Base Map	→	15	Perennial plantation
Inside logged over areas and Inside Concession (Current and Expired, purchase before 2010)	→	16	Logging
Within 10 km from CU	→	17	Gardening
	→	18	Subsistence agriculture

* Logged over areas: 500 m buffer from logging road (- 2011)

7. Assign other Hansen loss greater than 5ha to “Disaster”
8. Add driver info for each FMU by overlaying Hansen loss polygon with driver info

* Employ upper driver if multiple Hansen loss polygons intersect FMU

Method of DD Info Construction (Cont.)

9. Identify driver by overlaying the Forest Base Map and data below prepared in step.2

Condition		Order	Driver
Inside logged over areas and Inside Concession (Current and Expired, purchase before 2010)	→	20	Logging
Within 10 km from CU	→	21	Wood collection/Understory extraction

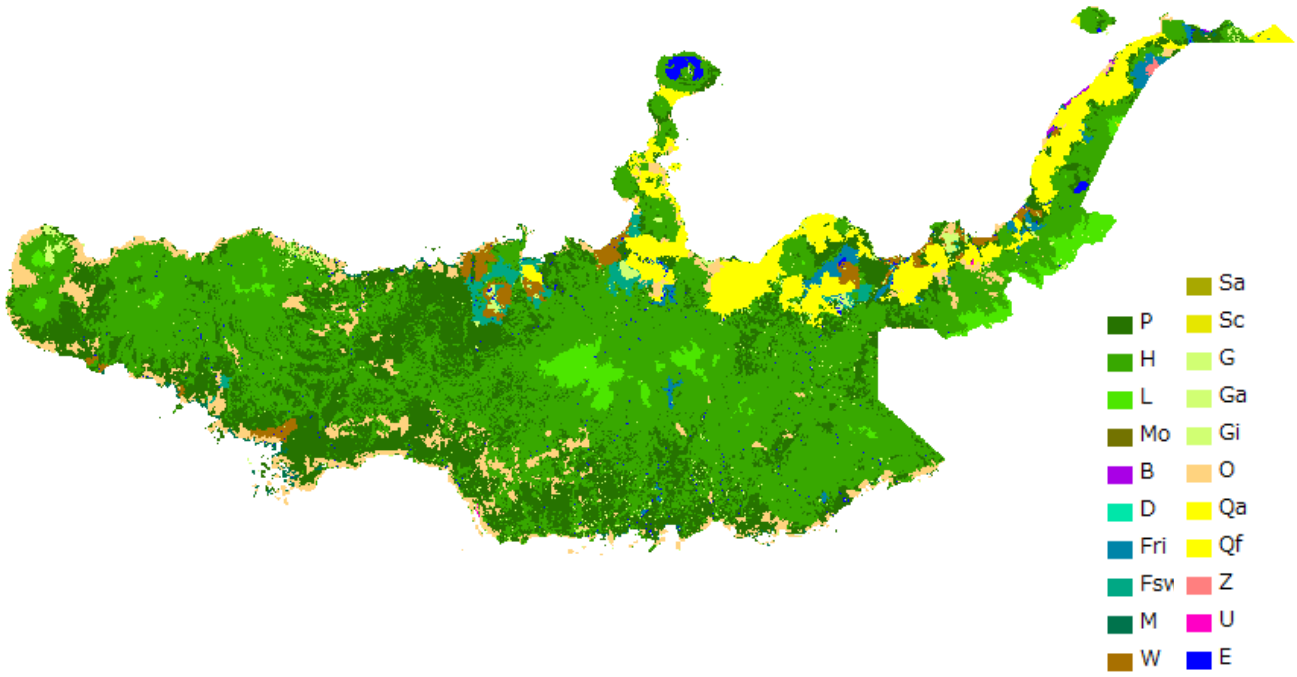
FMU without driver info would be intact forest.

For Past Forest Cover Maps

- Add driver info into past forest cover maps in the same way, but use
  - Hansen loss (2001-2004), logging road (-2005), concession (purchase before 2004), and Qf, Qa and O (in the forest cover map 2005) data for the past forest cover map 2005
  - logging road (-2000), concession (purchase before 1999) data for the past forest cover map 2000 without Hansen loss data

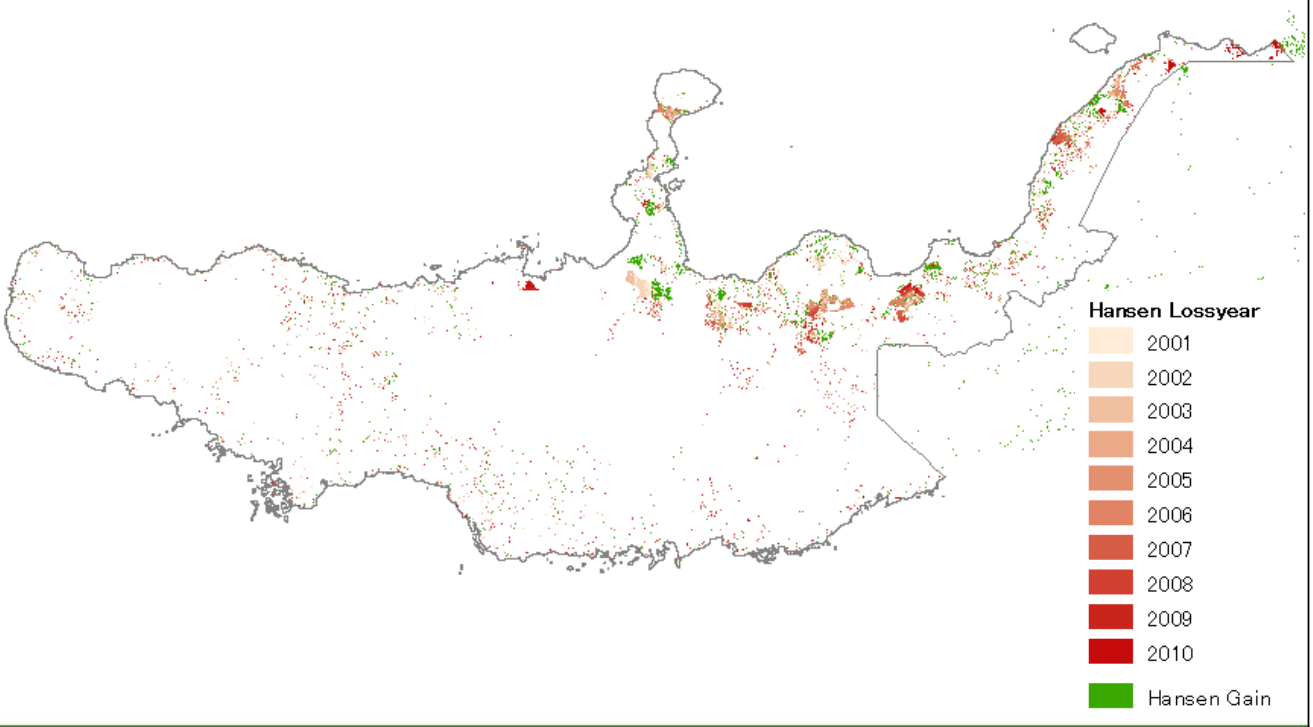
Forest Base Map (WNB)

Forest Base Map



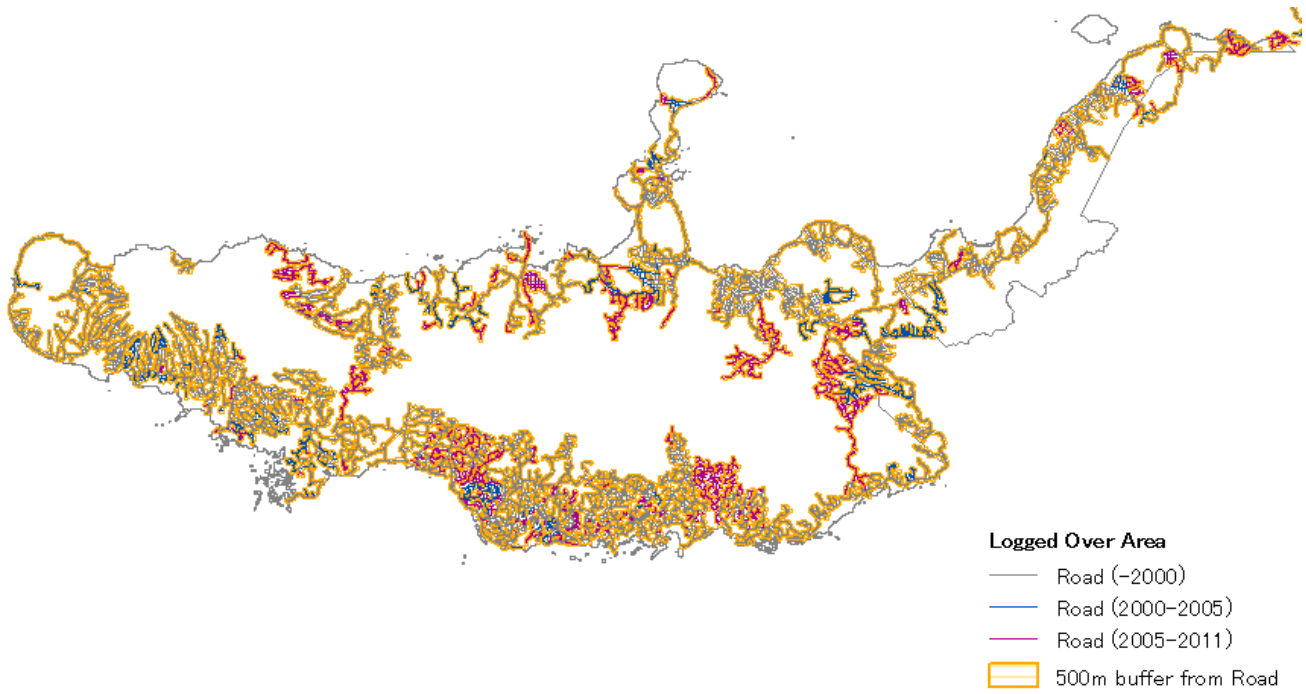
Reference Data for Driver Analysis (WNB)

Hansen data (Lossyear, Gain)



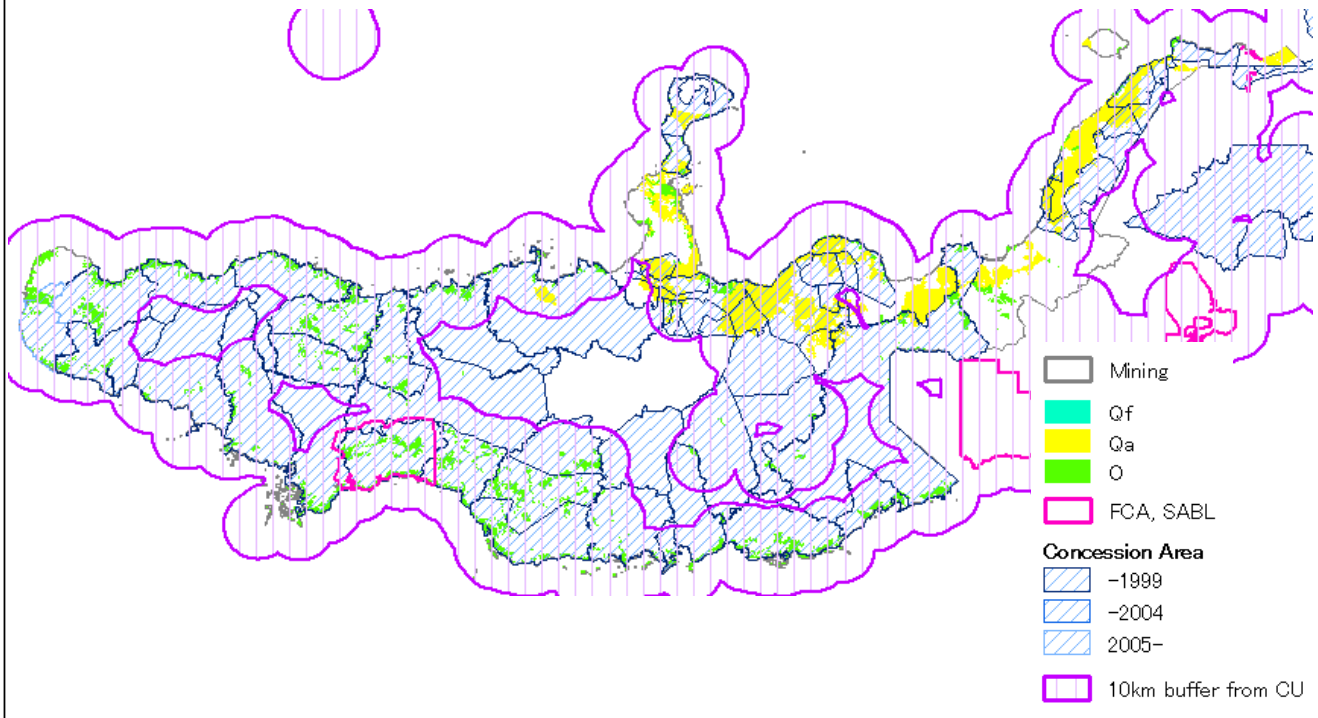
Reference Data for Driver Analysis (WNB) (Cont.)

Logged over area (500m buffer from roads)

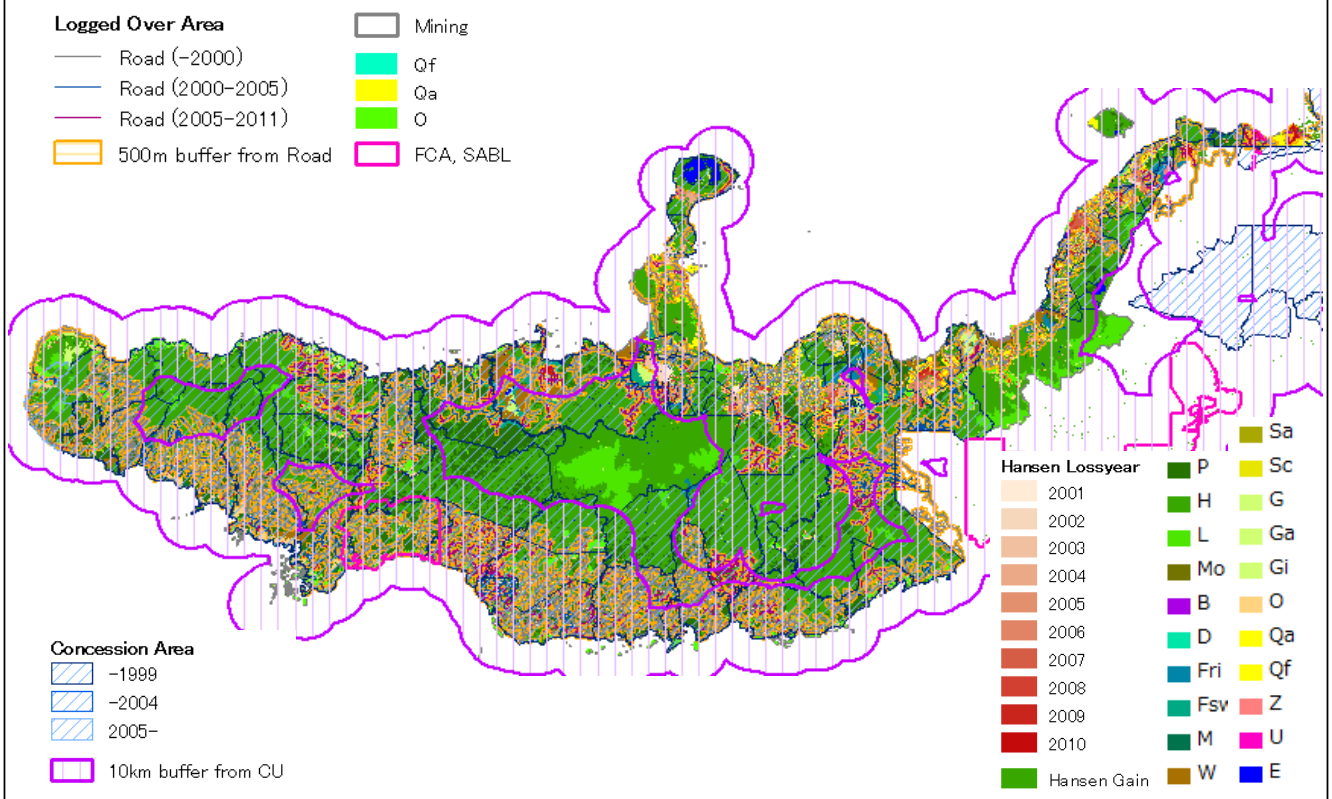


Reference Data for Driver Analysis (WNB) (Cont.)

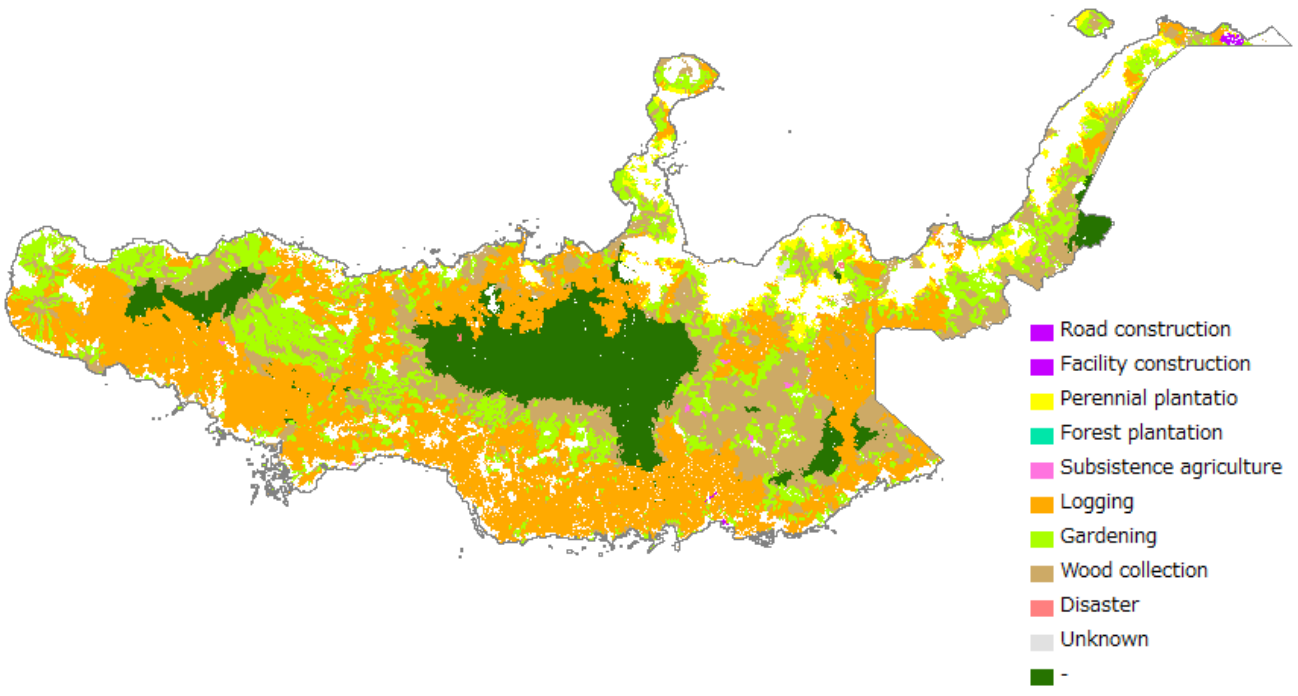
Some of reference data



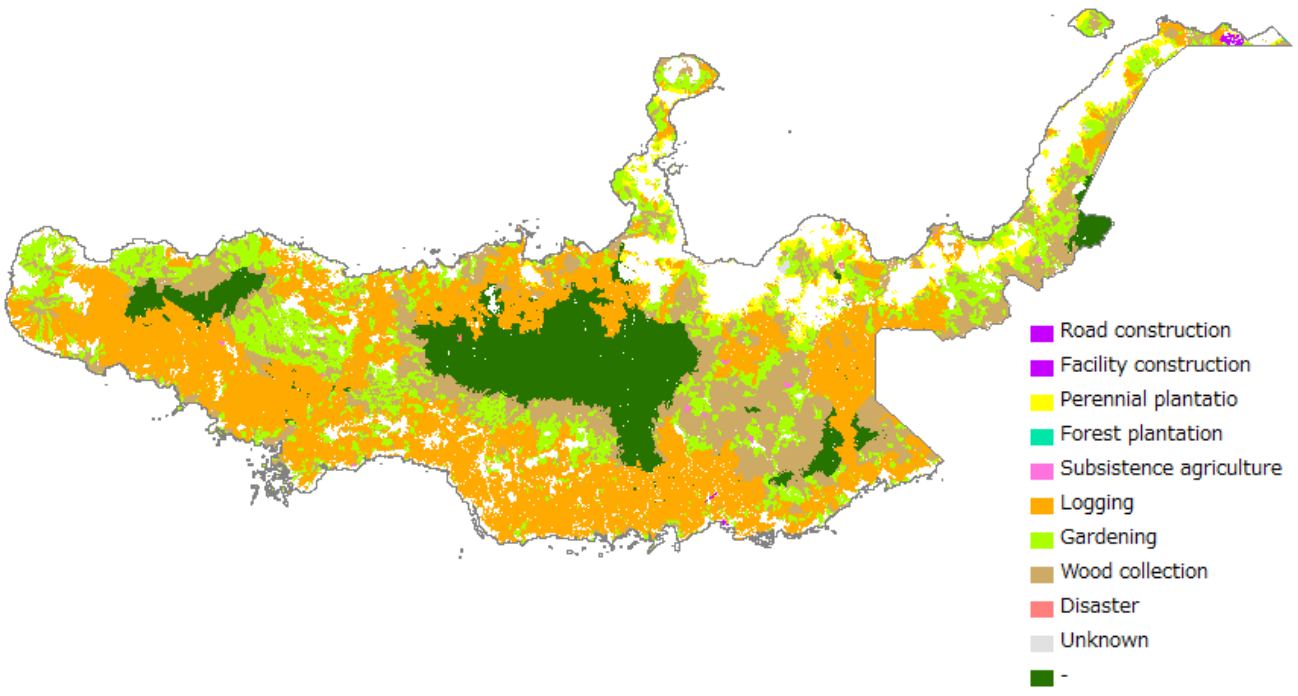
Forest Base Map + Reference Data (WNB)



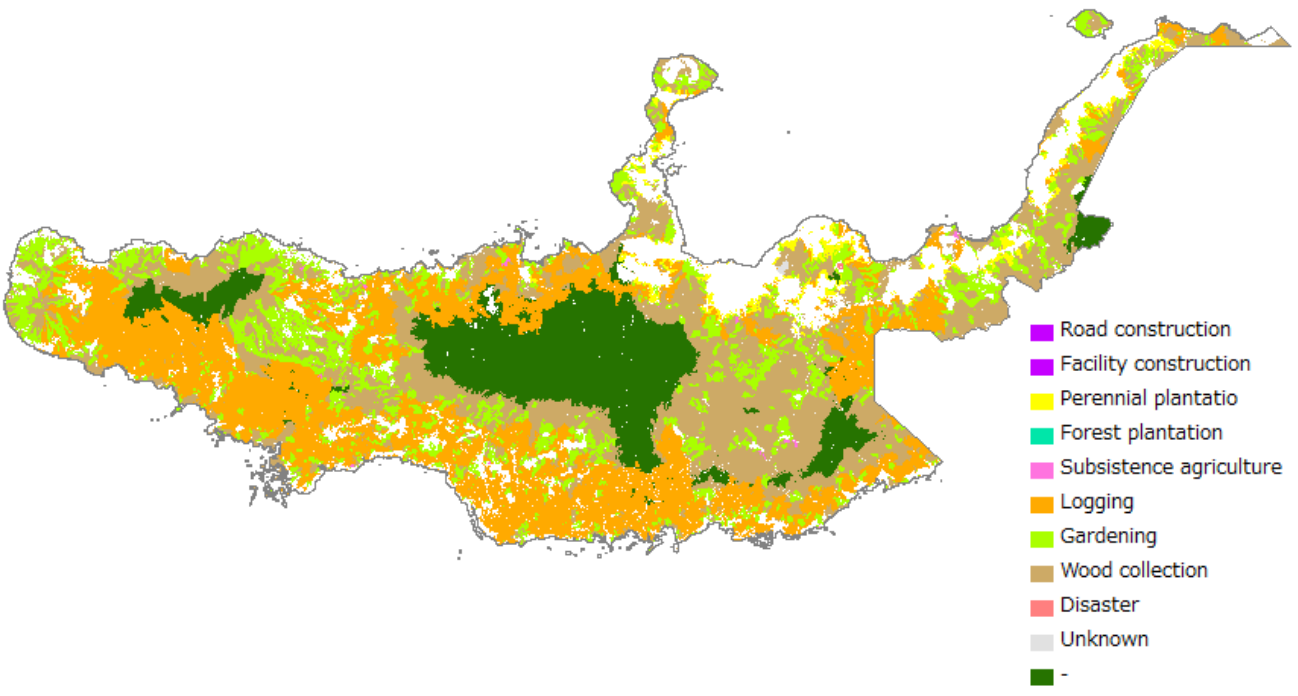
Results: Driver info of Forest Base Map (WNB)



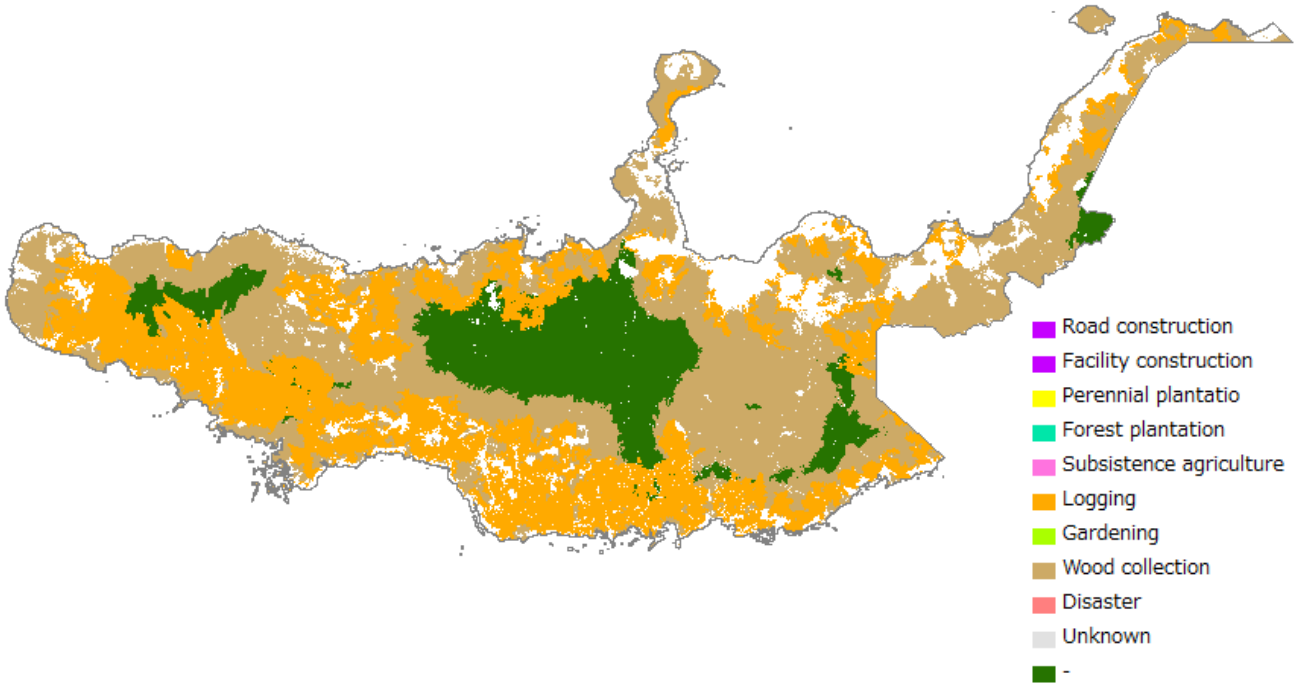
Results: Driver info of Revised Forest Cover Map 2011



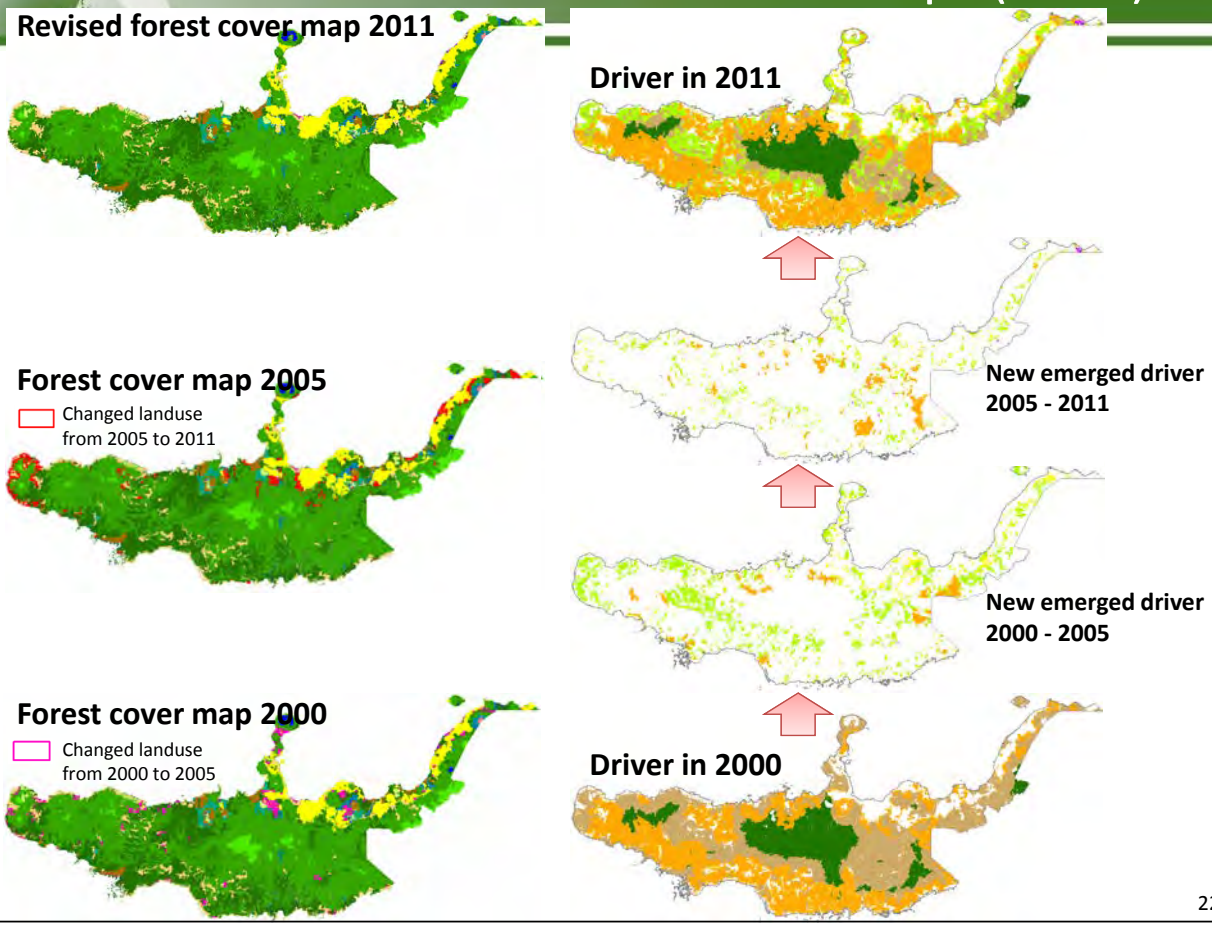
Results: Driver info of Forest Cover Map 2005



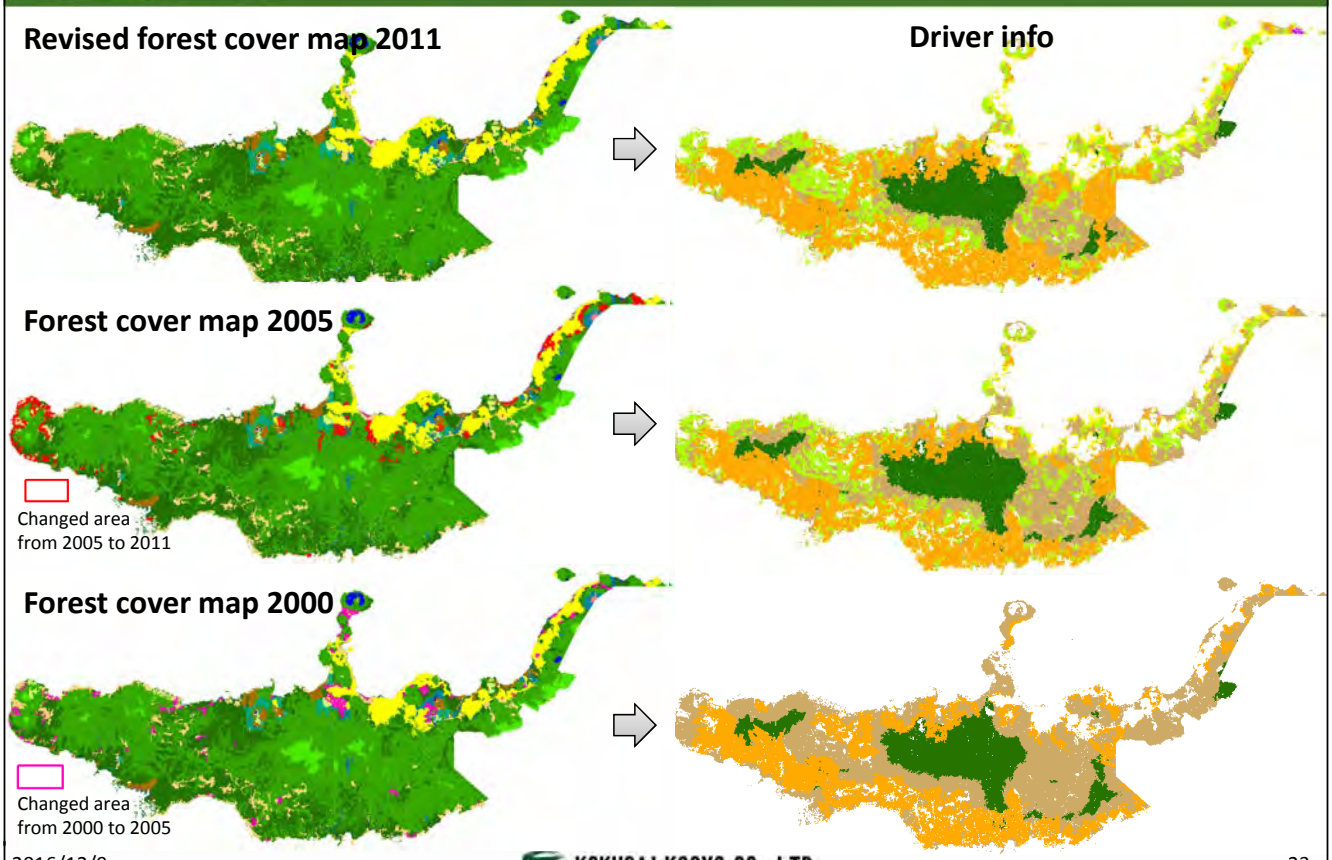
Results: Driver info of Forest Cover Map 2000



Results: Driver info of Forest Cover Maps (WNB)



Results: Driver info of Forest Cover Maps (WNB)



Plan for Future

- Comments by PNGFA staff are welcome if any.
- Data will be rearranged and reanalyzed if necessary.
- Logging roads (2000, 2000-2005, 2005-2011) for all provinces will be created.
- Capacity building for this work will be implemented to cartographer team.
- DD info will be constructed for the Forest Base Map of all provinces and the past forest cover maps of WNP and WSP.
- Technical and operational findings from this trial and error work will be a help to consider monitoring of forest resource for the future.
- These forest maps will be used for the following analyses such as land change model as well.

Annex 19

Past Forest Cover Maps

(West New Britain Province and West Sepik Province)

Vegetation areas and vegetation changed areas of past Forest Cover Maps (2000, 2005 and 2011) (WNB)

Areas of each vegetation change type (WNB)

Past Forest Cover Maps (2000, 2005 and 2011) and vegetation changed area map (WNB)

Vegetation areas and vegetation changed areas of past Forest Cover Maps (2000, 2005 and 2011) (WSP)

Areas of each vegetation change type (WSP)

Past Forest Cover Maps (2000, 2005 and 2011) and vegetation changed area map (WSP)

Areas of drivers of past Forest Cover Maps (2000, 2005 and 2011) (WNB and WSP)

Distribution of drivers of past Forest Cover Maps (2000, 2005 and 2011) (WNB)

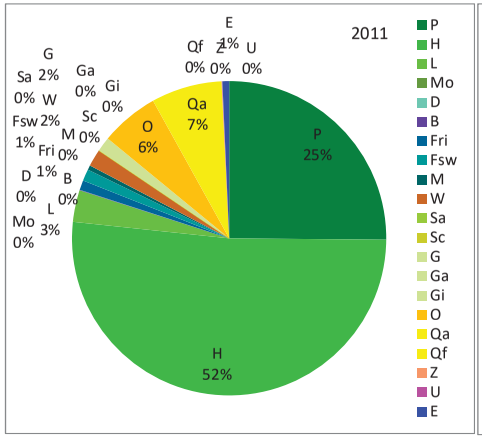
Distribution of drivers of past Forest Cover Maps (2000, 2005 and 2011) (WSP)

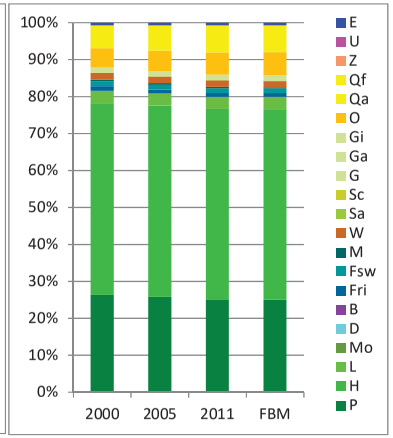
Forest Cover Map of WNB: Vegetation Type Area (ha) x Year

	VEG	VEGNAME	2000	2005	2011	FBM
	P	Low Altitude Forest on Plains & Fans	535,769	524,515	511,652	508,762
	H	Low Altitude Forest on Uplands	1,056,131	1,053,508	1,048,040	1,050,299
	L	Lower Montane Forest	66,383	66,383	66,313	66,313
	Mo	Montane Forest				
	D	Dry Seasonal Forest				
	B	Littoral Forest	1,392	1,222	1,111	1,111
	Fri	Seral Forest	25,263	20,605	20,366	20,373
	Fsw	Swamp Forest	26,076	26,029	24,208	24,365
	M	Mangrove Forest	9,667	9,667	9,553	8,299
	W	Woodland	37,156	36,803	36,203	33,882
	Sa	Savanna				
	Sc	Scrub	112	112	112	112
	G	Grassland and Herbland	29,015	29,121	30,721	32,069
	Ga	Grassland (Alpine)				
	Gi	Grassland (Subalpine)				
	O	Cropland/Agriculture land	106,022	112,050	122,038	125,999
	Qa	Plantation other than Qf	125,378	138,350	147,766	146,980
	Qf	Forest Plantation				
	Z	Bare areas	1,137	1,137	1,137	1,137
	U	Larger Urban Centres	651	651	651	185
	E	Lake & Larger Rivers	14,130	14,130	14,130	14,114
		SUM	2,034,281	2,034,281	2,034,000	2,034,000

	Forest Cover Area				
	Forest	1,720,681	1,701,927	1,681,243	1,679,523
	Forest & Woodland	1,757,837	1,738,730	1,717,446	1,713,405
*	Forest & Woodland & Scrub & Savanna	1,757,949	1,738,842	1,717,558	1,713,517

	Forest Cover Rate				
	Forest	84.6%	83.7%	82.7%	82.6%
	Forest & Woodland	86.4%	85.5%	84.4%	84.2%
*	Forest & Woodland & Scrub & Savanna	86.4%	85.5%	84.4%	84.2%





*FBM: Forest Base Map 2012 (ver.1.1)

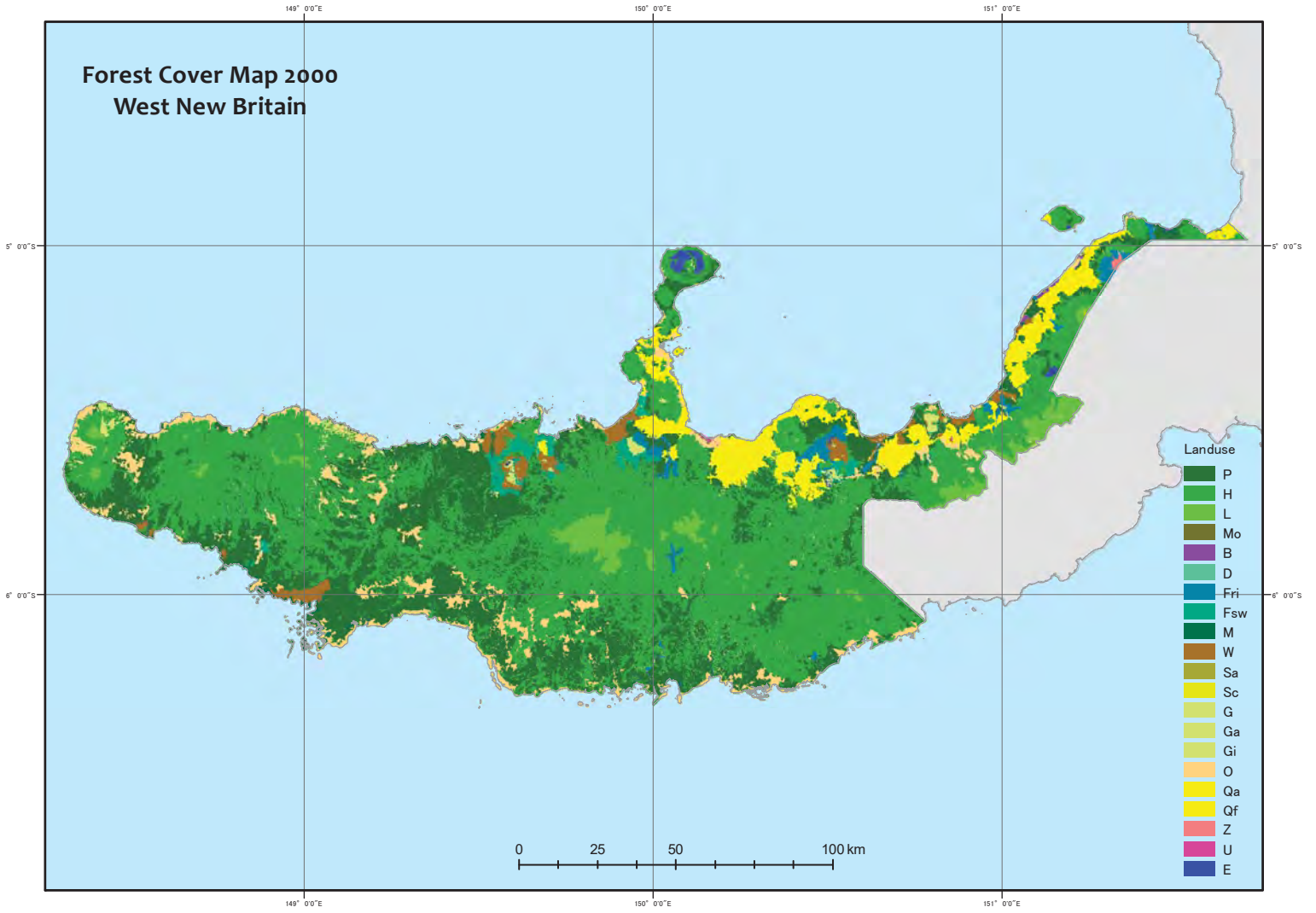
Forest Cover Map of WNB: Changed Area (ha) x Year

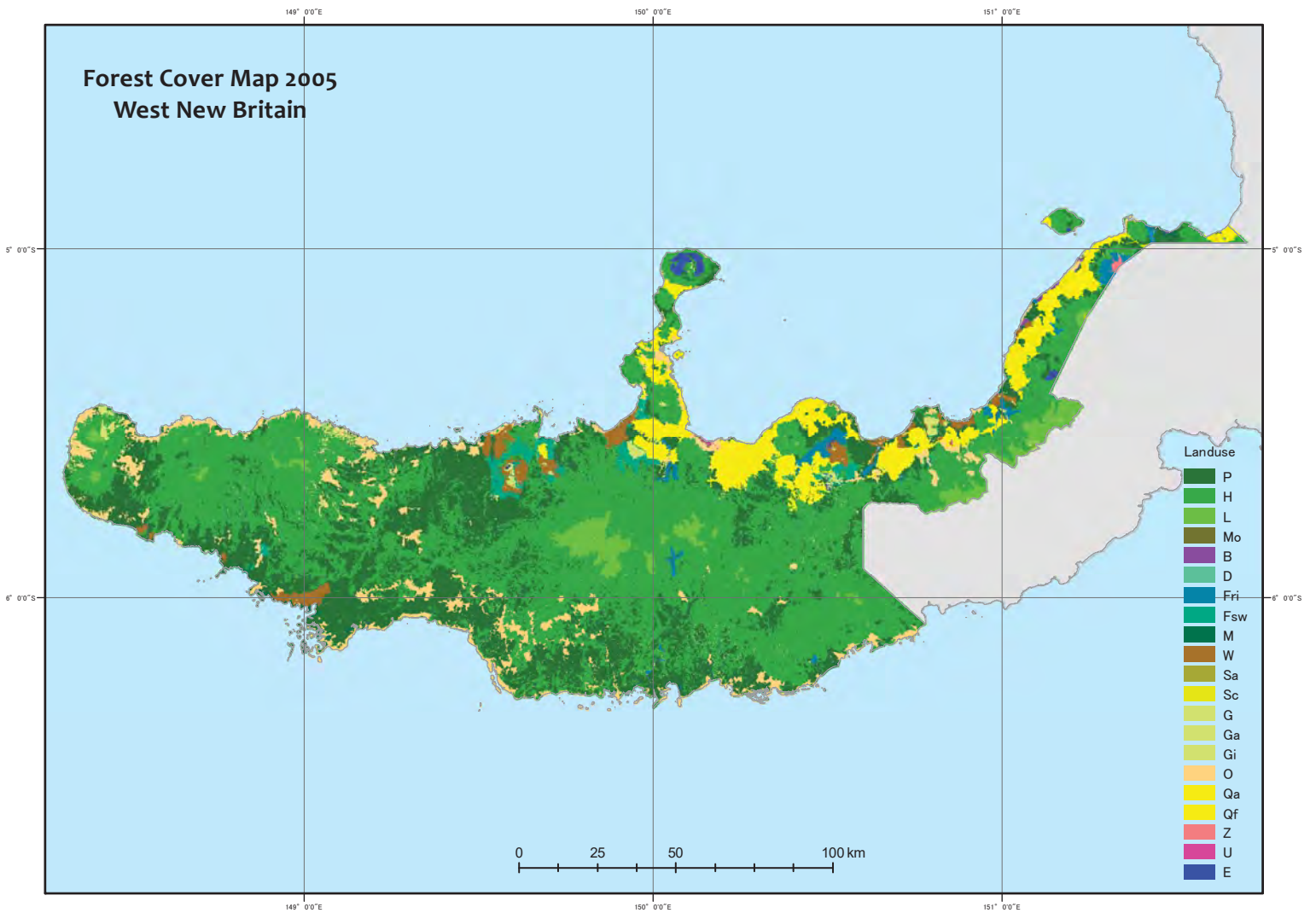
	VEG	2000->2005	2005->2011	Sum
	P	-11,254	-12,863	-24,117
	H	-2,623	-5,468	-8,092
	L	0	-70	-70
	Mo	0	0	0
	D	0	0	0
	B	-171	-111	-281
	Fri	-4,658	-238	-4,896
	Fsw	-47	-1,820	-1,868
	M	0	-114	-114
	W	-354	-600	-954
	Sa	0	0	0
	Sc	0	0	0
	G	106	1,600	1,706
	Ga	0	0	0
	Gi	0	0	0
	O	6,028	9,988	16,016
	Qa	12,972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

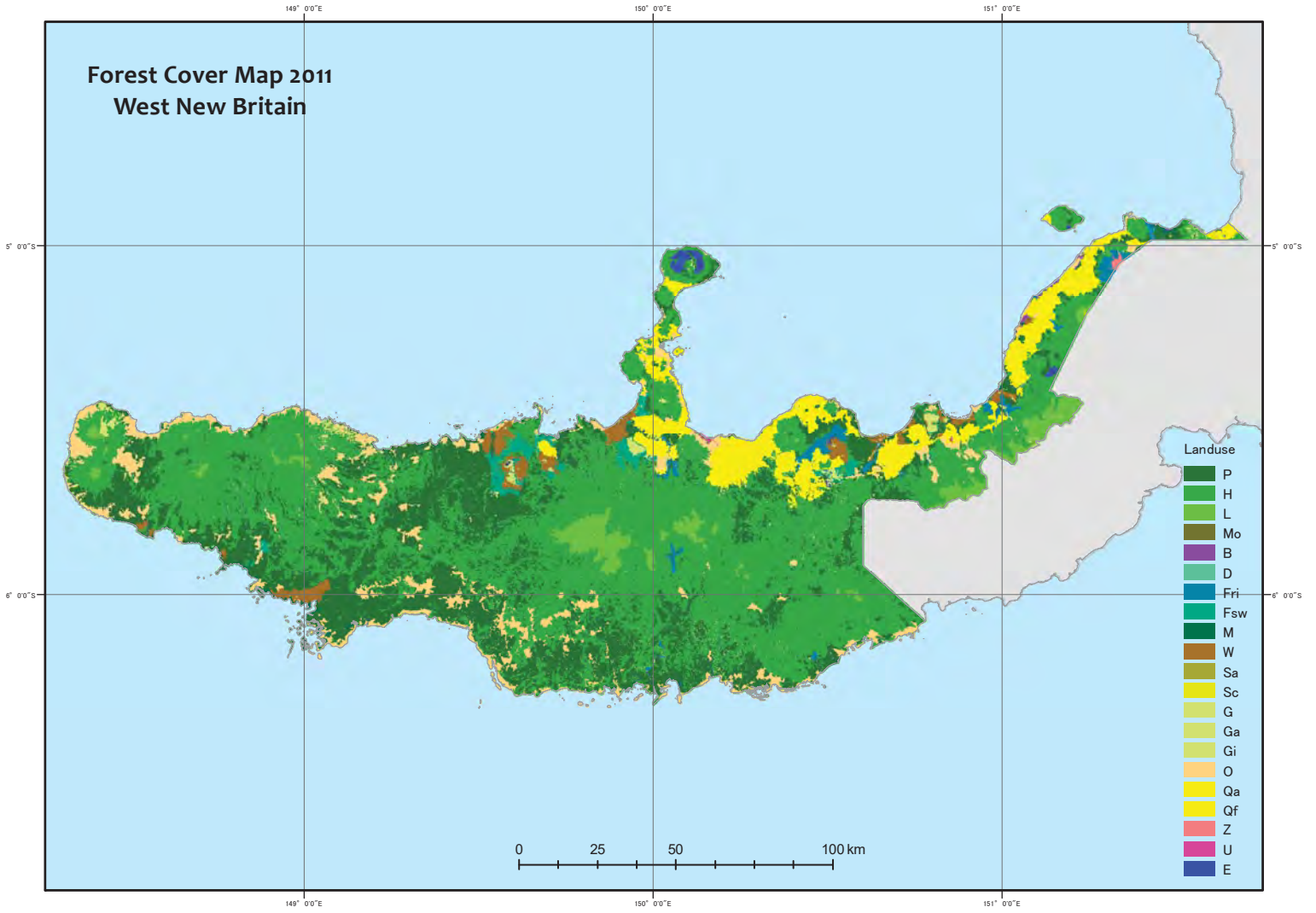
Forest Cover Map of WNB: Changed Vegetation Type x Area (ha) x Year

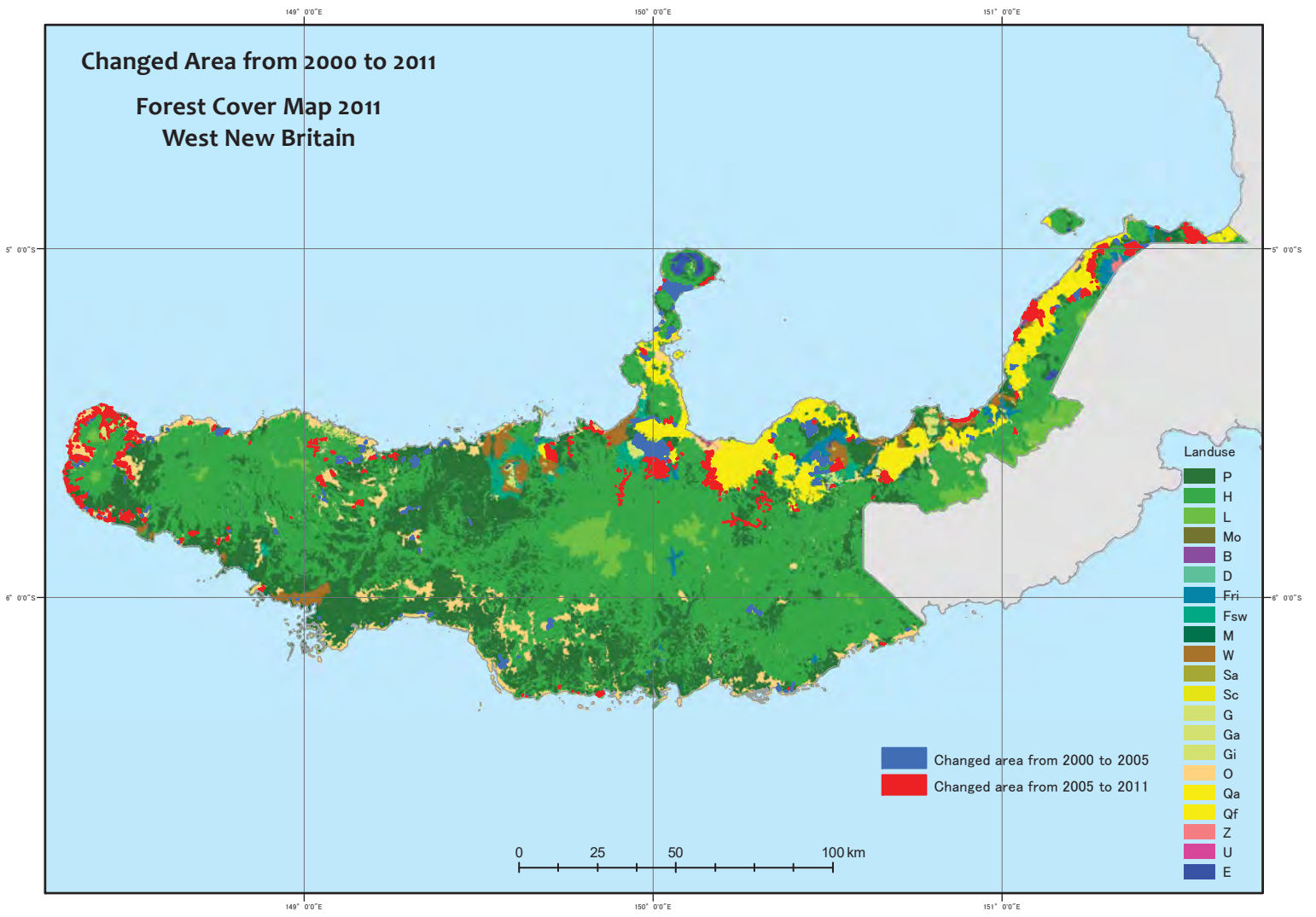
	2000	2005																					
	Landuse	P	H	L	Mo	D	B	Fri	Fsw	M	W	Sa	Sc	G	Ga	Gi	O	Qa	Qf	Z	U	E	Sum
	P	524,499	0	0	0	0	0	0	0	0	0	0	0	40	0	0	3,844	7,385	0	0	0	0	535,769
	H	0	1,053,459	0	0	0	0	0	0	0	0	0	0	78	0	0	2,075	520	0	0	0	0	1,056,131
	L	0	0	66,383	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66,383
	Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	1,222	0	0	0	0	0	0	0	0	0	0	171	0	0	0	0	1,392
	Fri	0	0	0	0	0	0	20,605	0	0	0	0	0	0	0	0	122	4,536	0	0	0	0	25,263
	Fsw	0	0	0	0	0	0	0	26,029	0	0	0	0	0	0	0	0	47	0	0	0	0	26,076
	M	0	0	0	0	0	0	0	0	9,667	0	0	0	0	0	0	0	0	0	0	0	0	9,667
	W	0	0	0	0	0	0	0	0	0	36,803	0	0	0	0	0	23	331	0	0	0	0	37,156
	Sa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sc	0	0	0	0	0	0	0	0	0	0	0	112	0	0	0	0	0	0	0	0	0	112
	G	0	0	0	0	0	0	0	0	0	0	0	0	29,004	0	0	11	0	0	0	0	0	29,015
	Ga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	O	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	105,975	17	0	0	0	0	106,022
	Qa	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125,343	0	0	0	0	125,378
	Qf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,137	0	0	1,137
	U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	651	0	651
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,130	14,130
	Sum	524,515	1,053,508	66,383	0	0	1,222	20,605	26,029	9,667	36,803	0	112	29,121	0	0	112,050	138,350	0	1,137	651	14,130	2,034,281

	2005	2011																					
	Landuse	P	H	L	Mo	D	B	Fri	Fsw	M	W	Sa	Sc	G	Ga	Gi	O	Qa	Qf	Z	U	E	Sum
	P	511,175	11	0	0	0	0	0	0	0	0	0	0	451	0	0	5,996	6,880	0	0	0	0	524,515
	H	116	1,047,447	0	0	0	0	0	0	0	0	0	0	1,562	0	0	3,664	720	0	0	0	0	1,053,508
	L	0	0	66,309	0	0	0	0	0	0	0	0	0	74	0	0	0	0	0	0	0	0	66,383
	Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	1,111	0	0	0	0	0	0	0	0	0	0	111	0	0	0	0	1,222
	Fri	0	0	0	0	0	0	20,366	0	0	0	0	0	87	0	0	9	143	0	0	0	0	20,605
	Fsw	0	0	0	0	0	0	0	24,208	0	0	0	0	3	0	0	389	1,429	0	0	0	0	26,029
	M	0	0	0	0	0	0	0	0	9,552	0	0	0	1	0	0	8	0	0	0	0	0	9,667
	W	0	0	0	0	0	0	0	0	1	36,203	0	0	101	0	0	239	84	0	0	0	0	36,803
	Sa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sc	0	0	0	0	0	0	0	0	0	0	0	112	0	0	0	0	0	0	0	0	0	112
	G	231	316	4	0	0	0	0	0	0	0	0	0	28,342	0	0	219	9	0	0	0	0	29,121
	Ga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Gi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	O	126	265	0	0	0	0	0	0	0	0	0	0	101	0	0	111,514	44	0	0	0	0	112,050
	Qa	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	138,346	0	0	0	0	138,350
	Qf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,137	0	0	1,137
	U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	651	0	651
	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,130	14,130
	Sum	511,652	1,048,040	66,313	0	0	1,111	20,366	24,208	9,553	36,203	0	112	30,721	0	0	122,038	147,766	0	1,137	651	14,130	2,034,281


Forest Cover Map 2000
West New Britain
149° 0'0"E
150° 0'0"E
151° 0'0"E
5° 0'0"S
6° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km


Forest Cover Map 2005
West New Britain
149° 0'0"E
150° 0'0"E
151° 0'0"E
5° 0'0"S
6° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km


Forest Cover Map 2011
West New Britain
149° 0'0"E
150° 0'0"E
151° 0'0"E
5° 0'0"S
6° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km

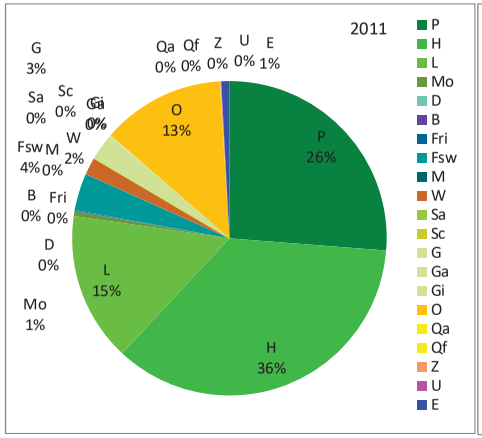

Changed Area from 2000 to 2011
Forest Cover Map 2011
West New Britain
149° 0'0"E
150° 0'0"E
151° 0'0"E
5° 0'0"S
6° 0'0"S
Changed area from 2000 to 2005
Changed area from 2005 to 2011
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km

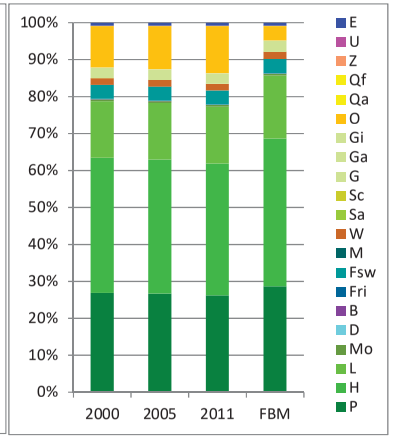
Forest Cover Map of WSP: Vegetation Type Area (ha) x Year

	VEG	VEGNAME	2000	2005	2011	FBM
	P	Low Altitude Forest on Plains & Fans	966,122	960,534	942,453	1,031,108
	H	Low Altitude Forest on Uplands	1,313,392	1,302,847	1,282,868	1,436,375
	L	Lower Montane Forest	550,787	550,608	550,405	611,335
	Mo	Montane Forest	18,002	18,002	18,002	18,002
	D	Dry Seasonal Forest				
	B	Littoral Forest	1,972	1,799	1,611	2,265
	Fri	Seral Forest	2,976	2,976	2,976	2,976
	Fsw	Swamp Forest	136,275	136,053	135,997	137,879
	M	Mangrove Forest	667	667	667	669
	W	Woodland	64,520	64,173	63,962	66,858
	Sa	Savanna				
	Sc	Scrub	280	280	280	282
	G	Grassland and Herbland	99,671	99,266	99,940	106,321
	Ga	Grassland (Alpine)	1,792	1,802	1,802	1,802
	Gi	Grassland (Subalpine)	2,550	2,550	2,550	2,550
	O	Cropland/Agriculture land	399,017	417,481	454,517	141,174
	Qa	Plantation other than Qf	1,272	1,299	1,501	1,479
	Qf	Forest Plantation				
	Z	Bare areas	1,999	1,992	2,022	1,984
	U	Larger Urban Centres	1,489	1,495	1,495	318
	E	Lake & Larger Rivers	29,984	29,716	29,719	29,389
		SUM	3,592,766	3,593,541	3,592,766	3,592,766

	Forest Cover Area				
	Forest	2,990,193	2,973,486	2,934,978	3,240,610
	Forest & Woodland	3,054,713	3,037,660	2,998,940	3,307,467
*	Forest & Woodland & Scrub & Savanna	3,054,992	3,037,939	2,999,220	3,307,749

	Forest Cover Rate				
	Forest	83.2%	82.7%	81.7%	90.2%
	Forest & Woodland	85.0%	84.5%	83.5%	92.1%
*	Forest & Woodland & Scrub & Savanna	85.0%	84.5%	83.5%	92.1%





*FBM: Forest Base Map 2012 (ver.1.1)

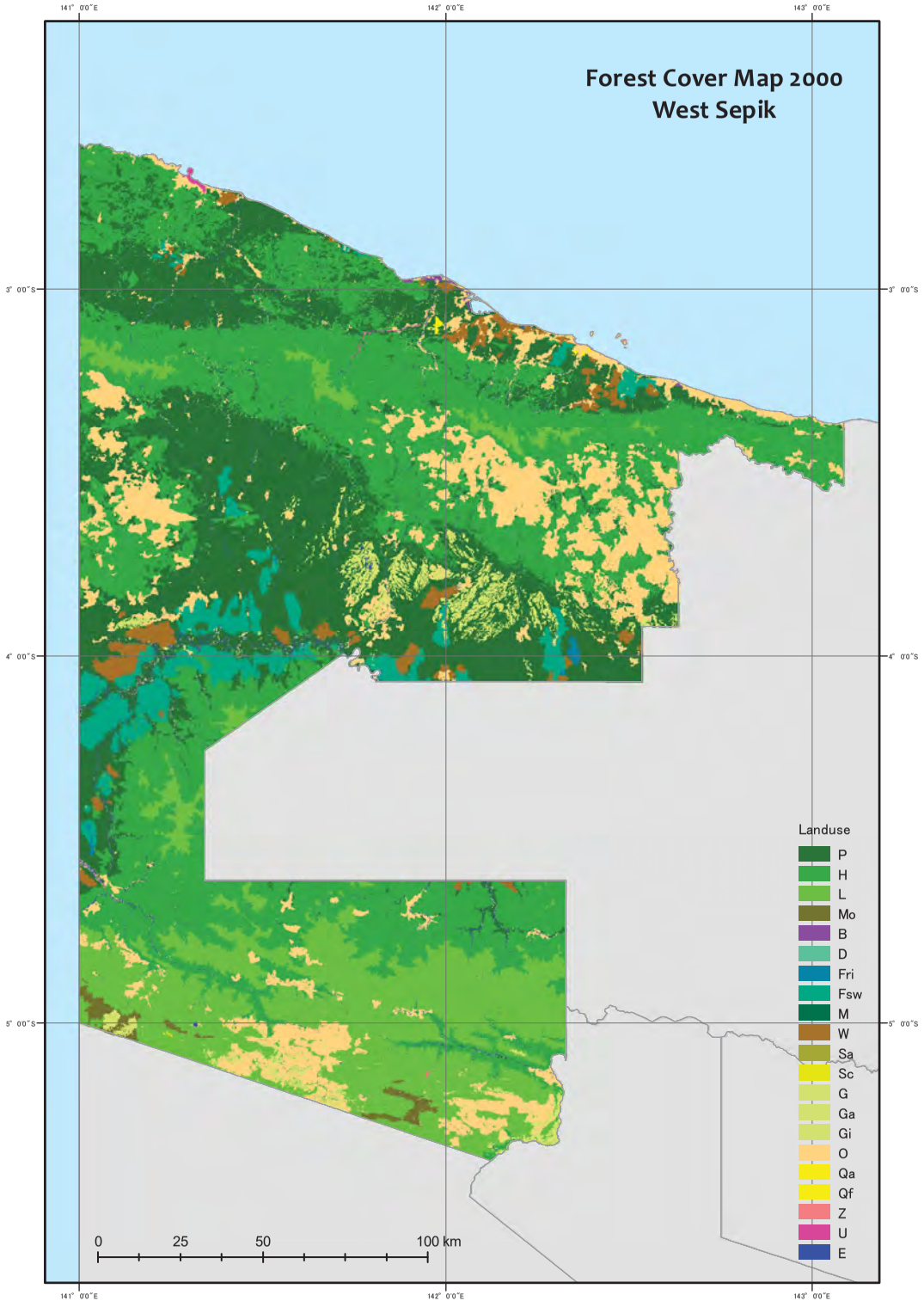
Forest Cover Map of WSP: Changed Area (ha) x Year

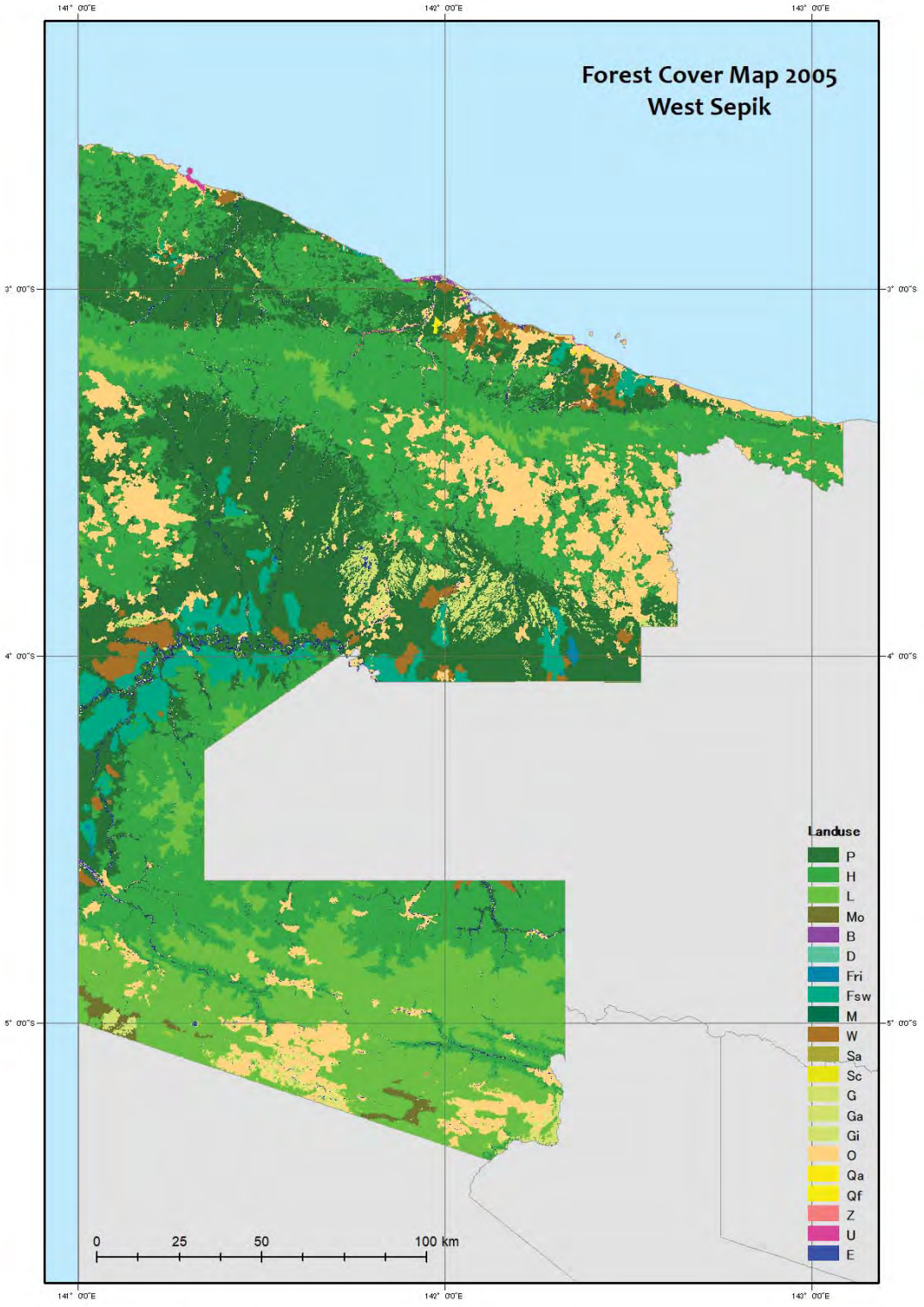
	VEG	2000->2005	2005->2011	Sum
	P	-5,588	-18,081	-23,669
	H	-10,545	-19,979	-30,525
	L	-178	-203	-382
	Mo	0	0	0
	D	0	0	0
	B	-173	-188	-362
	Fri	0	0	0
	Fsw	-222	-56	-278
	M	0	0	0
	W	-347	-211	-558
	Sa	0	0	0
	Sc	0	0	0
	G	-404	673	269
	Ga	11	0	11
	Gi	0	0	0
	O	18,464	37,036	55,499
	Qa	27	202	229
	Qf	0	0	0
	Z	-7	30	23
	U	6	0	6
	E	-268	3	-265

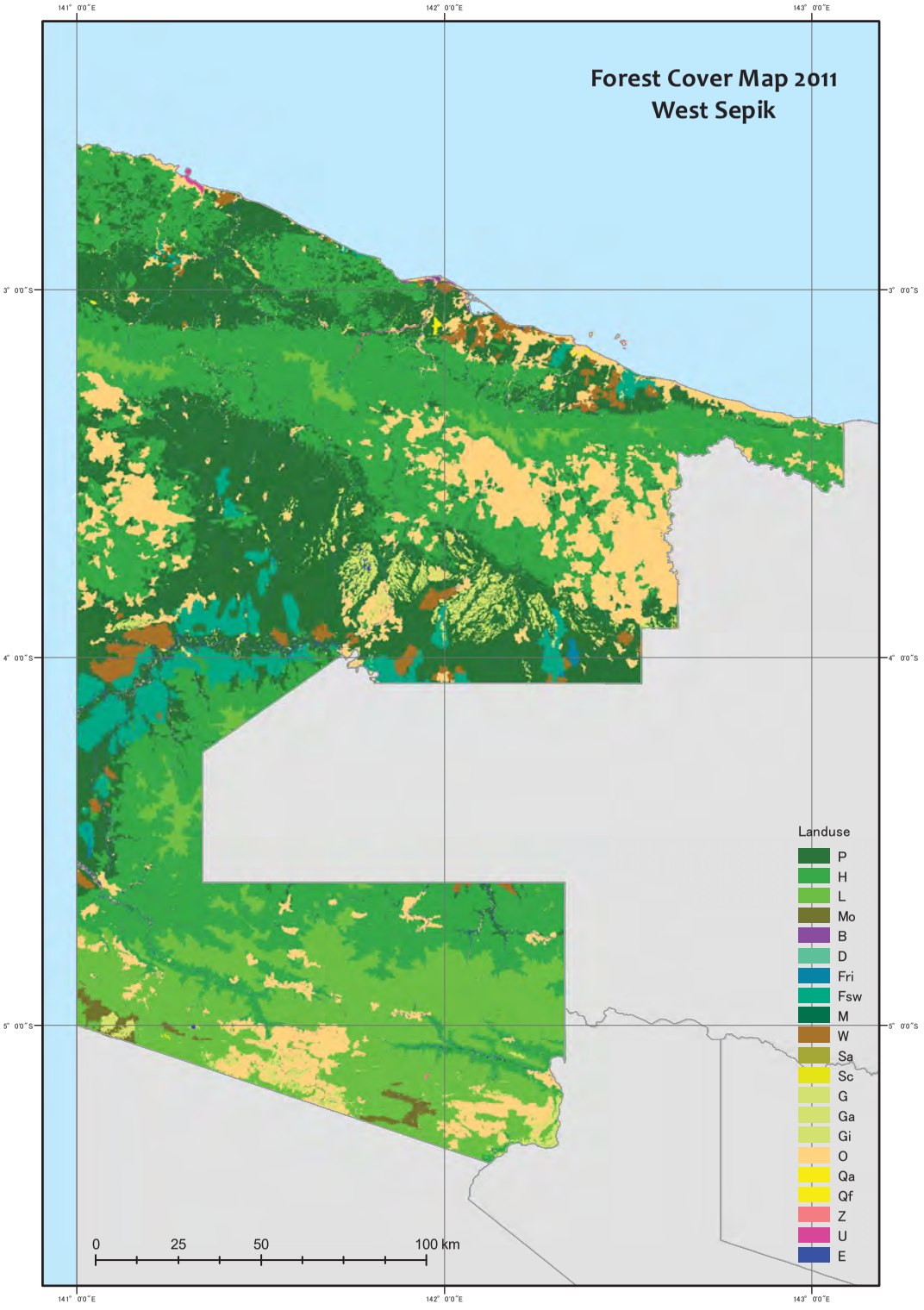
Forest Cover Map of WSP: Changed Type x Area (ha) x Year

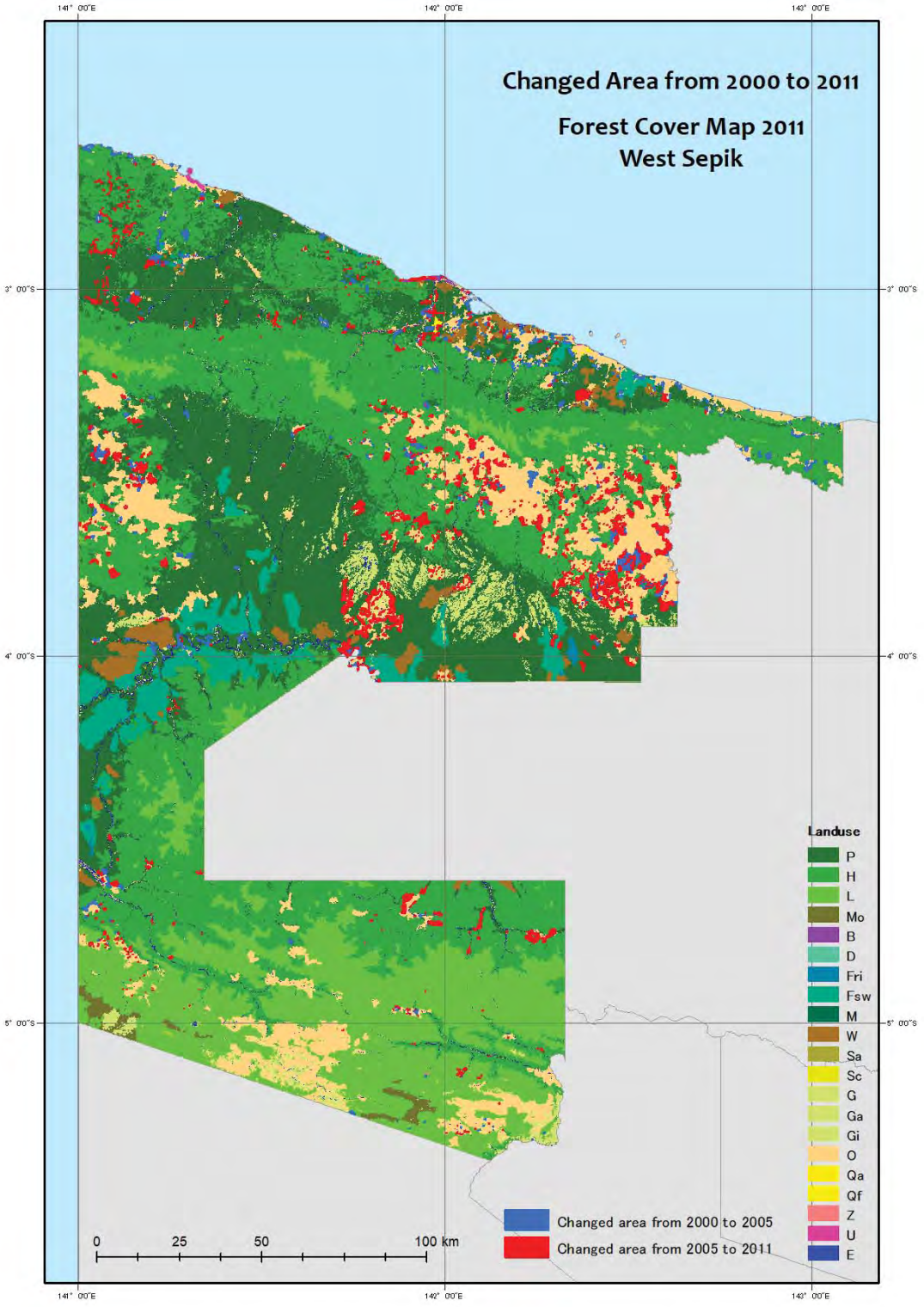
	2000	2005																					
	Landuse	P	H	L	Mo	D	B	Fri	Fsw	M	W	Sa	Sc	G	Ga	Gi	O	Qa	Qf	Z	U	E	Sum
	P	959,748	0	0	0	0	0	0	0	0	90	0	0	38	0	0	6,812	27	0	0	0	181	966,897
	H	0	1,301,919	0	0	0	0	0	0	0	0	0	0	77	0	0	11,391	0	0	5	0	0	1,313,392
	L	0	0	550,601	0	0	0	0	0	0	0	0	0	26	11	0	149	0	0	0	0	0	550,787
	Mo	0	0	0	18,002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,002
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	1,799	0	0	0	0	0	0	7	0	0	166	0	0	0	0	0	1,972
	Fri	0	0	0	0	0	0	2,976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,976
	Fsw	0	0	0	0	0	0	0	136,053	0	0	0	0	0	0	0	222	0	0	0	0	0	136,275
	M	0	0	0	0	0	0	0	0	667	0	0	0	0	0	0	0	0	0	0	0	0	667
	W	0	0	0	0	0	0	0	0	0	64,068	0	0	7	0	0	434	0	0	0	0	10	64,520
	Sa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sc	0	0	0	0	0	0	0	0	0	0	0	280	0	0	0	0	0	0	0	0	0	280
	G	402	45	2	0	0	0	0	0	0	0	0	0	98,903	0	0	314	0	0	0	4	0	99,671
	Ga	0	0	0	0	0	0	0	0	0	0	0	0	0	1,792	0	0	0	0	0	0	0	1,792
	Gi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,550	0	0	0	0	0	0	2,550
	O	210	883	5	0	0	0	0	0	0	0	0	0	32	0	0	397,885	0	0	0	2	0	399,017
	Qa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	497	0	0	0	0	497
	Qf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Z	0	0	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	1,988	0	0	1,999
	U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,489	0	1,489
	E	174	0	0	0	0	0	0	0	0	15	0	0	164	0	0	107	0	0	0	0	29,524	29,984
	Sum	960,534	1,302,847	550,608	18,002	0	1,799	2,976	136,053	667	64,173	0	280	99,266	1,802	2,550	417,481	524	0	1,992	1,495	29,716	3,592,766

	2005	2011																					
	Landuse	P	H	L	Mo	D	B	Fri	Fsw	M	W	Sa	Sc	G	Ga	Gi	O	Qa	Qf	Z	U	E	Sum
	P	943,112	7	0	0	0	0	0	0	0	0	0	0	899	0	0	16,326	186	0	1	0	3	960,534
	H	8	1,282,569	0	0	0	0	0	0	0	0	0	0	512	0	0	19,729	0	0	29	0	0	1,302,847
	L	0	0	550,297	0	0	0	0	0	0	0	0	0	61	0	0	250	0	0	0	0	0	550,608
	Mo	0	0	0	18,002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,002
	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	B	0	0	0	0	0	1,607	0	0	0	0	0	0	0	0	0	192	0	0	0	0	0	1,799
	Fri	0	0	0	0	0	0	2,976	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,976
	Fsw	0	0	0	0	0	0	0	135,997	0	0	0	0	0	0	0	52	0	0	4	0	0	136,053
	M	0	0	0	0	0	0	0	0	667	0	0	0	0	0	0	0	0	0	0	0	0	667
	W	0	0	0	0	0	0	0	0	0	63,962	0	0	0	0	0	211	0	0	0	0	0	64,173
	Sa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sc	0	0	0	0	0	0	0	0	0	0	0	280	0	0	0	0	0	0	0	0	0	280
	G	3	0	102	0	0	0	0	0	0	0	0	0	98,210	0	0	929	15	0	8	0	0	99,266
	Ga	0	0	0	0	0	0	0	0	0	0	0	0	0	1,802	0	0	0	0	0	0	0	1,802
	Gi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,550	0	0	0	0	0	0	2,550
	O	105	287	5	0	0	3	0	0	0	0	0	0	250	0	0	416,829	0	0	0	0	0	417,481
	Qa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	524	0	0	0	0	524
	Qf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Z	0	5	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	1,981	0	0	1,992
	U	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	29,716	29,716
	Sum	943,229	1,282,868	550,405	18,002	0	1,611	2,976	135,997	667	63,962	0	280	99,940	1,802	2,550	454,517	726	0	2,022	1,495	29,719	3,592,766


Forest Cover Map 2000
West Sepik
141° 0'0"E
142° 0'0"E
143° 0'0"E
3° 0'0"S
4° 0'0"S
5° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km

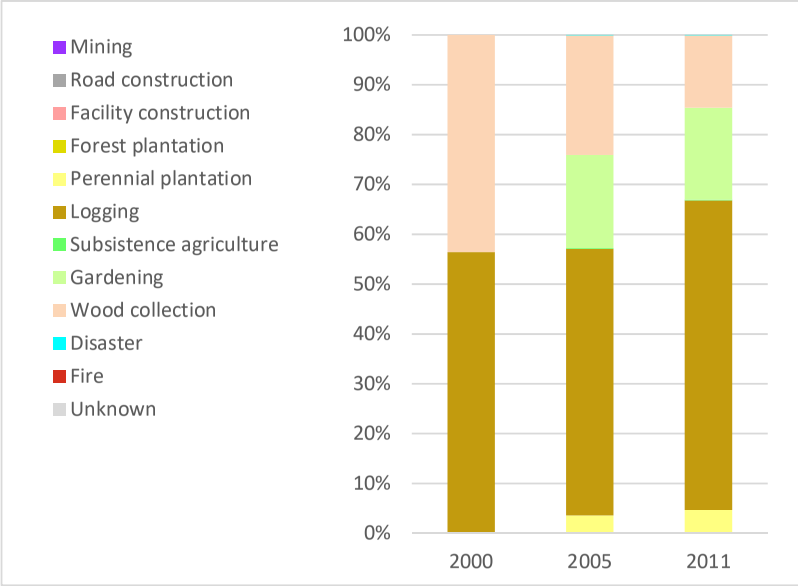

Forest Cover Map 2005
West Sepik
141° 0'0"E
142° 0'0"E
143° 0'0"E
3° 0'0"S
4° 0'0"S
5° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km


Forest Cover Map 2011
West Sepik
141° 0'0"E
142° 0'0"E
143° 0'0"E
3° 0'0"S
4° 0'0"S
5° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
0
25
50
100 km


Changed Area from 2000 to 2011
Forest Cover Map 2011
West Sepik
141° 0'0"E
142° 0'0"E
143° 0'0"E
3° 0'0"S
4° 0'0"S
5° 0'0"S
Landuse
P
H
L
Mo
B
D
Fri
Fsw
M
W
Sa
Sc
G
Ga
Gi
O
Qa
Qf
Z
U
E
Changed area from 2000 to 2005
Changed area from 2005 to 2011
0
25
50
100 km

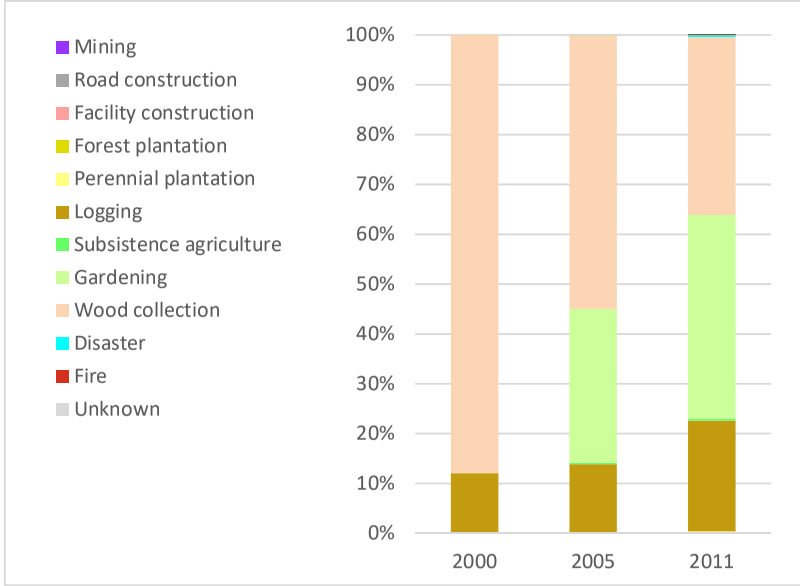
Forest Degradation Drivers of WNB: Drivers Area (ha) x Year

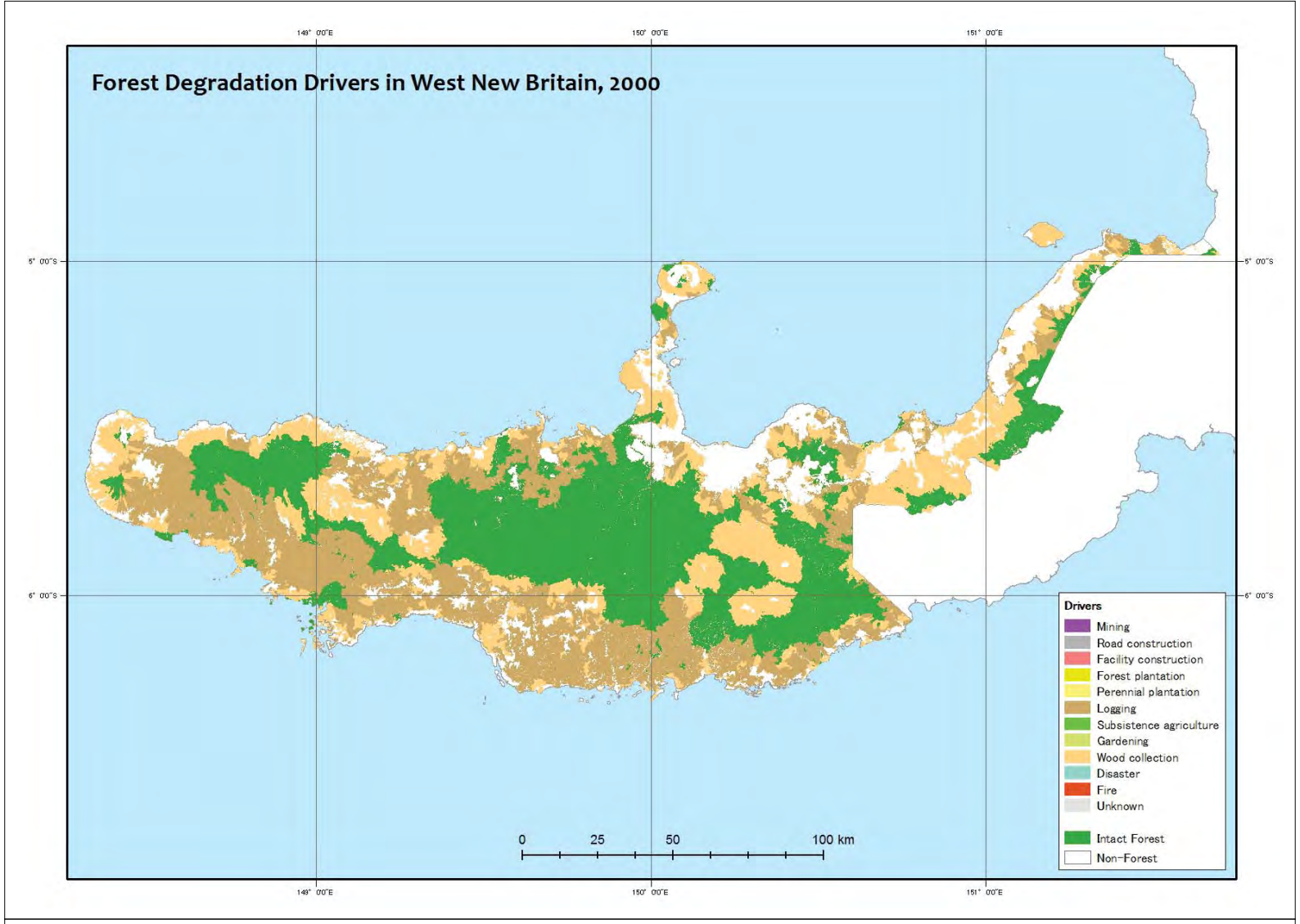
	Drivers	2000	2005	2011
	Mining	–	0	0
	Road construction	–	0	0
	Facility construction	–	0	180
	Forest plantation	–	0	137
	Perennial plantation	–	39,818	54,294
	Logging	614,318	592,924	724,572
	Subsistence agriculture	–	1,862	2,003
	Gardening	–	207,225	214,989
	Wood collection	474,105	265,713	169,140
	Disaster	–	1,209	1,306
	Fire	–	0	0
	Unknown	–	0	0
	(Intact Forest)	669,525	629,811	550,934
	SUM	1,757,949	1,738,561	1,717,558

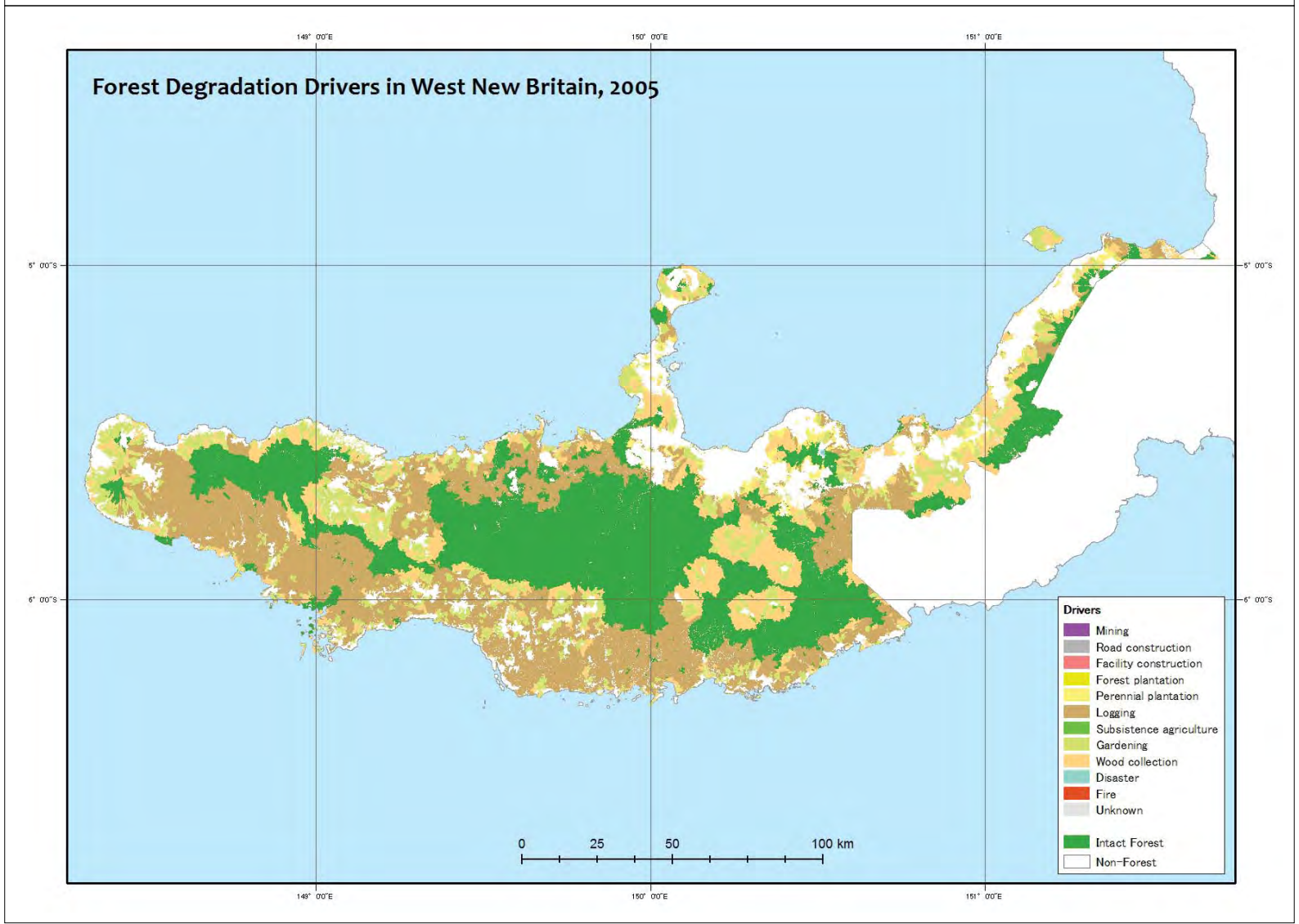


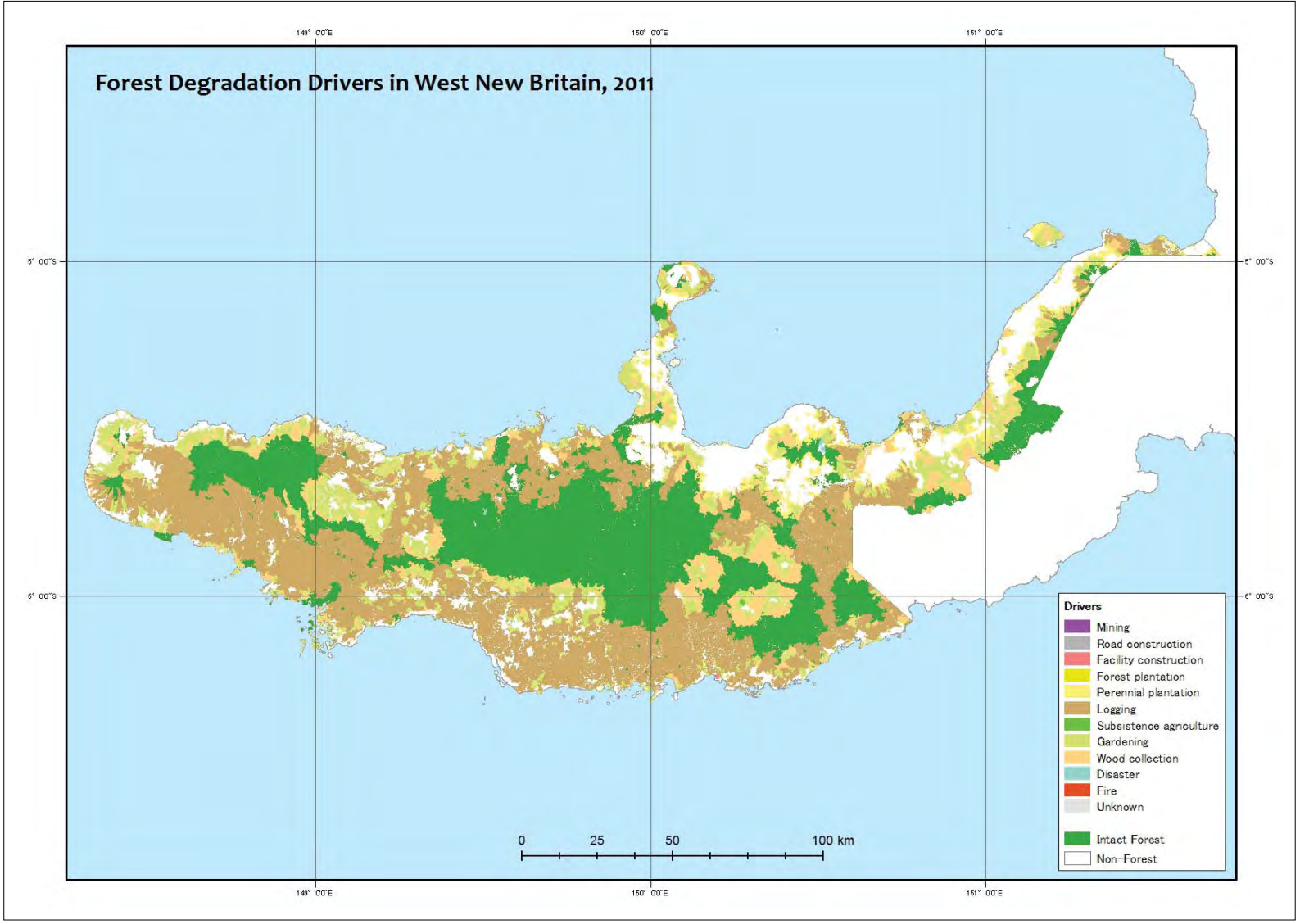
Forest Degradation Drivers of WSP: Drivers Area (ha) x Year

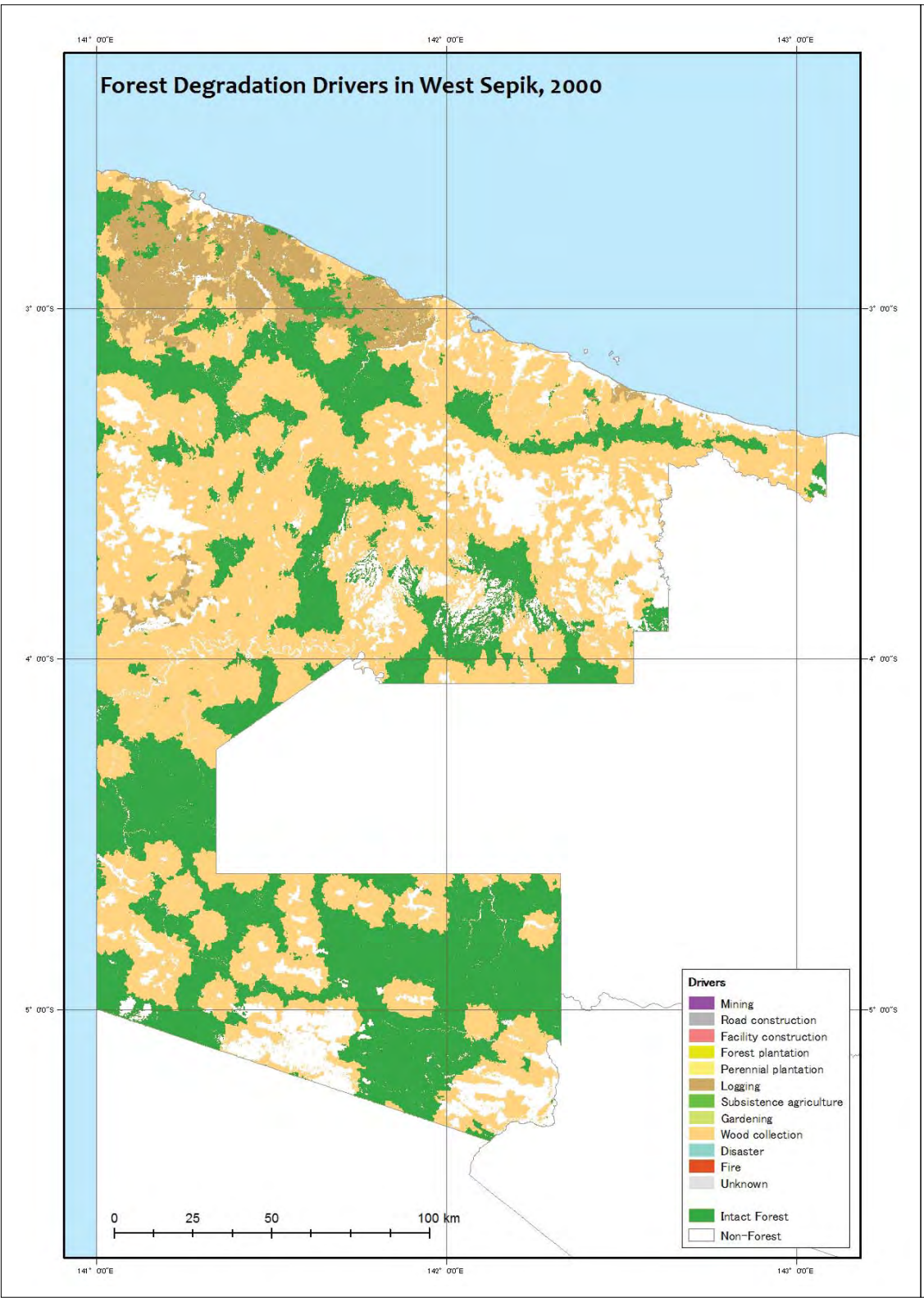
	Drivers	2000	2005	2011
	Mining	–	3,350	4,455
	Road construction	–	0	513
	Facility construction	–	0	135
	Forest plantation	–	0	0
	Perennial plantation	–	444	3,362
	Logging	232,422	263,344	432,329
	Subsistence agriculture	–	5,720	6,302
	Gardening	–	594,167	796,861
	Wood collection	1,690,079	1,057,868	695,540
	Disaster	–	549	7,920
	Fire	–	0	321
	Unknown	–	0	0
	(Intact Forest)	1,132,492	1,111,709	1,051,445
	SUM	3,054,993	3,037,150	2,999,183

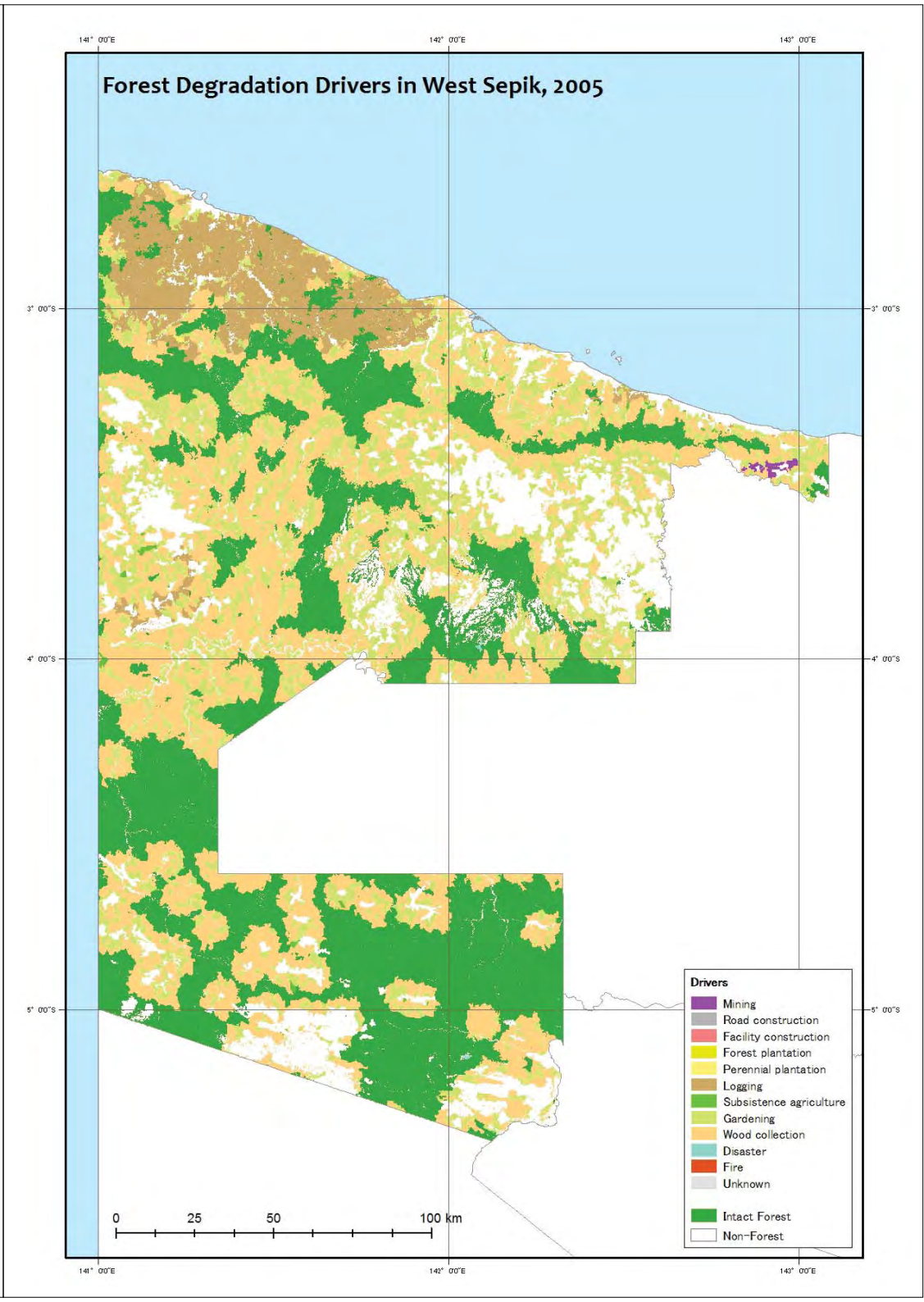


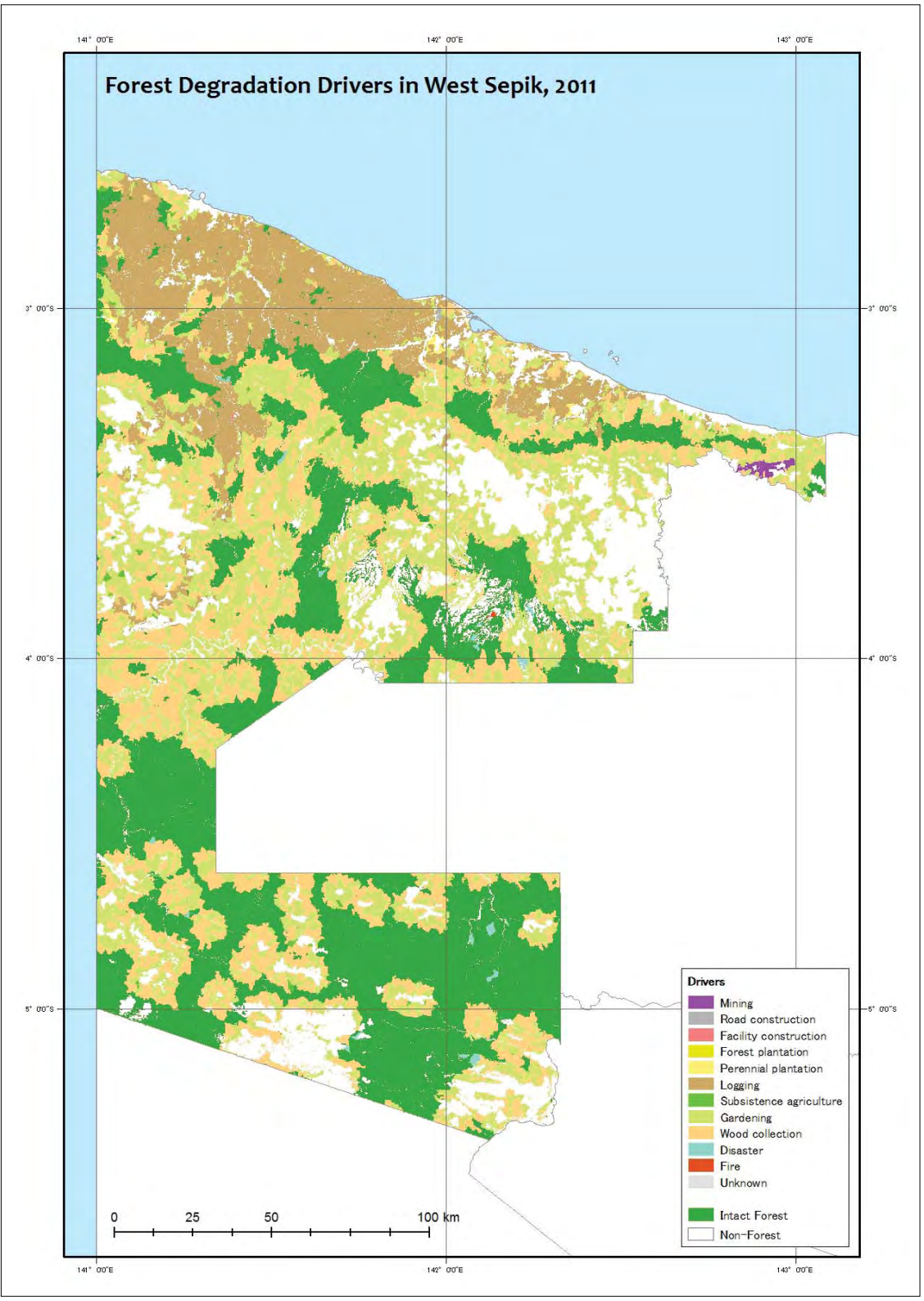

Forest Degradation Drivers in West New Britain, 2000
148° 00'E
150° 00'E
151° 00'E
5° 00'S
6° 00'S
0
25
50
100 km
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest


Forest Degradation Drivers in West New Britain, 2005
148° 00'E
150° 00'E
151° 00'E
5° 00'S
6° 00'S
0
25
50
100 km
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest


Forest Degradation Drivers in West New Britain, 2011
148° 00'E
150° 00'E
151° 00'E
5° 00'S
6° 00'S
0
25
50
100 km
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest


Forest Degradation Drivers in West Sepik, 2000
141° 00'E
142° 00'E
143° 00'E
3° 00'S
4° 00'S
5° 00'S
0
25
50
100 km
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest


Forest Degradation Drivers in West Sepik, 2005
141° 00'E
142° 00'E
143° 00'E
3° 00'S
4° 00'S
5° 00'S
0
25
50
100 km
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest


Forest Degradation Drivers in West Sepik, 2011
141° 00'E
142° 00'E
143° 00'E
3° 00'S
4° 00'S
5° 00'S
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest
0
25
50
100 km

Annex 20

Forest Cover Map 2015

Vegetation areas of past Forest Cover Maps 2015

Forest Cover Maps 2015

Areas of drivers of Forest Cover Maps 2015

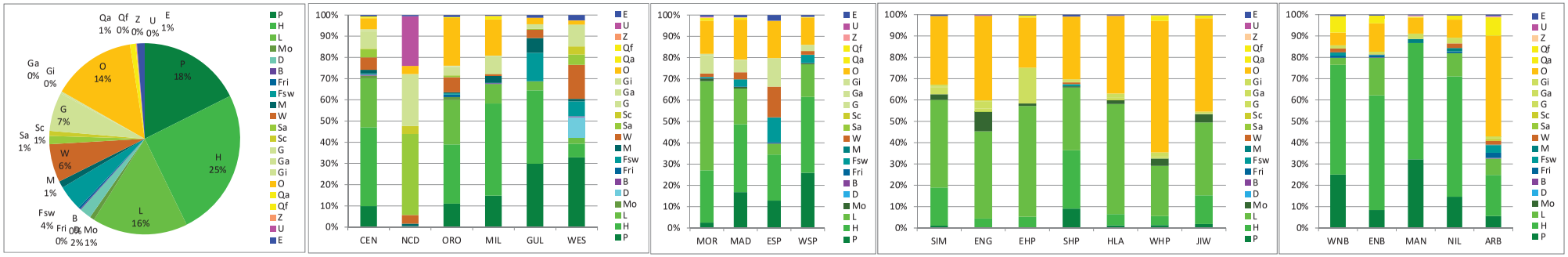
Distribution of drivers of Forest Cover Maps 2015

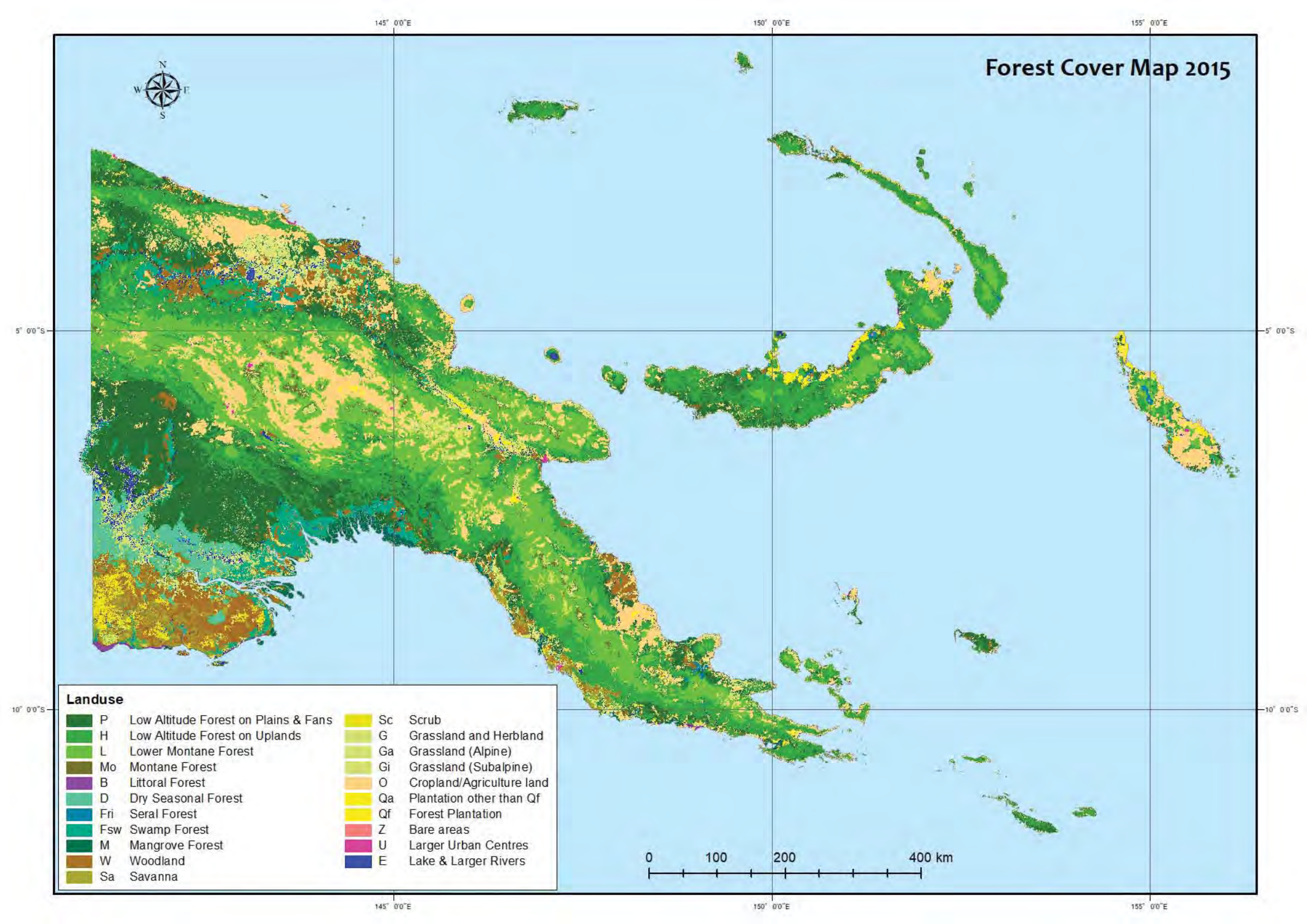
Forest Cover Map 2015: Vegetation Type Area (ha) x Province　　＊Islands outside PNG, which are located to the south of WES and ARB, are removed.

	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

	Forest Cover Area	(ha)																							
	Forest	31,283,279	2,210,079	423	1,438,002	1,010,762	3,094,881	5,918,102	2,407,454	2,020,165	2,269,094	2,920,861	384,257	640,072	655,720	1,014,513	632,666	142,262	256,300	1,675,681	1,262,009	171,117	792,722	366,137
	Forest&Woodland	34,272,288	2,382,804	1,494	1,598,863	1,022,763	3,231,582	7,493,002	2,458,833	2,118,089	2,899,490	2,984,823	384,257	640,072	655,720	1,027,622	633,045	142,262	256,300	1,710,400	1,264,318	171,117	812,915	382,517
*	Forest&Woodland&Scrub&Savanna	35,299,122	2,503,069	12,442	1,619,404	1,024,130	3,246,068	8,345,275	2,458,844	2,118,089	2,899,490	2,985,102	384,257	640,090	655,720	1,027,622	633,156	142,262	256,300	1,710,512	1,264,344	171,117	812,915	388,913

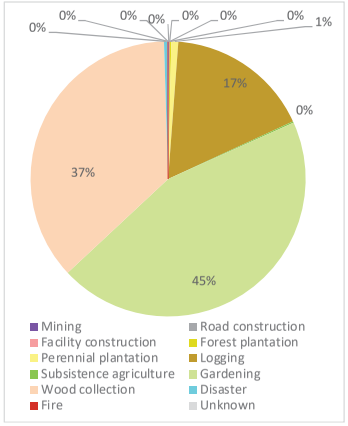
	Forest Cover Rate	(%)																							
	Forest	67.8%	74.8%	1.6%	63.5%	71.3%	89.1%	60.4%	71.5%	69.9%	51.9%	81.3%	62.6%	54.5%	58.8%	67.4%	59.9%	32.9%	53.3%	82.4%	82.5%	88.6%	84.4%	39.0%
	Forest&Woodland	74.2%	80.6%	5.7%	70.6%	72.2%	93.1%	76.5%	73.0%	73.3%	66.4%	83.1%	62.6%	54.5%	58.8%	68.3%	60.0%	32.9%	53.3%	84.1%	82.7%	88.6%	86.5%	40.8%
*	Forest&Woodland&Scrub&Savanna	76.5%	84.7%	47.6%	71.5%	72.3%	93.5%	85.2%	73.0%	73.3%	66.4%	83.1%	62.6%	54.5%	58.8%	68.3%	60.0%	32.9%	53.3%	84.1%	82.7%	88.6%	86.5%	41.5%

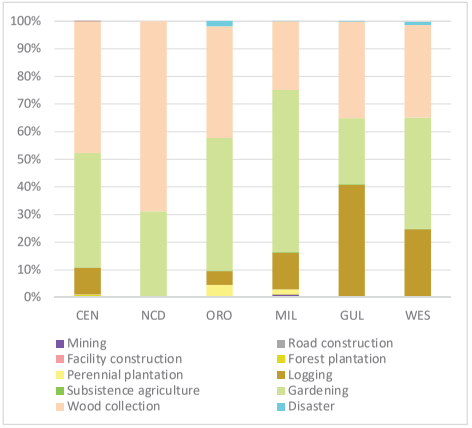


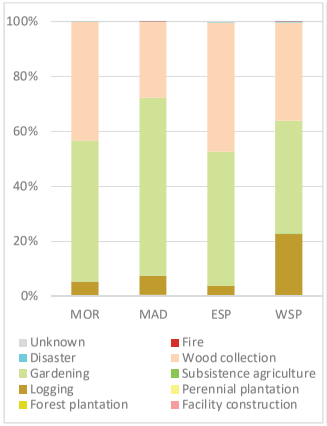

Forest Cover Map 2015
145° 0'0"E
150° 0'0"E
155° 0'0"E
5° 0'0"S
10° 0'0"S
N
W
E
S
Landuse
P Low Altitude Forest on Plains & Fans
H Low Altitude Forest on Uplands
L Lower Montane Forest
Mo Montane Forest
B Littoral Forest
D Dry Seasonal Forest
Fri Seral Forest
Fsw Swamp Forest
M Mangrove Forest
W Woodland
Sa Savanna
Sc Scrub
G Grassland and Herbland
Ga Grassland (Alpine)
Gi Grassland (Subalpine)
O Cropland/Agriculture land
Qa Plantation other than Qf
Qf Forest Plantation
Z Bare areas
U Larger Urban Centres
E Lake & Larger Rivers
0 100 200 400 km

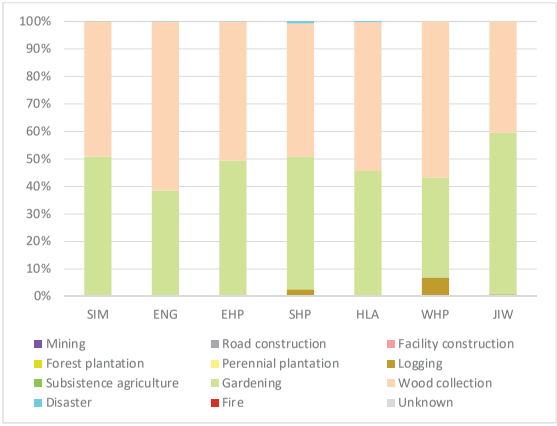
Forest Degradation Drivers of Forest Cover Map 2011: Drivers Area (ha) x Province

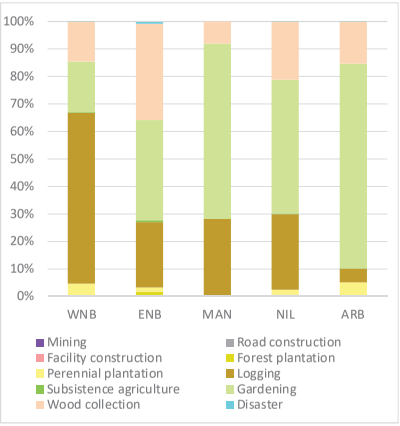
Drivers	SUM	CEN	NCD	ORO	MIL	GUL	WES	MOR	MAD	ESP	WSP	SIM	ENG	EHP	SHP	HLA	WHP	JIW	WNB	ENB	MAN	NIL	ARB
Mining	37,262	1,162	0	0	8,517	5,218	273	6,417	1,646	4,305	4,455	0	226	798	0	0	0	0	0	1,338	0	2,907	0
Road construction	2,722	0	0	0	0	1,442	0	0	0	0	513	0	0	0	0	0	0	0	0	579	0	187	0
Facility construction	1,630	0	0	0	0	581	589	0	145	0	135	0	0	0	0	0	0	0	180	0	0	0	0
Forest plantation	34,225	12,658	0	0	2,687	0	0	1,266	5,836	0	0	0	0	576	0	0	41	0	137	11,024	0	0	0
Perennial plantation	175,703	2,158	0	43,599	11,410	229	0	765	1,239	910	3,362	25	0	147	0	0	30	103	54,294	11,790	474	10,725	34,441
Logging	3,512,466	148,504	0	47,753	106,917	626,746	720,713	85,983	115,480	63,834	432,329	0	0	0	12,621	0	8,047	1,231	724,572	182,551	42,279	159,544	33,361
Subsistence agriculture	35,869	1,818	0	2,167	1,248	3,512	2,395	3,542	2,261	1,344	6,302	71	844	713	73	795	21	317	2,003	4,781	58	863	743
Gardening	9,293,873	633,626	3,868	460,737	467,578	369,876	1,177,497	911,065	1,084,992	891,873	796,861	121,177	183,384	253,156	235,690	159,874	43,246	124,412	214,989	279,746	96,982	282,066	501,176
Wood collection	7,578,478	732,405	8,573	388,916	199,108	544,289	977,640	775,314	463,411	860,090	695,540	117,326	295,095	262,168	237,441	191,132	67,796	86,050	169,140	268,620	12,251	122,555	103,614
Disaster	90,487	783	0	18,178	394	3,018	36,535	1,906	2,188	4,868	7,920	25	324	670	3,571	981	0	0	1,306	6,940	0	358	523
Fire	6,542	234	0	0	0	0	4,370	0	969	647	321	0	0	0	0	0	0	0	0	0	0	0	0
Unknown	2,457	0	0	0	0	0	954	0	0	1,413	0	0	0	0	0	0	0	0	0	90	0	0	0
(Intact Forest)	16,109,308	953,620	0	912,278	225,433	1,692,013	5,427,632	693,057	435,812	1,326,067	1,051,445	186,016	301,792	150,911	705,234	464,389	60,403	88,007	550,934	495,351	26,382	236,062	126,473
SUM	36,881,022	2,486,968	12,442	1,873,627	1,023,293	3,246,924	8,348,598	2,479,316	2,113,980	3,155,350	2,999,183	424,640	781,664	669,138	1,194,631	817,171	179,585	300,120	1,717,558	1,262,811	178,426	815,269	800,330



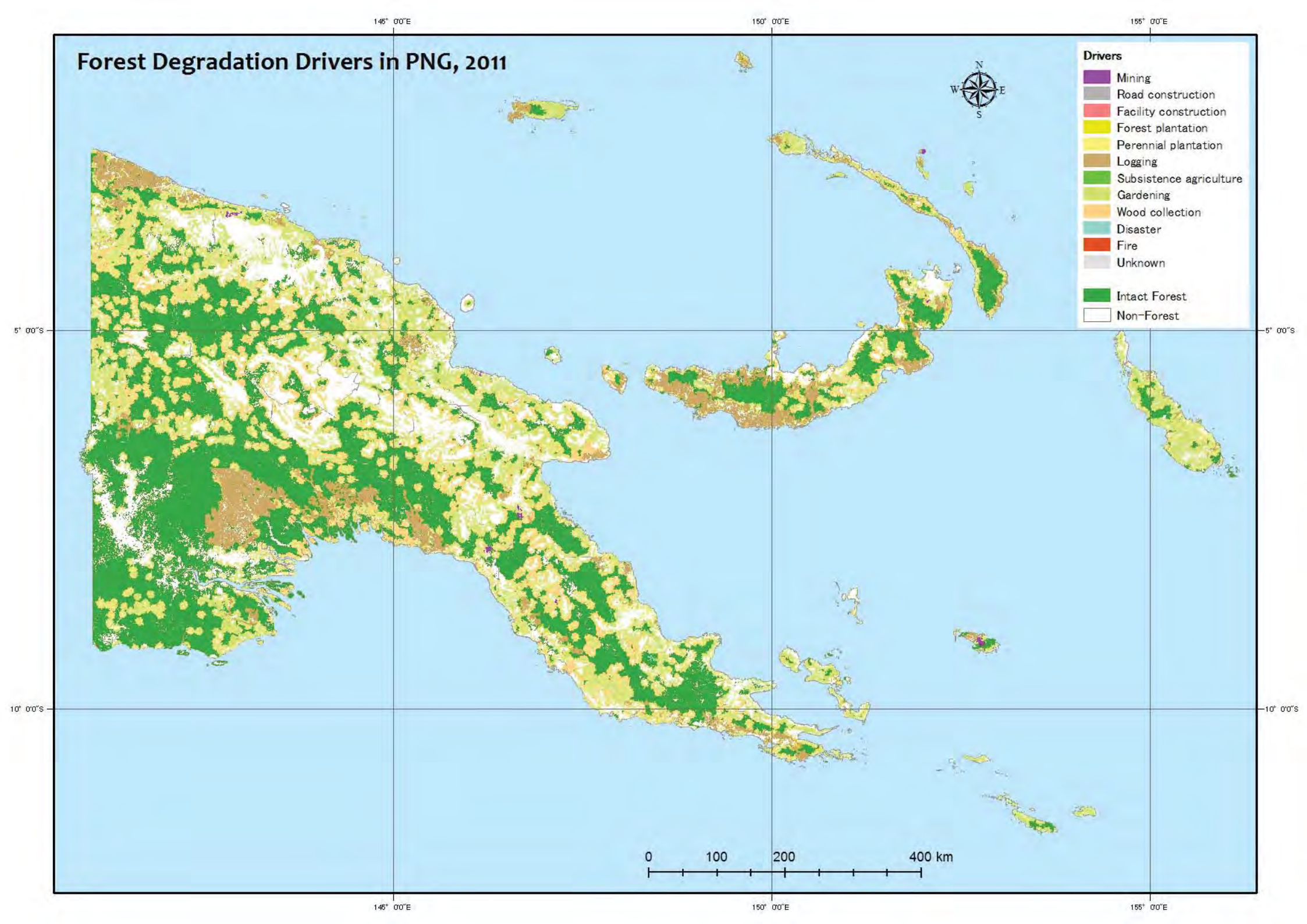








* The Forest Base Maps are used. But, as for WNB and WSP, the revised Forest Cover Maps 2011 are used.
* Islands outside PNG, which are located to the south of WES and ARB, are removed.


Forest Degradation Drivers in PNG, 2011
Drivers
Mining
Road construction
Facility construction
Forest plantation
Perennial plantation
Logging
Subsistence agriculture
Gardening
Wood collection
Disaster
Fire
Unknown
Intact Forest
Non-Forest
N
W
E
S
145° 0'0"E
150° 0'0"E
155° 0'0"E
5° 0'0"S
10° 0'0"S
0
100
200
400 km

Annex 21

Examination of PINFORM for Integrating to PNG-FRIMS

DRAFT JICA Project Activity Memo (Activity 1.4.2)

Examining PINFORM for integrating to the PNG-FRIMS

10th February 2016

JICA Expert Team (Dr Koide, Mr Watanabe, Mr Nishimura)

1 The PDM (Project Design Matrix) of the Project provides that '**1.4.2 Examine the possibilities of integrating PINFORM into PNG-FRIMS.' (Planned Mar 2015 – Feb 2016.)** This activity description was made according to a request from PNGFA at project formulation stage.

PINFORM: PNG/ITTO Natural Forest Model

PNG-FRIMS: PNG Forest Resource Information Management System

2 The PINFORM was developed on obsolete Excel 5 (or Excel 97) originally in 1998. The program is not operational (and even impossible to 'open') in 2011 because of the incompatibility with current Excel versions (for example Excel 2010). For coping this situation the JICA Project Short-term Expert team (Kokusai Kogyou Co., Ltd., KKC) revised the PINFORM fitting to Excel 2010.

3 The JICA expert team examined the PINFORM programme, after handing over the revised PINFROM to PNGFA (and thus FRI). The summary of the result is as follows.

(1) PINFORM is a stand-alone[1] computer programme that is designed to do a site-specific growth simulation by using FIPS[2] data (diameter at breast height, DBH). The PINFORM needs input data of DBH that may be substituted by basal area (total cross-section area at breast height per hectare) by species. The PINFORM is a suitable tool for working on the continuous survey on permanent sample plot (like FRI PSP and National Forest Inventory (NFI)).

(2) The verification of the simulation result has not been done for the PINFORM. In other words, no quantitative assessment has been done on the accuracy of the re-growth prediction by PINFORM. Thus, before PNGFA uses PINFORM for practical purpose, it is favourable to do a verification of the accuracy on its growth simulation with new or additional data and make fine-tuning if necessary to improve the model in PINFORM. This process may require substantial resource including at least 1 to 2 man-month of highly knowledgeable experienced professional.

(3) Since some of the Excel 'sheets' in PINFORM are locked by password, the detail of original diameter input to PINFORM is not clear[3]. Apparently, the PINFORM is using PSP data obtained from c.a. 200 survey conducted since early 1990s to late 1990s. The

[1] Therefore, a copy of the PINFORM programme can be readily set in the PNG-FRIMS server with appropriate 'lock'.

[2] FIPS: Forest Inventory Processing System of PNGFA

[3] The function of conversion and taking data from FIPS format to PINFORM is working.

JICA expert team was informed that FRI conducted additional c.a. 170 surveys in total by first half of 2009. The situation (result) since 2009 is not clear for the JICA expert team. These additional data from c.a. 170 survey can be used for the verification and fine-tuning.

(4) The verification and fine-tuning for accuracy assessment and improvements (for site specific simulation) do not change the nature of site-specific simulation of PINFORM. In other words, even after the verification and fine-tuning, the accuracy of the PINFORM simulation on other sites (where topography, tree species and other conditions are different from where the original diameter input data taken) cannot be quantified even in a very close site (for example, in a same logging concession project). In this sense, we cannot compare (or judge) the accuracy levels between current PINFORM simulation and simple linear prediction model (for example, simple average value).

4 Regarding the possibility to integrate the PINFORM into the PNG-FRIMS after revising PINFROM applicable to all PNG sites,

(1) Direct input of FIMS ('volume') data to PIFORM is impossible because the FIMS 'volume' data does not accompany any diameter data (or even 'clue' to the diameter) but assumption of 'more than 50 cm'. The volume data tentatively allotted to the Forest Base Map 2012 has same nature (no diameter information).

(2) Theoretically, we may be able to input basal area (allotted by province, forest zone, forest type, and species composition) to the PINFROM. However, in order to conduct the selection of parameters and accuracy verification, we need to do large scale ground survey and analysis for tens of years with inputting huge human and financial resource. Consequently, the revised PINFORM will have substantially different algorithm from that in the current PINFORM.

(3) Given the limited human resource available for PNGFA and its resource poured into the ongoing Multipurpose National Forest Inventory (MpNFI) under EU/FAO support, it may be realistic to wait for some time and consider to use results from MpNFI or conduct additional survey and analysis for above 4 (2).

5 The JICA expert team therefore proposes followings.

(1) A practical and realistic option for the regrowth model to use in PNG-FRIMS is an expedient use of simple model (for example, simple average as a simple linear prediction model).

(2) The above said simple model may assume thirty five (35) years for regrowth recovery of timber volume after logging. The design of the model accommodates easy-replacement (modification) of the recovery period so that future research and development outcomes by FRI in this regard can be easily fed. The easy-replacement must capable to address differentiated value (period) by province, forest zone, forest type, and other factors.

Annex 22

Species Groups and Species Codes for Log Exports

APPENDIX 8

SPECIES GROUPS AND SPECIES CODES FOR LOG EXPORTS

Note: An application for a Price Endorsement for the export of logs must show the proposed price for each individual species where that species is a Group 1 species. A proposed group price must be shown for each of Groups 2, 3 and 4.

PNGFA PRODUCT NUMBER[4]	COMMERCIAL NAME	SPECIES CODE	SCIENTIFIC NAME
GROUP 1.			
1	Burckella	BUR	*Burckella obovata/B. sorei*
2	Grey Canarum	CAG	*Canarium oleosum*
3	Calophyllum	CAL	*Calophyllum*
4	Red Canarium	CAR	*Canarium indicum*
5	Pencil Cedar	CEP	*Palaquium warburgianum*
6	Dillenia	DIL	*Dillenia papuana*
7	Erima	ERI	*Octomeles sumatrana*
8	Hekakoro	HEK	*Gluta papuana*
9	Kwila	KWI	*Intsia*
10	Lophopetalum/ Perupok	LOP	*Lophopetalum torricellense*
11	Malas	MAL	*Homalium foetidum*
12	PNG Mersawa	MER	*Anisoptera thurifera*
13	Red Planchonella	PLR	*Planchonella torricellensis*
14	White Planchonella	PLW	*Planchonella kaernbachiana*
15	Taun	TAU	*Pometia pinnata*
16	Terminalia	TER	*Terminalia sp.*
17	PNG Walnut	WAL	*Dracontomelon dao*
GROUP 2.			
20	Aglaia	AGL	*Aglaia*
	Amoora/Pacific Maple	AMO	*Aglaia cucullata*
	Antiaris	ANT	*Antiaris toxicaria*
	PNG Basswood	BAS	*Endospermum*
	Wau Beech	BEW	*Elmerrillia papuana*
	Mangrove Cedar	CEM	*Xylocarpus papuanum*
	Red Cedar	CER	*Toona sureni*
	Hopea Heavy	HOH	*Hopea iriana/H. glabrifolia*
	Hopea Light	HOL	*Hopea forbesii/H. papuana/ H. similis/H. celtidiflora*

[4] For PNGFA internal use only.

Kamarere	KAM	*Eucalyptus deglupta*
Kempas	KEM	*Koompassia grandiflora*
Labula	LAB	*Anthocephalus chinensis*
Silkwood Maple	SIL	*Flindersia pimentelania*
Vitex	VIT	*Vitex cofassus*

GROUP 3.

30	Amberoi	AMB	*Pterocymbium beccarii*
	PNG Camphorwood	CAH	*Cinnamomum*
	Campnosperma	CAM	*Campnosperma brevipetala*
	Hard Celtis	CEH	*Celtis philippinensis/P. latifolia*
	Light Celtis	CEL	*Celtis nymanii/C. kajewekii*
	Cryptocarya/Medang	CRY	*Cryptocarya*
	Dysox	DYS	*Dysoxylum*
	Endiandra/Medang	END	*Endiandra*
	Garo Garo	GAG	*Mastixiodendron pachyclado*
	Water Gum	GUW	*Syzigium sp.*
	Heritiera	HER	*Heritiera*
	Litsea	LIT	*Litsea*
	Pink Satinwood	SAP	*Buchanania*
	White Siris	SIW	*Ailantus integrifolia*

GROUP 4.

40	Brown Albizia	ALB	*Albizia procera*
	Hard Alstonia	ALH	All *Alstonia* except *A. scholaris*
	White Albizia	ALW	All *Albizia* except *A. procera*
	White Almond	AMW	*Alphitonia*
	Scaly Ash	ASG	*Ganophyllum falcatum*
	Silver Ash/ Silkwood Ash	ASS	*Flindersia schottiana*
	PNG Hickory Ash	ASH	*Flindersia ifflaina*
	Papuan Silver Ash	ASP	*Flindersia amboinensis*
	PNG Beech	BEP	*Nothofagus sp.*
	Pink Birch	BIP	*Schizomeria*
	Bombax	BOM	*Bombax ceiba*
	PNG Swamp Box	BOS	*Tristania suaveolens*
	PNG Boxwood	BOW	*Xanthophyllum papuanum*
	Brown Tulip Oak	BTO	*Heritiera trifoliolata*
	Candlenut	CAD	*Aleurites moluccana*
	Cananga	CAN	*Canaga oderata*
	Java Cedar	CEJ	*Bischofia javanica*
	Chrysophyllum	CHR	*Chrysophyllum roxburghii*
	Carallia	CLL	*Carallia brachiata*
	PNG Coachwood	COW	*Ceratopetalum succirubr.*
	White Cheesewood/ Milky Pine	CWW	*Alstonia scholaris*
	Yellow Cheesewood	CWY	*Nauclea*
	Drypetes	DRY	*Drypetes*
	Duabanga	DUA	*Duabanga moluccana*

Pericopsis	PER	*Pericopsis mooniana*
Pimeleodendron	PIM	*Pimeleodendron*
Planchonia	PLA	*Planchonia papuana*
Busu Plum	PLB	*Maranthes corymbosa*
Tulip Plum	PLT	*Pleiogynium*
Polyalthia	POL	*Polyalthia*
Quandong	QUA	*Elaeocarpus*
Oriomo Redwood	RWD	*Adinandra forbesii*
Green Satinheart	SAG	*Geijera salicifolia*
Saffronheart	SAH	*Halfordia*
PNG Sassafras	SAS	*Dryadodaphne*
Semicarpus	SEM	*Semicarpus sp.*
Sloanea	SLO	*Sloanea*
Spondias	SPO	*Spondias cytherea*
Sterculia	STE	*Sterculia*
Tetrameles	TEM	*Tetremeles nudiflora*
Tea Tree	TET	*Malaleuca leucadendron*
Trichadenia	TRC	*Trichadenia philippinens*
Tristiropsis	TRI	*Tristiropsis*
PNG Tulipwood	TUL	*Harpullia*
Vatica	VAT	*Vatica raasak*
Brown Wattle	WAB	*Acacia aulacocarpa*
Red Wattle	WAR	*Acacia crassicarpa*

Plus any other species not listed above and not banned from export in log form as listed below - species code OTH.

SPECIES BANNED FROM EXPORT IN LOG FORM

Kauri pine	AGA	*Agathis*
Hoop Pine	ARH	*Auracaria cunninghamii*
Klinkii Pine	ARK	*Auracaria hunsteinii*
Celery-Top Pine	CLP	*Phyllocladus hypophyllus*
Cordia	COR	*Cordia dichotoma*
Dacrydium	DAC	*Dacrydium nidulum*
Ebony	EBO	*Diospyros ferrea*
Kerosene Wood	KEW	*Cordia subcordata*
Libocedrus	LIB	*Libocedrus pauanus*
Podocarp	POD	*Podocarpus sp.*
Brown Podocarp	POB	*Decussocarpus*
Highland Podocarp	POH	*Dacrycarpus imbricatus*
Rosewood	ROS	*Pterocarpus indicus*
Balsa	BAL	*Ochroma lagopus*
Blackbean	BLB	

Annex 23

Timber Volume by Each Forest Zone Type and Each Vegetation Type (Tentatively Classified in the Forest Base Map)

Timber Volume (DBH > 50 cm) tentatively given into Forest Base Map (m^3 ha^{-1})

Province	Zone	Pl	Ps	Po	P_general	Hl	Hm	HmAr	Hmd	Hme	Hs	H_general
ARB	North Solomons			14	14		23	23	23	23		24
CEN	Central North	56			48		38	38	38	38	12	20
CEN	Central South	38	11	10	25		13	13	13	13	19	17
EHP	Highland				33							50
ENB	Central New Britain				59	25	29	29	29	29		34
ENB	Gazelle			26	25		29	29	29	29		32
ENG	Jimi				33			18				18
ENG	Highlands				33							36
ESP	Bewani-Sepik				29							33
ESP	Sepik-Costal			49	46		65	65	36	65		50
ESP	Sepik-South				40							48
GUL	Aramia-Kikori			33	33							49
GUL	Kerema	23	33		30		29	29	29	29		30
MAD	Finisterre-Huon				12		29	29	29	29		30
MAD	Gogol-Ramu		37	47	42		24	24	33	24		34
MAD	Madang-Bogia				37		39	39	50	39		40
MAD	Ramu-Bismark	28		19	25		39	41	22	39		35
MAN	Manus				33					25		76
MIL	D'Entrecasteaux		24		24						30	28
MIL	Louisiade				30						15	19
MIL	Milne Bay	8	8		31		33	33	33	33	37	33
MIL	Oro	15			35							30
MIL	Woodlark		29		31						34	34
MOR	Finisterre-Huon	12			12		33	33	33	33		33
MOR	Lae	34			34		32	32	32	32		32
MOR	Morobe				33		39	39	39	39		42
MOR	Umboi			10	10		22	22	22	22		22
MOR	Watut	38		55	40		25	25	25	25		29
NIP	Central New Ireland				33		32	32	32	32		33
NIP	Mussau				33		34	34	34	34		55
NIP	New Hanover				33		30	30	30	30		35
NIP	Northern New Ireland				33		19	19	19	19	31	28
NIP	Southern New Ireland				33		20	20	20	20		26
ORO	Morobe	37		30	33		19	19	19	19	18	25
ORO	Oro	24		21	35		29	29	29	29		30
SHP	Bosavi-Strickland				33	31						55
SHP	Highland				33							40
SIM	Highland				33		49	49	49	49		45
WES	Aramia-Kikori				33		42	42	42	42		43
WES	Bosavi-Strickland				33		24	24	24	24		33
WES	Central - Fly				33							22
WES	Kiunga				33		16	16	16	16		20
WES	South Fly				33							22
WHP	Highland				33							44
WHP	Jimi				33			27				62
WNB	Central New Britain				59	17	55	55	55	55		42
WNB	West New Britain	56		29	39		25	25	25	25		34
WSP	Aitape				27		26	26	26	26		23
WSP	Bewani-Sepik				31		31	31	31	31		33
WSP	Oenake				33		15	15	15	15		15
WSP	Pual River				27		36	36	36	36		36
WSP	Sepik Plains				27							57
WSP	Sepik-Costal				27							27
WSP	Sepik-South				27		55	55	55	55		55
WSP	Telefomin				27		54	54	54	54		54

Timber Volume (DBH > 50 cm) tentatively given into Forest Base Map (m^3 ha^{-1})

Province	Zone	L	LN	Lc	Ls	L_general	D	FriK	Fsw	FswTb	M	W	Wsw	Wx	Others
ARB	North Solomons					36				8					34
CEN	Central North					36									34
CEN	Central South					36									34
EHP	Highland		32	23		29									34
ENB	Central New Britain	37	37	37		28									34
ENB	Gazelle					20		18							34
ENG	Jimi					10									34
ENG	Highlands	26	42	29		35									34
ESP	Bewani-Sepik					36									34
ESP	Sepik-Costal					36									34
ESP	Sepik-South					36									34
GUL	Aramia-Kikori					36									34
GUL	Kerema					36			17		24				34
MAD	Finisterre-Huon					28									34
MAD	Gogol-Ramu					36									34
MAD	Madang-Bogia					36									34
MAD	Ramu-Bismark					36									34
MAN	Manus					36									34
MIL	D'Entrecasteaux					36									34
MIL	Louisiade					36									34
MIL	Milne Bay					36									34
MIL	Oro					36									34
MIL	Woodlark					36									34
MOR	Finisterre-Huon	29	29	29	25	28									34
MOR	Lae					44									34
MOR	Morobe					44			29				13	13	34
MOR	Umboi					44									34
MOR	Watut	43	53	43		52									34
NIP	Central New Ireland					36									34
NIP	Mussau					36									34
NIP	New Hanover					36									34
NIP	Northern New Ireland					36									34
NIP	Southern New Ireland					36									34
ORO	Morobe					36									34
ORO	Oro					36									34
SHP	Bosavi-Strickland					30									34
SHP	Highland	31	31	43		30									34
SIM	Highland	17	50	17		28									34
WES	Aramia-Kikori					36	56								34
WES	Bosavi-Strickland					36									34
WES	Central - Fly					36	45								34
WES	Kiunga					36									34
WES	South Fly					36						29		27	34
WHP	Highland		81	8		52									34
WHP	Jimi					10									34
WNB	Central New Britain					28									34
WNB	West New Britain					36									34
WSP	Aitape					36									34
WSP	Bewani-Sepik					36									34
WSP	Oenake					36									34
WSP	Pual River					36									34
WSP	Sepik Plains					36									34
WSP	Sepik-Costal					36									34
WSP	Sepik-South					36									34
WSP	Telefomin					36									34

Annex 24

An Issue with FCA Data

JICA Project Activity Memo: An element to Activity 1.6
(Relevant to 1.4.1 element: Undated logged over area in FIMS)
Item: Other information necessary for PNG-FRIMS

16th February 2016

An issue of FCA boundary data

JICA Expert Team (Dr Koide, Okada, Watanabe, Nishimura)

1. During an in-country mission to PNG (1st to 19th Feb 2016), Dr Koide and Mr Okada identified an important lack in PNGFA workflow-chain (detailed in section 2). They also figured out the difference between actual entire boundary of FCAs and stored FCA boundary in PNG-FRIMS (detailed in section 3, illustrated in the figure below). Considering the importance of FCA clearance area ('deforestation') for forest monitoring by PNGFA as well as the level of data integrity in PNG-FRIMS, the JICA expert team would like to suggest following action for PNGFA Management to take.

   [Suggestion] PNGFA Management may consider to establish a procedure (or normal workflow) between two directorates (Project Allocation and Forest Policy & Planning) to digitize (or incorporate) GIS data of both entire project boundary and annual logged boundary of FCA projects when PNGFA receives submissions of 5-years plan and annual plan of a FCA project from a developer (during or immediately after the PNGFA approval process).

2. Developers operating under FCA license are required to submit 5-year plan and annual plan containing boundary information to PNGFA. This requirement is similar to the logging concession license (FMA and TRP). Although more than ten (about 16) FCA developers actually submitted 5-year and annual plans to PNGFA (Project Allocation Directorate), there is no established procedure (or normal workflow) to incorporate the submitted FCA boundary into the GIS data system (PNG-FRIMS) by the Inventory & Mapping Branch (Forest Policy and Planning Directorate).

3. There are some FCA boundary data in the PNG-FRIMS which were digitized a few years ago from maps submitted from developers as indications of actual logged areas. Those boundary data are very different from the boundaries of entire FCA projects (an example is shown below). The FCA boundary data existing in the

PNG-FRIMS have been never updated after the digitization and there is no plan to update them at this moment. Thus, even though a developer works inside of the approved FCA boundary, sometimes the logging activity seems to go beyond the boundary when we refer to FCA boundary data in the PNG-FRIMS.

4. Once the boundaries from 5-year and annual plans are incorporated to the PNG-FRIMS, we can make it accessible through the FRIMS LAN map browser within PNGFA (with appropriate limited access privileges, if necessary).

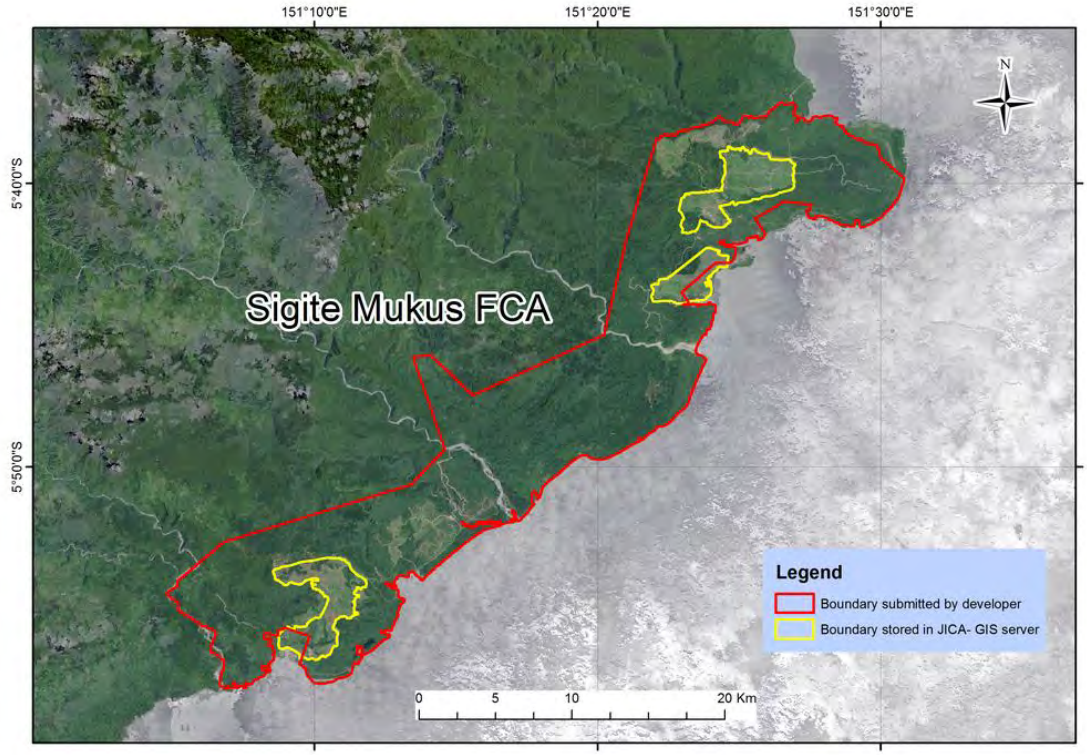


Figure: An example of difference between FCA entire boundary (red) and area to be logged (yellow, stored in PNG-FRIMS).

Annex 25

Work on Digitizing ALPs, FWPs and FCAs

CAPACITY DEVELOPMENT PROJECT FOR OPERATIONALIZATION OF PNG FOREST RESOURCE INFORMATION MANAGEMENT SYSTEM(PNG-FRIMS) FOR ADDRESSING CLIMATE CHANGE

WORK OUTPUT REPORT ON ANNUAL LOGGING PLAN, FOREST WORKING PLAN & FOREST CLEARANCE PLAN

Presented by Ms Aida KAI

CONTENT

- ❑Introduction
- ❑Background
- ❑Aim/Objectives
- ❑Methodology
- ❑Results
- ❑Discussion
- ❑Conclusion/Recommendation

Pictures involved in creating a Master List to developing a Digital data

Pictures taken during the short contract work.

INTRODUCTION

- PNGFA is mandated to focus on mission to secure forest resource & facilitate their utilization for social & economical benefit of the people of PNG in a sustainable manner.
- It plays a vital role in bring tangible development to rural area and more boost the economy of the country
- Hence ,to tackle all the challenges in Forestry sector of Timber logging operation, a system (PNG FRIMS) is developed to monitor Timber Harvesting in the country

BACKGROUND

- JICA in collaboration with PNGFA has implement a Forest Monitoring System(FRIMS) is developed to better manage the forest resource in the Country.
- According to Manual on Monitoring Control Procedure and pursuant to section 3.8 on the distribution of approved yearly plan. The requirement and procedures for each level of planning is presented in a hard copy.
- Annual Logging Plans (ALPs) are named according to the concession areas where current logging projects are planned, total harvest volume reported(previous year) and done annually by logging companies then grouped into different Setups and send for an approval from PNGFA HQ (Managing Director Office).

BACKGROUND

- Purpose
  - update forest information and to fully operationalize and utilize PNG Forest Resource Information Management System (hereinafter referred to as "PNG-FRIMS") for promoting sustainable forest management and for addressing climate change is enhanced.
  - What is PNG-FRIMS?
    - PNG-FRIMS is a system responsible for acquiring, managing and using "spatial information" on forests in Papua New Guinea. This promotes efficiency and sophication of forest administration, and supports PNGFA decision making.
    - It is a system for browsing of various spatial information/data among PNGFA; estimation of forest area using Forest Base (which includes vegetation and topographical information); estimation of commercial timber/carbon stock amount using logging history; projection of land change using time series data.
  - And for PNGFA can update forest resource information and geospatial data in PNG-FRIMS using field survey data with GPS, logging plan submitted from logging companies and forest area/condition changed monitored using satellite images etc.
- Types of data in PNG-FRIM:
  - Logging Concession Information
  - Constraints and Land use
  - Forest Base Map/Cover Map
  - Topography

MY TERMS OF REFERENCE

- **Aim**
  - To continuously update forest information and to fully operationalize and utilize PNG Forest Resource Information Management (PNG-FRIMS) for promoting sustainable forest management and for addressing climate change is enhanced.
- **Objectives**
  - To organize the storage room in PNGFA which contains ALP's plans and FCA's plans in some chronological order
  - Create a list of the existing and missing paper-based information on ALP and FCA's
  - To support making (composing, designing, apportioning, proofreading, editing) a material compiling the outputs related to the **PNG-FRIMS**

Methodology

Resources and Equipment

- The resources and equipment are physical hardware, that were used in the processing of the inputs to deliver the final outputs include:
  - PC
  - Hardcopy ALP reports
  - Note Book & Stick on pad and other stationary

Methodology

- Pencil/Biro/Markers/Scissors/Glue/Manila Folders
- Plotter (scanning machine – theodist scanner)
- Flash Drive
- **Filing and storage Room**
  - **Process involved developing a Master List from all the Map plans (ALPs, FWPS & FCAS) Timber operation in the country.**

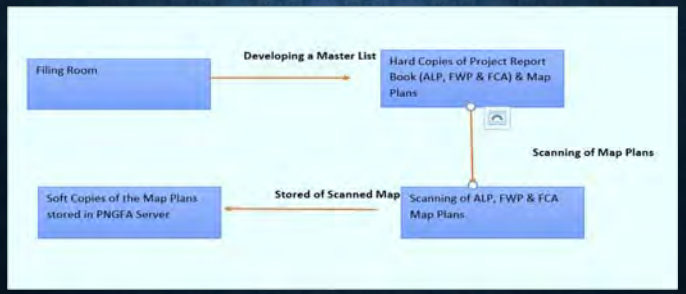


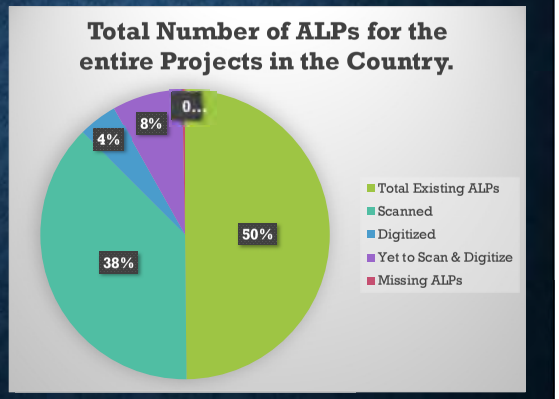
Table Showing progressive result of the Master List Summary Statistics for the Country Projects.

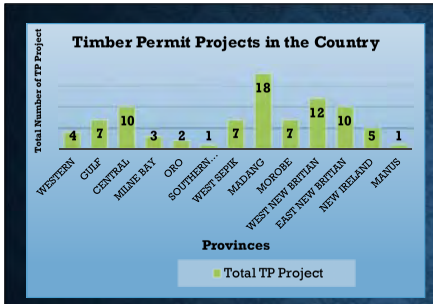
Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps	
FCA			
	Existing(Scanned, Digitized & Not Scan/Digitize)	180	
	Missing	7	
	Scanned(include Maps NA but scanned)	84	
	Digitized(include Maps NA but digitized)	53	
	Yet to scan/digitize	43	
ALPs (FMA,TRP & LFA)& Others (Bulolo Plantation)			
	Existing(Scanned, Digitized & Not Scan/Digitized)	1355	
	Missing(NA/Missing Maps)	51	
	Scanned(include Maps NA but scanned)	821	
	Digitized(include Maps NA but digitized)	210	
	Yet to scan/digitize	294	
	Total Number of sheets/Maps(ENTIRE COUNTRY PROJECTS) -1535		

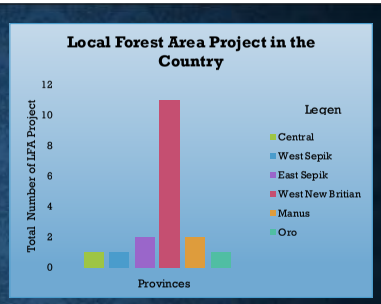
RESULTS

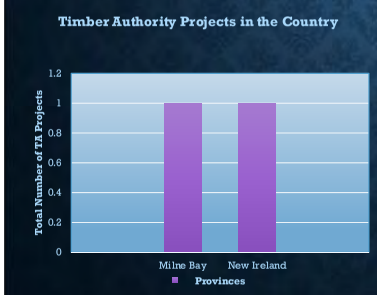
- Catalog List for all the projects in the Country *(Attached in the main Report)*
- Total number of ALPs for the entire projects in the Country.

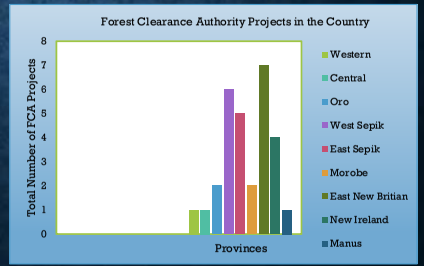
Total Existing Annual Logging plan	622
Scanned	470
Digitized	54
Yet to scan & Digitize	98
Missing ALPs	4

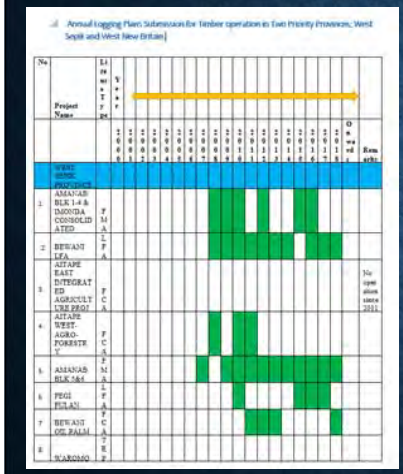


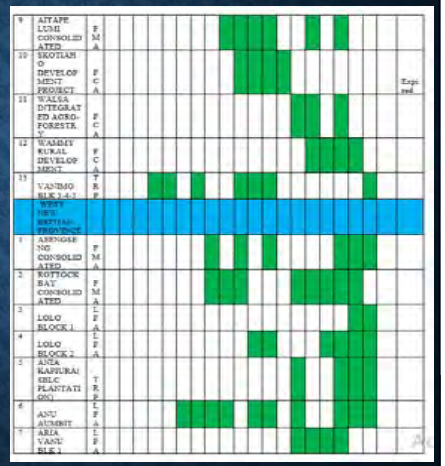


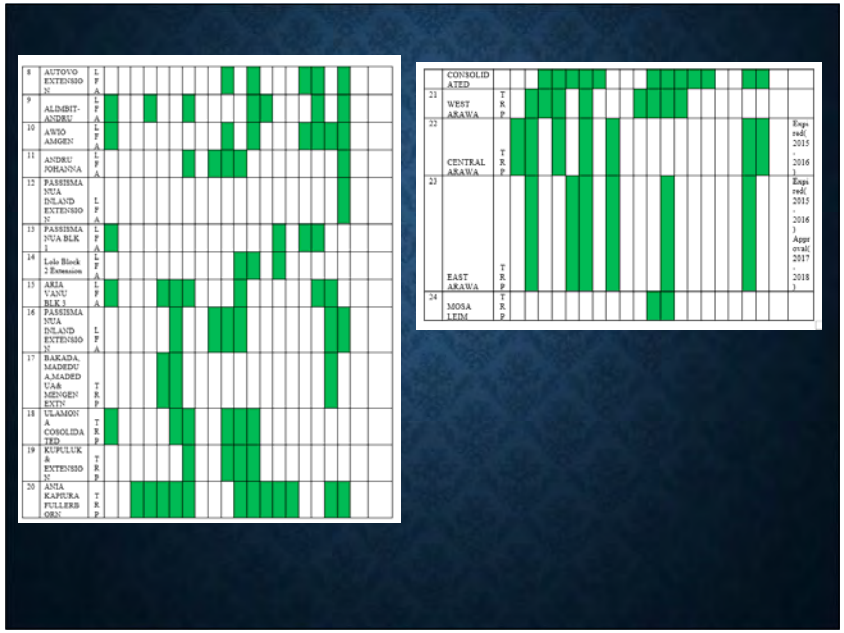












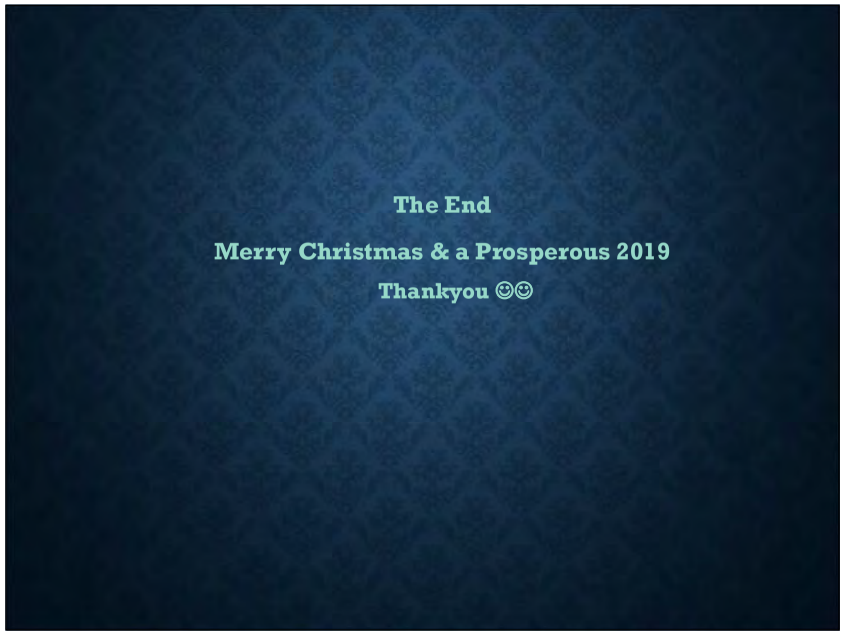
RESULTS/DISCUSSION

- A Master List of ALPs ,FWPs and FCAs plan were developed
- Map plans have four types of license issued under current Forestry legislation; Timber Permit(TP), Local Forest Area(LFA), Timber Authority(TA) and Forest Clearance Authority (FCA).
- Madang Province is recorded with the highest Timber Permit projects followed by West New Britian.LFA projects are very active in West New Britain Province with Timber Authority for only Milne Bay & New Ireland Provinces. West Sepik has the highest FCAs project in West Sepik.
- Total map plans listed are of 1535, FCAs have existing plans of 180,7 missing report,84 scanned and 53 digitized. Leaving 43 map plans to scan and digitize while ALP have 1355 existing plans,51 missing.821 scanned with 210 digitzed.294 map plan are remaining for scan and digitizing.
- Total ALP submission from the two priority project shows that a lot of ALPs are still missing the early year 2000 up. Noted as well the ALP has missed some year of submission .
- Missing of ALPs is due to the changing of logging companies for operation, space limitation to hold so move to other location(main archive),borrowers walked for good with the ALPs.
- Southern region hasn't been removed for scanning at the filing room due to time limitation.
- Existing map plans to be re-check from the filing room to scan for Momase, NGI region – are on hold due to contract ending 30 November 2018.

Table illustrating the ALP and FWP submission for operation by years.

CONCLUSION /RECOMMENDATION

- Proper storage of hard copies is very vital for the GIS work that is sufficient for planning.
- Annual Logging plan must be scanned and as a PDF or JPEG or TIFF file and provided to PNGFA. This should be a requirement for the Logging companies.
- There is a need for a officer in mapping section to monitor all the Annual Logging Plans and other Plans for updating logging information's especially log harvesting volume.
- Finally, the project is continuously updating the forest information and to fully operationalized and utilize PNG FRIMS for promoting sustainable forest management and for addressing climate change.


The End
Merry Christmas & a Prosperous 2019
Thankyou ☺☺

JICA-PNGFA PROJECT

GENERAL PRESENTATION SHOWING THE PROGRESSION OF WORK (JUNE – NOVEMBER, 2018)

OUTLINE

- Introduction
- Issues/Problems Encountered
- Suggestions/Recommendations
- Conclusion

INTRODUCTION

- This is a brief presentation showing the progress of work done over the period of six (6) months (June-November).
- The main activities in this assignment were mainly:
  - Rectification,
  - Digitization,
  - Adding of Attributes, and
  - QCQA Process (Geometry and Topology Checks).
- Issues/Problems encountered and the Suggestions/Recommendations have also been stated in the latter slides to give possible and alternate solutions.

LIST OF DIGITIZED WORK

Vailala Blk 1 TRP (2013-2014)	Ili Wawas Integrated Agricultural Project (Kokaim & Teseta)	Andru-Johanna _AFWP 2018-2019
Vailala Blk 1 TRP (2013-2014) Sht1	Ili Wawas Integrated Agricultural Project (Simbali)	Ania-Kapiura Fullborne TRP & Kulu Dagi TRP 2017-2019 Sht 2
Vailala Blk 1 TRP Sht2	Ili Wawas Integrated Agricultural Project_General Project Year Plan	Anu Alimit LFA 2017-2020
Vailala Blk 2 & 3 FMA A	Ili Wawas Integrated Agricultural Project_Land Use Plan	Aria Vanu Blk 1 LFA 2014-2015_Resource Map
Vailala Blk 2 & 3 FMA B	Ili Wawas Integrated Agricultural Project_Quarterly Schedule	Aria Vanu Blk 2 FMA (Rottock Bay Consolidated FMA) 2017-2018
Vailala Blk 2 & 3 FMA Sht 1	Inland Lassul Baining (Toriu) Integrated Agro-Forest Development	Aria Vanu Blk 3 LFA 2016-2017
Vailala Blk 2 & 3 FMA Sht 2	Nutive TRP	Aria Vanu Blk 3 LFA 2017-2018
Vailala Blk 2 & 3 FMA Sht 2 (2013-2014 & 2014-2015)	Nutive TRP_Inland Pomio	Central Arowe TRP 2018-2019
Wawoi Guavi Consolidated FMA Blk 3 East Sht 1 (2013-2015)	Open Bay _project areas_Statelands_Sht1	East Arowe_Coupe 4_2017-2018
Wawoi Guavi Consolidated FMA Blk 3 East (2013-2015) Sht 5	Open Bay 5YWP FMU BLK YR 1_Sht2	Gimomi Alternate Area - Ania Kapiura Fullborne TRP 2017-2018
Cape Orford TRP_ALP	Open Bay 5YWP FMU BLK YR2_Sht3	Inland Rauto Miu FMA (Rottock Bay Consolidated FMA) 2017-2018
Cape Orford TRP_General View	Open Bay 5YWP FMU BLK YR3_Sht4	Kisang TRP_Kulu Dagi Map 2 2018-2019
Cape Orford TRP_5YFWP	Open Bay 5YWP FMU BLK YR4_Sht5	Lolo Blk 1 LFA 2018-2019
Dengnenge 'A' Agro-Forestry & Reforestation Plantation Project	Open Bay 5YWP FMU BLK YR5_Sht6	Lolo Blk 2 LFA 2010-2015
Extended Seraji & Seraji Extension Coupe 1	Open Bay 5YWP_Road Network	Marapu Alternate Area - Ania Kapiura Fullborne TRP 2017-2018
Gar Consolidated TRP	Open Bay _Base Camp_Logpond	Rottock Bay Consolidated FMA 2016-2017
Ili Wawas Integrated Agricultural Project (Awakta)	Sigite Mukus Integrated Rural Development Sht1	
Ili Wawas Integrated Agricultural Project (Kaluan)	Sigite Mukus Integrated Rural Development Sht2	Total Maps Digitized = 56 Maps (June-November 2018)
Ili Wawas Integrated Agricultural Project (Karong)	Tokai Matong TRP	
Ili Wawas Integrated Agrcultural Project (Kermen)	Alimbit Andru LFA 2018-2019	

ISSUES/PROBLEMS ENCOUNTERED

- There were a few minor and major issues encountered whilst carrying out the tasks required:
  - Software server license connection error;
  - Boundary and labelling issues;

Figure 1: Map (A) shows boundaries intersecting and Map (B) shows a label covering a road link.

SUGGESTIONS/RECOMMENDATIONS

- Screen maps before approval of plans, being that:
  - Some maps do not have proper titles or even no title at all,
  - Year of ALP, FWP or FCA not stated,
  - Legends/keys are missing.

Figure 2: A map with out legend and title.

CONCLUSION

- The digitizing work may have seem daunting at times but I have learned so much as well. Not only do we create a national database management system to manage forest resources and the information but these can also be used for protecting the wildlife and its habitants and the unique species.
- All in all, thank you for the wonderful work experience.

THANK YOU FOR YOUR ATTENTION & HAVE A LOVELY DAY!!!

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

Output Report

Outline

- Background
- Aims/Objectives
- Purpose
- Methodology
- Results
- Discussion
- Output Work Progress
- Modification to the Proposed Methodology
- Conclusion/Recomendation

Background

- JICA in collaboration with PNGFA have implemented a Forest Monitoring System(FRIMS) which was developed to better manage the forest resource in the Country.
- According to the Manual on Monitoring Control Procedure and pursuant to section 3.8 on the distribution of approved yearly plan. The requirements and procedures for each level of planning is presented in a hard copy.
- Annual Logging Plans (ALPs) are named according to the concession areas where current logging projects are planned, total harvest volume are reported(previous year) and done annually by logging companies, then, grouped into different Setups and sent for an approval from PNGFA HQ (Managing Director Office).

Purpose

- Main purpose of the Project is to Build Capacity of PNGFA to continuously update forest information and to fully operationalize and utilize PNG Forest Resource Information Management System(PNG-FRIMS) for promoting sustainable forest management and for addressing climate change

What is PNG-FRIMS?

- PNG-FRIMS is a system responsible for acquiring, managing and using "spatial information" on forests in Papua New Guinea. This promotes efficiency and sophistication of forest administration, and supports PNGFA decision making.
- It is a system for browsing of various spatial information/data among PNGFA; estimation of forest area using Forest Base (which includes vegetation and topographical information); estimation of commercial timber/carbon stock amount using logging history; projection of land change using time series data.
- PNGFA can update forest resource information and geospatial data in PNG-FRIMS using field survey data with GPS, Drone, logging plan submitted from logging companies and forest area/condition changed monitored using satellite images etc.

Types of data in PNG-FRIMS:

- Logging Concession Information(Digitizing work)
- Constraints and Land use
- Forest Base Map/Cover Map
- Topography

Aims/Objectives

- To search and list up the paper-based information necessary for the expanding and enhancing PNG-FRIMS stored in PNGFA
- Develop updated Master List of all Annual Logging Plans, Forest Working Plans & Forest Clearance Authority existing and non-existing located in Filing Room # 2 at ICT
- To develop digital data on the Logged Over Area in Logging concession which is recorded in Annual Logging Plan (ALP) and boundaries in FCA (Forest Clearance Plan).
- Geo-rectify all digital images (scanned paper maps) of the ALPs
- Digitize all spatial features present in the geo-rectified digital images
- Add attribute information to the spatial features that have been digitized
- Examine how to utilize new remote sensing technologies for forest monitoring
- Support publication of output in relation to PNG-FRIMS

Methodology

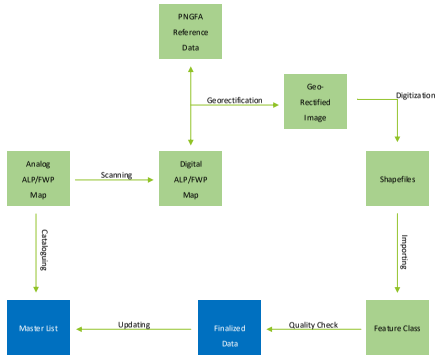
How the data is obtained

- **Datasets**
- The datasets that have been used in the project include:
- Toposheets
- Toposheet tile data
- Provincial Boundary data
- Concession Area data
- Scanned Maps containing the Annual Logging Plans of the project areas
- Datasets used were collected for the whole country at PNGFA Mapping & Inventory Datasets
- Example;

Name	Type	Spatial Reference	Data Type
TOPO7491SUAIN	Toposheet (TIFF)	GCS_Australian_1966	Raster

Cont....

Work Flow Diagram



Cont....

Filing Room (Collection, Cataloguing and Scanning)

- The first task was to find out the existing number of maps that were available
- All ALP reports are stored in the ICT File Room #2 of PNGFA, so the reports (containing the maps) were organized and recorded and a Master list was created
- The maps were then taken out of the reports, scanned, and then stored as digital image (TIFF, PDF, JPEG) files for registration.

Cont....

Geo-rectification (Image Registration)

- Geo-rectification or Image registration or Geo-referencing refers to the process in which the scanned paper maps (digital images) were assigned a projection system by using ground control points to relate actual ground coordinates to corresponding points on the scanned paper maps
- This was done in ArcMap 10.2 using the method of image registration by toposheets. The process involves using the Georectification tools to 'pick up' coordinates from the toposheets and adding the coordinates to the same exact point in the scanned paper map.
- Using at least four (4) control points, the scanned paper maps were registered and stored as rectified images for digitizing.

Cont....

Digitization

- Digitization refers to the process of converting geographic data either from a hardcopy or a scanned image into vector data by tracing the features
- Using ArcMap 10.2, this is done by tracing the features and saving them as shapefiles
- There are three main types of shapefiles that can be created in Arc Catalog 10.2; Polygons, Polylines and Points. These can be used to represent and store attribute data relating to the different geographical features present in the registered scanned image; these three types of shapefiles form the basis of digitization.
- The features that were digitized include the Planned areas or Logged-Over areas, as well as the Roads, Log Ponds, Buffer zones, and the Base Camps.

Cont....

Attributes

- The shapefiles created need to have attribute information added
- All shapefiles have an attribute table that contains the attribute information in reference to the shapefile that it represents
- The attribute tables of the shapefiles in ArcGIS 10.2 have three standard columns that are generated when a shapefile is created. They are; FID, Shape, and ID
- The columns that were added to the shapefiles for this task, included: Project Name, Name, Year of ALP, Duration, Actual Harvest Volume (only for logged over areas), Related Concession ID and Type (only for Planned Areas)
- The attribute information added were according to the information presented on the map, such as the title of the map, the legend or key, and the labels.

Cont....

Geodatabase (shapefile import)

- This refers to the creation of a Personal geodatabase in ArcCatalog, creating a feature dataset within that geodatabase and importing the shapefiles into the feature dataset
- This shapefiles inside the feature datasets are known as feature classes.

Cont....

Geometry Checks and Topology Checks

- In the QCQA Process, the Geometry Check is done first, then the Topology Check.
- The Geometry Check was executed by using the “Geometry Check Tool” and the “Repair Tool” in the Arc ToolBox in ArcGIS 10.2.
- The Topology Check is done by creating a Topology, adding the feature classes and assigning the topology rules
- The topology is then validated to see if there are any errors. The main errors that were checked for in this task were Slivers, which can be categorized as Gaps or Overlaps. Once identified, the errors were cleaned by merging the overlaps and creating new features to fill in the gaps.

Results

1. Catalogue -Containing all ALPs, FWPs & FCAs situated at Filing Room # 2-Total of 133 ,NB:More Projects Reports going into filing Room

Discussion

- Catalogue was developed for all existing logging concession occurring in the country
- A Master List of ALPs,FWP & FCAs map plans were developed
- Two priority provinces(WSP &WNBP) are completed as part of PNG FRIMS project main digitizing work objective.
- Total map plans are of 1574.*FCAs* existing plans 182,6 *Missing* reported, *Scanned* is 90 and *Digitized* is 81.Remaining FCAs yet to digitise to 11.While existing ALPs of other concession types (TRP,FMA &LFA)has a total map plans to 1392.43 *missing plans*,481 *scanned* and 495 *digitized*. Remaining map plans yet to scan & digitize are 56(Plans exits but wasn't in the filing room during scanning period) .
- *48% of Digitizing* Work Progress.(Only completion of WSP & WNBP while other provinces yet to digitize)
- More map/plans awaiting *digitizing* and cross check the *blank map plans* with Project Branch and Field Service Branch as important for Timber Harvest Volume reporting.

Cont... Statistical Summary Report on Work Progress

WEST SEPIK PROVINCE STATISTICAL SUMMARY SHEET OF UPDATED FCAs,ALPs & FWPs LISTING

Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	27
	Missing	0
	Scanned(awaiting digitizing)	0
	Digitized(include Maps NA but digitized)	27
	Yet to scan/digitize(Blank)	0
ALPs (FMA,TRP & LFA)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	151
	Missing(NA/Missing Maps)	0
	Scanned(Include Maps NA but scanned-Undefined map figu	0
	Digitized(include Maps NA but digitized)	151
	Yet to scan/digitize(Blank)	0
	Total Number of sheets/Maps	178

WEST NEW BRITAIN PROVINCE STATISTICAL SUMMARY SHEET OF UPDATED FCAs,ALPs & FWPs

Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	2
	Missing	0
	Scanned(Include Maps NA but scanned)	0
	Digitized(Include Maps NA but digitized)	2
	Yet to scan/digitize(Blank)	0
ALPs (FMA,TRP & LFA)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	348
	Missing(NA/Missing Maps)	12
	Scanned(Include Maps NA but scanned-Undefined m	0
	Digitized(Include Maps NA but digitized)	348
	Yet to scan/digitize(Blank)	0
	Total Number of sheets/Maps	350

FCAs,ALPs & FWPS UPDATED MASTER LIST_FILING ROOM #2_ICT BRANCH
STATISTICAL SUMMARY OF THE UPDATED FCAs ,ALPs & FWPs Listing from Filing Room #2_ICT Branch

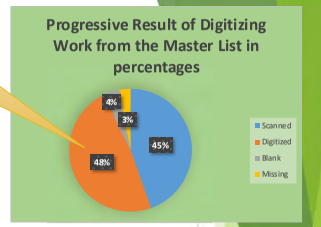
Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	180
	Missing	2
	Scanned(Include Maps NA but scanned)	90
	Digitized(include Maps NA but digitized)	90
	Yet to scan/digitize(Blank)	11
ALPs (FMA,TRP &LFA)& Others (Bulolo Plantation)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	1393
	Missing(NA/Missing Maps)	43
	Scanned(Include Maps NA but scanned)	724
	Digitized(include Maps NA but digitized)	544
	Yet to scan/digitize(Blank)	56
	Total Number of sheets/Maps (ENTIRE COUNTRY PROJECT	1574

i. Digitizing Progress

Updated Statistical Summary of Logging Projects Nationwide.

Project Types	Existing/Missing ALPs,FWPs & FCAs	Total Number of sheets/Maps
ALPs,FWPs & FCPs (FMA, TRP, LFA & FCA)& Others (Bulolo Plantation)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	1574
	Missing(NA/Missing Maps)	49
	Scanned(include Maps Not Available but scanned)	724
	Digitized(include Maps Not Available but digitized)	783
	Yet to scan/digitize(Blank)	67

48% have been Digitized (incld;WSP & WNBP)

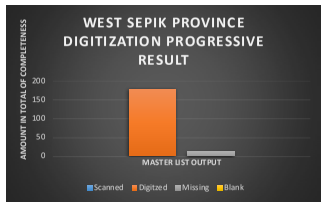


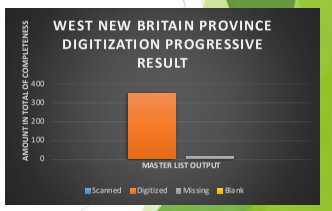
ii.Two Priority Provinces Data Analysis

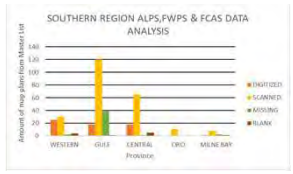
COMPLETED

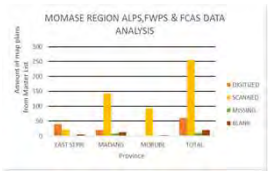
WEST SEPIK PROVINCE	
Scanned	0
Digitzed	178
Missing	12
Blank	0

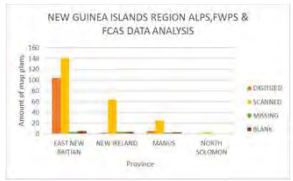
WEST NEW BRITIAN PROVINCE	
Scanned	0
Digitized	350
Missing	12
Blank	0

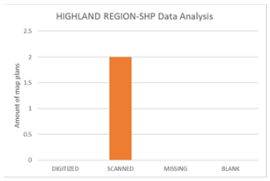




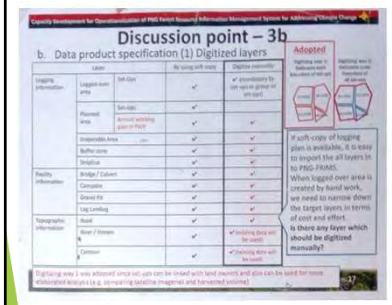


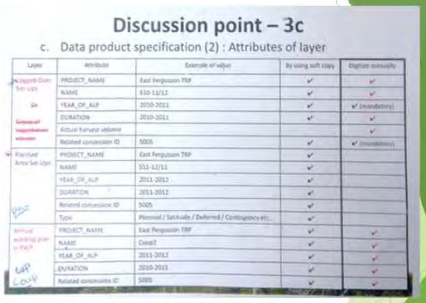






Modification to the Proposed Methodology





Conclusion

- Proper storage of hard copies is very vital for the GIS work that is sufficient for planning.
- Annual Logging plan must be scanned and submit as a PDF or JPEG or TIFF file to PNGFA. This should be a requirement for the Logging companies.
- PNGFA to develop the ALPs,FWPs for all logging operation in the country so information's on each map plans are accurate.
- There is a need of officers in mapping section to monitor and provide consistency of Annual Logging Plans and other Plans in the updating digital logging information's especially for log harvesting volume reporting .
- Finally, the FRIMS is in placed and need to provide updated information on Logged Over Area and well provide forest information in promoting sustainable forest management and enhanced climate change .

THE END OF PRESENTATION

THANKYOU

Annex 26

List of ALPs, FWPs and FCAs

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

- OUTPUT REPORT -

E. Paul, D. Davai, A. Kai, J. Turia, B. Matambuai

JICA-PNGFA Project Phase 2
August 2019

Executive Summary

This Output Report covers the activities undertaken by the casual support staff team contracted by Kokusai Kogyo Co. (KKC), Ltd. under the JICA-PNGFA Project, "Capacity Development Project for Operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change" (hereinafter referred to as "The Project") from June 2018 to August 2019. These activities involved the organization, cataloguing and digitization of the Annual Logging Plan (ALP) and Forest Working Plan (FWP) maps of the logging projects in the two designated pilot provinces; (i) West Sepik Province (also known as, Sandaun) and, (ii) West New Britain Province in Papua New Guinea.

The activities included the manual collection and cataloguing of available analogue ALP/FWP maps (in Filing Room #2 at the ICT Branch, PNGFA HQ), geo-rectification of the maps, feature extraction by digitization of the maps and the building of the database to record attribute information of the features, and quality checks to reduce the number of errors in the final output deliverables. These tasks were a part of the processes used to reach the main aim of the project which was to digitize the map information provided in the ALP and FWP analogue maps. The information is stored in PNG-FRIMS and can subsequently used to calculate how much of the forest areas of the West Sepik Province (WSP) and the West New Britain Province (WNBP) have been deforested and degraded.

The deliverables that were produced from the project activities include the feature classes that were digitized along with their attributes stored in geodatabases. The data that was digitized covered the amount of logging activities in WSP and WNBP. They are catalogued according to their individual projects, licences, the year of ALP, duration of the project, the Concession ID, and classified as set-up areas depending on whether they are Planned areas or Logged-Over areas. Other features that were digitized include the Roads, Log Ponds, Buffer zones, and the Base Camps.

There were also a couple of limitations that hindered the progress of the project ranging from the poor production of maps submitted, to the lack of organization of the physical hard copies of the ALP/FWP reports and maps in the filing rooms. It has been indicated that the ALP/FWP information for all the projects that range in year 2000 to 2018 and onwards provided in the filing room is insufficient as there is a significant number of missing ALP/FWP map plans. To overcome this issue, the Projects Branch (PNGFA HQ) and Field Services Branch (PNGFA HQ) provided their data to assist in finding the ALP/FWP maps rate of completeness provided in the Master List.

Apart from these main activities, the team also provided support to JICA and PNGFA personnel, most notably in preparing manuals, reports and publications. These included the training manuals for GPS/GIS/UAV applications, the Fact Sheet and Analytical Report Series', and the Big Book Reports (Map Atlas and PNG-FRIMS).

While the project has come to a close for the pilot provinces, much of the digitizing work is yet to be completed for the logging projects in other provinces in the country.

Table of Contents

Introduction

The use of Geographic Information Systems (GIS) in the field of Forestry, particularly, Forest Inventory and Resource Management has come a long since the very first system that was designed and utilised by the federal Department of Forestry and Rural Development in Canada by Dr Roger Tomlinson (Obi Reddy & Singh, 2019) . With advancements in Information Technology, this has seen a number of GIS software applications being developed as powerful tools and decision support systems, enabling the recording and manipulation of spatial data. The GIS software applications are able to store geographic information in geodatabases and perform both spatial and attribute analysis and queries to address specific problems and provide solutions.

Papua New Guinea (PNG) has the third largest tropical rainforest after Amazon and Congo Basin which is the largest tropical island in the world with 46 million hectares of land with 78% is covered with rainforest, mangroves and dry deciduous forest. These tree species mix and support a rich variety of flora and fauna in which the island is a well-known centre for biological endemism and species diversification. However, the forest is confronted with increasing pressure, due to resources extraction, especially through logging, large clearance for agriculture. Poor management of forest resource over the years has given rise to forest deforestation and degradation with no proper monitoring system or management system to keep the loss of forest areas in check.

In PNG, the Papua New Guinea Forest Authority (PNGFA) is the mandated body to regulate the Forestry Sector in PNG, with its mission statement; to secure forest resources, natural or plantation, and facilitate their utilization for the social and economic benefit of the people of Papua New Guinea, on the sustainable basis. (PNGFA Corporate Plan). To tackle the challenges in the Forestry sector of timber logging operation, a system (PNG-FRIMS) was developed in PNGFA to monitor logging operations throughout the country.

Background Information

PNGFA has taken great actions in combating the forest loss activities through REDD+ strategies for monitoring and managing the Forest as well as the forest resource through upgrading its system from FIPS to FRIMS. This extends to the Climate Change Policies of the country as forests naturally reduce carbon emissions to the atmosphere. Now with the partnership of JICA and PNGFA in the implementation of its 2014-2019 Forestry Project, along with National Forestry Inventory (NFI) Project sponsored by the United Nations Food & Agriculture Organization (FAO), there have been vast developments in acquiring spatial information and data and its utilization in PNG-FRIMS.

PNG-FRIMS is a system for responsible for acquiring, managing and using spatial information/data on Forests in the country. To improve the capabilities of the PNG-FRIMS, logging information is needed; the majority of which is found in ALP reports and maps submitted by logging companies operating. The information contained within the ALP maps include, include – but are not limited to – the loggedover areas and planned areas to be logged. Since the maps submitted are in hard-copy form, the task of digitization is important as it is able to convert the analogue information to digital information which can analysed and managed in a geographic information system such as PNG-FRIMS.

The ALP/FWP maps are classified according to the type of forest concession they come under. The forest concessions provided by PNGFA comprise of:

- Local Forest Area (LFA)
- Forest Management Agreement (FMA)
- Timber Rights Purchase (TRP)
- Timber Authority (TA)
- Forrest Clearance Authority (FCA)

While all other concessions accommodate the regrowth of forests, the FCA is a concession is used for clearing forests for commercial, agricultural or other activities that is not purposely for logging, thus, this forest areas under FCA concessions are degraded forest areas. In line with the Projects objectives of addressing Climate Change and Forest Degradation, the focus of the digitization activities was prioritized on FCA concessions.

Aims & Objectives

The output deliverables of the project can be grouped into two; Output 1: Primary Activities, and Output 2: Secondary Activities.

Output 1 (Primary)

The main aim of these activities is to create a geodatabase containing all spatial information from the analogue ALP/FWP maps from all the logging operations in WSP and WNBP. This was achieved through five (5) objectives:

1. Collect, catalogue and scan all available existing ALP/FWP maps and develop Master List
2. Geo-rectify all digital images (scanned maps) of the ALPs/FWPs
3. Digitize spatial features present in the geo-rectified digital images
4. Add attribute information to the spatial features that have been digitized
5. Run Topology and Geometry Checks on completed data sets
6. Check geodatabase records and fields for corrections and catalogue records according to specific queries

Output 2 (Secondary)

The secondary objectives in which the team provided support for JICA and PNGFA personnel included:

- Taking and preparing meeting minutes
- Conducting drone training workshop for PNGFA Officers
- Preparing training manuals for GPS/GIS/LAN-MAP and UAV applications
- Producing maps to be included in the Big Book Map Atlas
- Editing and compiling Big Book Map Atlas and Big Book PNG-FRIMS
- Editing and compiling Fact Sheet and Analytical Reports Series'
- Editing and compiling Logging Emissions Report,
- Miscellaneous office support staff duties

Methodology

Shown below is the workflow diagram of the methodology used from the collection of the paper maps to the completion of the geodatabase containing all the feature classes, and the creation of the Master List containing the catalogued ALP/FWP Maps.

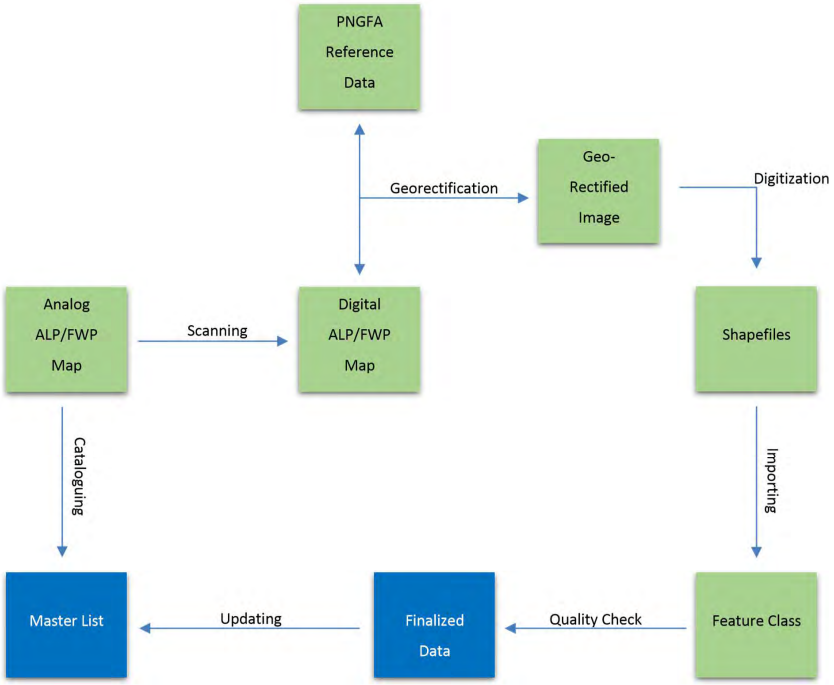


Figure 1: The Workflow Diagram of the Methodology

Datasets

The datasets that have been used in the project include:

- Toposheets - PNGFA (Inventory & Mapping Branch)
- Provincial Boundary data - PNGFA (Inventory & Mapping Branch)
- Concession Area data - PNGFA (Inventory & Mapping Branch)
- Analog ALP/FWP Map - PNGFA (ICT Branch, Projects Branch, Field Services)

Procedures

The software used for these activities was ArcGIS 10.2. – Standard License. Much of the processing was done using ArcMap, while the organization of the files in the system, was done using ArcCatalog.

The operating system of the PC used was a 64-bit Windows 7 running on Service Pack 1 with an Intel® Xeon ® CPU @ 2.40 GHz processor, and 22.0 GB RAM.

Cataloguing and Scanning

The first task was to find out the existing number of maps that were available, then scan, geo-rectify and digitize them. All ALP reports are stored in the ICT Branch File Room #2 of PNGFA, so the reports (containing the maps) were organized and recorded and the Master List was created. The maps were then taken out of the reports, scanned, and then stored as digital image (TIFF) files for registration.

Geo-rectification (Image Registration)

Image registration or Geo-rectification (Geo-referencing) refers to the process in which the scanned paper maps (digital images) were assigned a projection system by using ground control points to relate actual ground coordinates to corresponding points on the scanned paper maps. This was done in ArcMap 10.2 using the method of image registration by toposheets. The process involves using the Georectification tools to 'pick up' coordinates from the toposheets and adding the coordinates to the same exact point in the scanned paper map. Using at least four (4) control points, the scanned paper maps were registered and stored as rectified images for digitizing.

Digitization

Digitization refers to the process of converting geographic data either from a hardcopy or a scanned image into vector data by tracing the features. Using ArcMap 10.2, this is done by tracing the features and saving them as shapefiles. There are three main types of shapefiles that can be created in Arc Catalog 10.2; Polygons, Polylines and Points. These can be used to represent and store attribute data relating to the different geographical features present in the registered scanned image; these three types of shapefiles form the basis of digitization. The features that were digitized include the Planned areas or Logged-Over areas, as well as the Roads, Log Ponds, Buffer zones, and the Base Camps.

Registration of Attributes

The shapefiles created need to have attribute information added. All shapefiles have an attribute table that contains the attribute information in reference to the shapefile that it represents. The attribute tables of the shapefiles in ArcGIS 10.2 have three standard columns that are generated when a shapefile is created. They are; FID, Shape, and Id. These columns cannot be deleted as they define the shapefile itself. Depending on the type of attribute information available, or requested, further columns can be added to the attribute table and their information saved. The columns that were added to the shapefiles for this task, included: Project Name, Name, Year of ALP, Duration, Actual Harvest Volume (only for logged over areas), Related Concession ID and Type (only for Planned Areas). The attribute information added were according to the information presented on the map, such as the title of the map, the legend or key, and the labels.

Import to geodatabase

The Geometry Check can be performed directly on Shapefiles, unlike the Topology Check, which is performed on datasets within a Geodatabase. For this reason, before the shapefiles can be run through a Topology Check, they will first have to be imported into feature dataset within a geodatabase. This is done by creating a Personal geodatabase in ArcCatalog, creating a feature dataset within that geodatabase and importing the shapefiles into the feature dataset. This shapefiles inside the feature datasets are known as feature classes.

Quality Checks

In the QCQA Process, the Geometry Check is done first, then the Topology Check. The Geometry Check was executed by using the Geometry Check Tool in ArcGIS 10.2. After the checks were run, the mistakes that were found were fixed using the Repair Tool. Both the Geometry Check Tool and the Repair tool are found in the ArcToolBox, under the Features tools which are under the Data Management Tools toolbox.

The Topology Check is done by creating a Topology, adding the feature classes and the topology rules. The topology is then validated to see if there are any errors. The main errors that were checked for in this task were Slivers, which can be categorized as Gaps or Overlaps. Once identified, the errors were cleaned by merging the overlaps and creating new features to fill in the gaps.

The database checks involved manually checking each of the attribute tables of the feature classes to see if the information added were correct. This process also involved the normalizing of some records so that the merging of all the feature classes would be done seamlessly and there would exist a constant flow of records without any outliers.

Master List Update

After all the checks were completed, the information is then used to update the Master List. This was to keep a tally of the maps that were already scanned, geo-rectified and digitized, and also check what maps were available and those that were not.

Results

Output 1: Primary Activities

Geodatabase and Features Classes

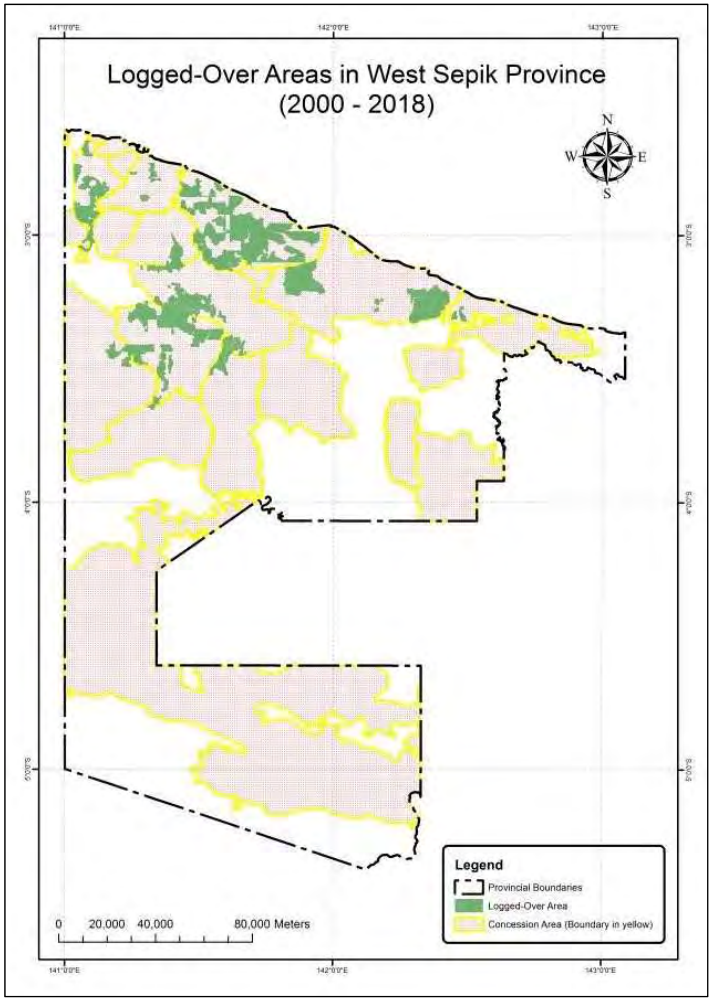


Figure 2: Map showing the logged-over areas in West Sepik Province from the year 2000 to the year 2018 (not to scale)

Table

Planned_Area

FID	Shape *	Project Name	Name	Year of ALP	Duration	Actual Harvest Volume	Related Concession ID	Type
0	Polygon	East Arawe TRP	S05-06 / 04	2005 - 2006	2005 - 2006	106.156 ha	19048	Planned Area
1	Polygon	East Arawe TRP	S05-06 / M27	2005 - 2006	2005 - 2006	145.806 ha	19048	Planned Area
2	Polygon	East Arawe TRP	S05-06 / 01	2005 - 2006	2005 - 2006	129.457 ha	19048	Planned Area
3	Polygon	East Arawe TRP	S05-06 / 03	2005 - 2006	2005 - 2006	82.774 ha	19048	Planned Area
4	Polygon	East Arawe TRP	S05-06 / 06	2005 - 2006	2005 - 2006	149.759 ha	19048	Planned Area
5	Polygon	East Arawe TRP	S05-06 / 11	2005 - 2006	2005 - 2006	105.357 ha	19048	Planned Area
6	Polygon	East Arawe TRP	S05-06 / 10	2005 - 2006	2005 - 2006	131.263 ha	19048	Planned Area
7	Polygon	East Arawe TRP	S05-06 / 12	2005 - 2006	2005 - 2006	93.753 ha	19048	Planned Area
8	Polygon	East Arawe TRP	S05-06 / 13	2005 - 2006	2005 - 2006	117.451 ha	19048	Planned Area
9	Polygon	East Arawe TRP	S05-06 / 22	2005 - 2006	2005 - 2006	159.426 ha	19048	Planned Area
10	Polygon	East Arawe TRP	S05-06 / 21	2005 - 2006	2005 - 2006	143.796 ha	19048	Planned Area
11	Polygon	East Arawe TRP	S05-06 / 20	2005 - 2006	2005 - 2006	91.537 ha	19048	Planned Area
12	Polygon	East Arawe TRP	S05-06 / 19	2005 - 2006	2005 - 2006	162.652 ha	19048	Planned Area
13	Polygon	East Arawe TRP	S05-06 / 18	2005 - 2006	2005 - 2006	158.147 ha	19048	Planned Area
14	Polygon	East Arawe TRP	S05-06 / 14	2005 - 2006	2005 - 2006	119.540 ha	19048	Planned Area
15	Polygon	East Arawe TRP	S05-06 / 17	2005 - 2006	2005 - 2006	165.888 ha	19048	Planned Area
16	Polygon	East Arawe TRP	S05-06 / 16	2005 - 2006	2005 - 2006	126.956 ha	19048	Planned Area
17	Polygon	East Arawe TRP	S05-06 / 15	2005 - 2006	2005 - 2006	125.040 ha	19048	Planned Area
18	Polygon	East Arawe TRP	S05-06 / 07	2005 - 2006	2005 - 2006	123.148 ha	19048	Planned Area
19	Polygon	East Arawe TRP	S05-06 / 08	2005 - 2006	2005 - 2006	145.802 ha	19048	Planned Area
20	Polygon	East Arawe TRP	S05-06 / 09	2005 - 2006	2005 - 2006	116.348 ha	19048	Planned Area
21	Polygon	East Arawe TRP	S05-06 / 05	2005 - 2006	2005 - 2006	160.213 ha	19048	Planned Area
22	Polygon	East Arawe TRP	S05-06 / 02	2005 - 2006	2005 - 2006	79.575 ha	19048	Planned Area
23	Polygon	East Arawe TRP	S05-06 / M35	2005 - 2006	2005 - 2006	154.248 ha	19048	Planned Area
24	Polygon	East Arawe TRP	S05-06 / M34	2005 - 2006	2005 - 2006	150.677 ha	19048	Planned Area
25	Polygon	East Arawe TRP	S05-06 / M30	2005 - 2006	2005 - 2006	109.993 ha	19048	Planned Area
26	Polygon	East Arawe TRP	S05-06 / M33	2005 - 2006	2005 - 2006	147.862 ha	19048	Planned Area
27	Polygon	East Arawe TRP	S05-06 / M31	2005 - 2006	2005 - 2006	135.565 ha	19048	Planned Area
28	Polygon	East Arawe TRP	S05-06 / M28	2005 - 2006	2005 - 2006	121.575 ha	19048	Planned Area
29	Polygon	East Arawe TRP	S05-06 / M29	2005 - 2006	2005 - 2006	79.059 ha	19048	Planned Area
30	Polygon	East Arawe TRP	S05-06 / M24	2005 - 2006	2005 - 2006	118.095 ha	19048	Planned Area
31	Polygon	East Arawe TRP	S05-06 / M23	2005 - 2006	2005 - 2006	134.793 ha	19048	Planned Area
32	Polygon	East Arawe TRP	S05-06 / M25	2005 - 2006	2005 - 2006	88.068 ha	19048	Planned Area
33	Polygon	East Arawe TRP	S05-06 / M26	2005 - 2006	2005 - 2006	74.980 ha	19048	Planned Area
34	Polygon	East Arawe TRP	S05-06 / M32	2005 - 2006	2005 - 2006	139.997 ha	19048	Planned Area

Figure 3: The Attribute table of the Shapefiles/ Feature Classes

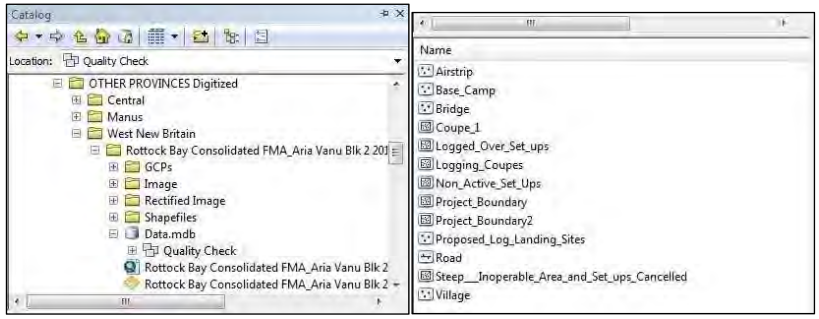


Figure 4: The Geodatabase containing the feature classes

Master List (excerpt on WSP and WNBP)

See Appendix.

WEST SEPIK PROVINCE STATISTICAL SUMMARY SHEET OF UPDATED FCAs,ALPs & FWPs LISTING

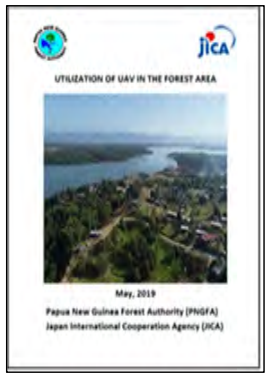
Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	**27**
	Missing	6
	Scanned	0
	Digitized(include Maps NA but digitized)	27
	Yet to scan/digitize(Blank)	0
ALPs (FMA,TRP & LFA)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	**151**
	Missing(NA/Missing Maps)	6
	Scanned(include Maps NA but scanned-Undefined map figur	17
	Digitized(include Maps NA but digitized)	129
	Yet to scan/digitize(Blank)	0
	Total Number of sheets/Maps	**178**

WEST NEW BRITIAN PROVINCE STATISTICAL SUMMARY SHEET OF UPDATED FCAs,ALPs & FWPs LISTING

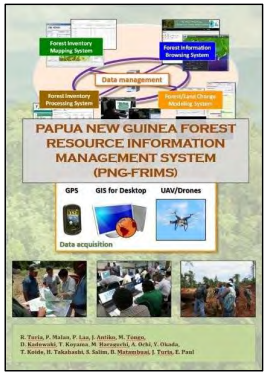
Project Types	Existing/Missing ALPs & FCAs	Total Number of sheets/Maps
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	2
	Missing	0
	Scanned(include Maps NA but scanned)	0
	Digitized(include Maps NA but digitized)	2
	Yet to scan/digitize(Blank)	0
ALPs (FMA,TRP & LFA)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	**348**
	Missing(NA/Missing Maps)	12
	Scanned(include Maps NA but scanned-Undefined m	0
	Digitized(include Maps NA but digitized)	348
	Yet to scan/digitize(Blank)	0
	Total Number of sheets/Maps	**350**

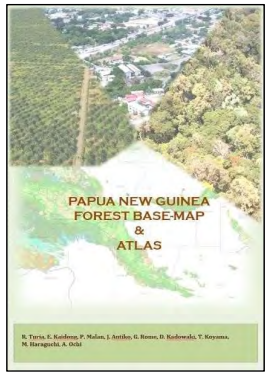
FCAS,ALPS & FWPS UPDATED MASTER LIST FILING ROOM # 2 ICT BRANCH		
STATISTICAL SUMMARY OF THE UPDATED FCAs ,ALPs & FWPs Listing from Filing Room #2 ICT Branch		
Project Types	**Existing/Missing ALPs & FCAs**	**Total Number of sheets/Maps**
FCA		
	Existing(Scanned,Digitized & Not Scan/Digitize)	**182**
	Missing	6
	Scanned(include Maps NA but scanned)	90
	Digitized(include Maps NA but digitized)	81
	Yet to scan/digitize(Blank)	11
ALPs (FMA,TRP & LFA)& Others (Bulolo Plantation)		
	Existing(Scanned,Digitized & Not Scan/Digitized)	**1392**
	Missing(NA/Missing Maps)	43
	Scanned(include Maps NA but scanned)	729
	Digitized(include Maps NA but digitized)	544
	Yet to scan/digitize(Blank)	56
	Total Number of sheets/Maps(ENTIRE COUNTRY PROJECTS	**1574**

Output 2: Secondary Activities

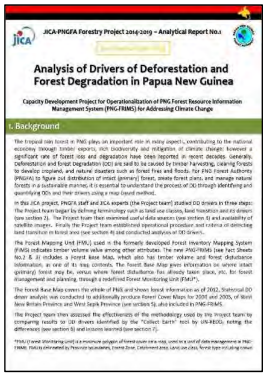


Training Manuals





Big Books



Fact Sheets and Analytical Reports

Discussions

The biggest challenge faced during the project was the lack of available information. This resulted in "gaps" or information voids that affects the accuracy of the data that were digitized in the project. This section will discuss the issues that were faced during the course of this project.

Lack of available data

As evident by the results of the final deliverables, there are some missing ALP/FWP maps in some of the projects from the time periods in focus from 2000 – 2018. This is largely due to the disorganization of the storage of submitted ALPs/FWPs. Possible reasons for this include:

- No room for storage of ALP
- No constant updating of current physical file cabinets that store the submitted ALPs/FWPs
- Files removed / borrowed from the storage rooms are not returned

- Filing errors that displace the ALPs

Listing the ALPs

The main issue regarding the listing of the ALPs was the lack of naming system adapted to differentiate and organize the maps. The criteria used to list the ALPs were based on a yearly basis. This, however, was still a challenge due to:

- Logging companies submitting monthly reports, amended reports or contingencies to the changes done during a project year
- The lack of technical forestry knowledge regarding the type of reports that are submitted
- Lack of information regarding the start date and end date of project licences, and whether a project has had any changes to name or owner of licence
- Lack of updated information from other PNGFA directorates concerning the exact number of projects that were in operation during the years 2000-2018
- No confirmation regarding whether ALPs are either just proposed or have been approved

The listing of the ALPs is a very important task as the list not only keeps the records of the ALPs but provides the identification of the ALPs with respect to the other ALPs that are being submitted. It forms the basis of the geodatabase being produced and guides the whole process of organizing the data from scanning to digitization to the compilation of the geodatabase.

Scanning Errors

The task of scanning, although as accurately done as possible, still had a few issues that hindered the progress of the project. Some of the scanned maps had errors due to technical hardware problems that caused discoloration in the digital images. Other issues faced included the production of multiple copies of the same maps.

Another issue was the map sizes. As most map sizes were larger than A4, and were folded to fit into the A4 report booklets, the maps had creases that affected the scanning. Some had to be split, which also caused inaccuracies and further problems.

Poor map production

Digitization errors were usually those caused by human error. Much of these errors were amended using the QCQA Checks to clean up the digitized data. The problem regarding digitization, however, lies in the production of the submitted maps by the logging companies. Some of the maps that were submitted did not follow basic cartographic rules. This made it difficult to ascertain the information that the map was displaying.

Recommendation

The issues and problems that have been encountered during the course of this activities, in one way or another, have solutions. This section will discuss those solutions regarding the limitations stated in the previous section.

Standards and guidelines

Current observation of the ALP maps that have been submitted to the PNGFA shows that the maps produced by logging companies lack any professionalism and do not follow the basic rules of map production. While there are existing conventions to guide the process of producing maps, there is currently no standards to which the maps being submitted to PNGFA, adhere to. To help solve many of the problems that were encountered this project, and to resolve these issues in future projects, a set of guidelines must be established as requirements by PNGFA for the submission of ALPs by the logging companies. For example, there should be a conventional method of setting out the map layout, the variables and components that make up the map, and the terminologies that are used in the production of the ALP maps.

Maintenance of Storage rooms

The storage rooms house the physical ALPs and therefore there should be a constant upkeep of the files and records that are kept there. This will ensure that the information contained within those rooms can be stored safely and accessed without any hassle.

Catalogue System

A catalogue or naming system is needed to sort out the physical files that are stored in the store room. This will aid in the process of file retrieval and returning for the different uses by external or internal requests. For the purposes, relating to the project, the naming system will keep track of what is being scanned. The system will also contain other information such as the names, dates, licence types, logging companies involved, approval status and the type of report that is being submitted. The system will also have to be updated to make sure new information is added as it is received. A good example is the current Decision Support System (DSS) being developed by the PNGFA. It will also aid in interdepartmental sharing of information between the directorates.

Conclusion

For any Decision Support System (DSS) to operate, firstly, a database from which data can be pooled and then queried must be created; to create such a database was the purpose of this project. The geodatabase for West Sepik Province and West New Britain Province was successfully created, despite

the limitations encountered, by adhering to and achieving the objectives mentioned in the introduction. However, as this is a first of its kind project for PNGFA, it would be appropriate to take this project as a pilot project. That being said, there are many ways in which the procedures involved in the pilot project can be improved to better aid PNGFA in its duties, as stated in the recommendations. In particular a standardized process should be created; from how the data is compiled by the logging companies to how the data is stored in PNGFA.

In summary, the data compiled in the geodatabase for the pilot provinces is sufficient to aid PNGFA to create its desired DSS to monitor and manage the rate at which forest degradation and deforestation occurs.

Appendix

Table 1: Excerpt from Master List containing records from West New Britain Province and West Sepik Province

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2017	Yes	2017-2022	Digitized	5
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2017	Yes	2017-2018	Digitized	5
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2016	Yes	2016-2017	Digitized	4
AMANAB BLK 1-4 & IMONDA CONSOILIDATED	TP 10_01	WSP	FMA	2015	Yes	2015-2016	Digitized	3
AMANAB BLK 1-4&IMONDA CONSOILIDATED	TP 10_01	WSP	FMA	2012	Yes	2012-2013	Digitized	3
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2013	Yes	2012-2017(5YFWP)	Digitized	1
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2011	Yes	2011-2012	Digitized	3
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2010	Yes	2010-2011	Digitized	1
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2010	Yes	2010-2011	Digitized	1
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2009	Yes	2009-2010	Digitized	1

AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2008	Yes	2008-2009	Digitized	2

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2011	Yes	2008-2013	Digitized	1
AMANAB BLK 1-4 & IMONDA CONSOLIDATED	TP 10_01	WSP	FMA	2007	Yes	2007	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2018	Yes	2018-2019	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2017	Yes	2017-2018	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2016	Yes	2016-2017	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2015	Yes	2015-2019	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2014	Yes	2014-2015	Digitized	2
BEWANI LFA	TP 10_01	WSP	LFA	2013	Yes	2013-2014	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2013	Yes	2013-2015(2YFWP)	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2012	Yes	2012-2013	Digitized	1

BEWANI LFA	TP 10_01	WSP	LFA	2010	Yes	2011-2014(3YFWP)	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2011	Yes	2011-2012	Digitized	2
BEWANI LFA _PERFORMANCE & REPORT & FWP	TP 10_01	WSP	LFA	2011	Yes	2011-2012	Digitized	1

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
BEWANI LFA	TP 10_01	WSP	LFA	2010	Yes	2010-2013	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2010	Yes	2010-2011	Digitized	2
BEWANI LFA	TP 10_01	WSP	LFA	2009	Yes	2009-2010	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2008	Yes	2008-2009	Digitized	1
BEWANI LFA_ CONTINGENCY PLAN	TP 10_01	WSP	LFA	2006	Yes	2006-2007	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2006	Yes	2006-2010(5YFWP)	Digitized	1
BEWANI LFA	TP 10_01	WSP	LFA	2005	Yes	2005-2010(5YFWP)	Digitized	2
AITAPE EAST INTEGRATED AGRICULTURE PROJ	FCA 10_01	WSP	FCA	2010	Yes	2010 - 2015 (5YFWP)	Digitized	1
AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2013	Yes	2013 - 2018	Digitized	1

AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2011	Yes	2011 - 2012	Digitized	1
AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2011	Yes	2011-2012	Digitized	1
AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2010	Yes	2010 - 2011	Digitized	1
AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2008	Yes	2008 - 2009	Digitized	1
AITAPE WEST-AGRO-FORESTRY	FCA 10_02	WSP	FCA	2010	Yes	2008 - 2012(5YFWP)	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2018	Yes	2018-2019	Digitized	4
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2017	Yes	2017-2018	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2017	Yes	2017 - 2022	Digitized	3
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2016	Yes	2016 - 2017	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2015	Yes	2015 - 2016	Digitized	1
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2014	Yes	2014 - 2015	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2013	Yes	2014-2019(5YFWP)	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2013	Yes	2014-2019(5YFWP)	Digitized	3
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2013	Yes	2013-2014	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2013	Yes	2013 - 2014	Digitized	4

AMANAB BLK 5&6	TP 10_02	WSP	FMA	2012	Yes	2012 - 2013	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2012	Yes	2011-2012	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2010	Yes	2011 - 2016(5YFWP)	Digitized	3
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2011	Yes	2011-2012	Digitized	2
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2010	Yes	2010-2011	Digitized	3
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2009	Yes	2009-2010	Digitized	1
AMANAB BLK 5&6	TP 10_02	WSP	FMA	2008	Yes	2008-2013	Digitized	1
AMANAB BLK 4	TP 10_02	WSP	FMA	2007	Yes	2007 - 2008	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2017	Yes	2017-2018	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2016	Yes	2016-2017	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
PEGI PULAN	LFA 10_02	WSP	LFA	2016	Yes	2015-2016	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2015	Yes	2015 - 2016	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2014	Yes	2014 - 2018(4YFWP)	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2014	Yes	2014-2017	Digitized	1

PEGI PULAN	LFA 10_02	WSP	LFA	2010	Yes	2010 - 2011	Digitized	1
PEGI PULAN	LFA 10_02	WSP	LFA	2010	Yes	2010 OPERATION	Digitized	1
PEGI PULAN -Base Camp	LFA 10_02	WSP	LFA	2007	Yes		Digitized	1
BEWANI OIL PALM	FCA 10_03	WSP	FCA	2018	Yes	2018-2019	Digitized	6
BEWANI OIL PALM	FCA 10_03	WSP	FCA	2013	Yes	2013 - 2014	Digitized	2
BEWANI OIL PALM	FCA 10_03	WSP	FCA	2012	Yes	2012 - 2016(4YFWP)	Digitized	1
BEWANI OIL PALM	FCA 10_03	WSP	FCA	2012	Yes	2012 - 2013	Digitized	5
BEWANI OIL PALM	FCA 10_03	WSP	FCA	2011	Yes	2011 - 2012	Digitized	3
WAROMO	TP 10_03	WSP	TRP	2018	Yes		Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
WAROMO	TP 10_03	WSP	TRP	2018	Yes	2018-2023	Digitized	1
WAROMO	TP 10_03	WSP	TRP	2018	Yes	2018-2019	Digitized	1

AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2017	Yes	2017-2022(5YFWP)	Digitized	4
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2016	Yes	2016-2017	Digitized	3
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2011	Yes	2016-2021(5YFWP)	Digitized	4
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2014	Yes	2014-2015	Digitized	3
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2011	Yes	2011-2012	Digitized	2
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2011	Yes	2011-2016	Digitized	2
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2010	Yes	2010-2011	Digitized	2
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2010	Yes	2010-2011	Digitized	1
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2009	Yes	2009-2010	Digitized	1
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2009	Yes	2009-2010	Digitized	2
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2009	Yes	2008-2013(5YFWP)	Digitized	1
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2008	Yes	2008-2009	Digitized	3
AITAPE LUMI CONSOLIDATED	TP 10_03	WSP	FMA	2003	Yes	2003-2013	Digitized	2
SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2011	Yes	2012 - 2013	Digitized	2
SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2011	Yes	2011 - 2012	Digitized	1
SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2011	Yes	2010 - 2011	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**

SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2011	Yes	2010 - 2015	Digitized	1
SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2009	Yes	2009 - 2010	Digitized	1
SKOTIAHO DEVELOPMENT PROJECT	FCA 10_04	WSP	FCA	2009	Yes	2009 - 2014(5YFWP)	Digitized	1
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2017	Yes	2017-2022	Digitized	2
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2016	Yes	2016-2017	Digitized	2
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2016	Yes	2016-2021	Digitized	1
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2014	Yes	2014-2015	Digitized	3
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2013	Yes	2013-2014	Digitized	2
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2013	Yes	2013-2016(3YFWP)	Digitized	2
WALSA INTEGRATED AGRO-FORESTRY	FCA 10_05	WSP	FCA	2012	Yes	2012-2017(5YFWP)	Digitized	1
WAMMY RURAL DEVELOPMENT	FCA 10_07	WSP	FCA	2017	Yes	2017-2018	Digitized	1
WAMMY RURAL DEVELOPMENT	FCA 10_07	WSP	FCA	2017	Yes	2017-2022(5YFWP)	Digitized	1

WAMMY RURAL DEVELOPMENT	FCA 10_07	WSP	FCA	2016	Yes	2016-2017	Digitized	2

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
WAMMY RURAL DEVELOPMENT	FCA 10_07	WSP	FCA	2015	Yes	2015-2016	Digitized	2
WAMMY RURAL DEVELOPMENT	FCA 10_07	WSP	FCA	2014	Yes	2014-2015	Digitized	1
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2011	Yes	2011-2012	Digitized	2
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2010	Yes	2010-2011	Digitized	7
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2010	Yes	2010-2011	Digitized	1
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2009	Yes	2009-2010	Digitized	8
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP		Yes	2004	Digitized	3
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2004	Yes	2004-2007	Digitized	5
VANIMO BLK 3-4-5	TP 10_08	WSP	TRP	2003	Yes	2003-2007	Digitized	1
VANIMO BLK 1-6	TP 10_08	WSP	TRP	2018	Yes	2018-2019	Digitized	3
VANIMO BLK 1-6	TP 10_08	WSP	TRP	2009	Yes	2009-2010	Digitized	3
VANIMO BLK 1-6	TP 10_08	WSP	TRP	2006	Yes	2006-2007	Digitized	4
VANIMO BLK 1-6	TP 10_08	WSP	TRP	2003	Yes	2003-2004	Digitized	5
VANIMO BLK 2	TP 10_08	WSP	TRP		Yes		Digitized	1
VANIMO BLK 5	TP 10_08	WSP	TRP	2007	Yes	2007	Digitized	1
VANIMO BLK 1,2,3 & 6	TP 10_08	WSP	TRP	2006	Yes	1995-2002	Digitized	1
ASENGSENG CONSOILDTED	TP 14_01	WNB	FMA	2018	Yes	2018-2019	Digitized	2

ASENGSENG CONSOLIDATED	TP 14_01	WNB	FMA	2017	Yes	2017-2018	Digitized	2
ASENGSENG CONSOILDATED	TP 14_01	WNB	FMA	2016	Yes	2016-2017(AFWP)	Digitized	2
ASENGSENG CONSOILDATED	TP 14_01	WNB	FMA	2015	Yes	2015-2020(5YFWP)	Digitized	1
ASENGSENG CONSOLIDATED	TP 14_01	WNB	FMA	2011	Yes	2011-2012	Digitized	1
ASENGSENG CONSOLIDATED	TP 14_01	WNB	FMA	2009	Yes	2009-2010	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
ASENGSENG CONSOLIDATED	TP 14_01	WNB	FMA	2009	Yes	2009-2014(5YFWP)	Digitized	1
ASENGSENG CONSOLIDATED	TP 14_01	WNB	FMA	2007	Yes	2007-2008	Digitized	1
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2017	Yes	2017-2018	Digitized	5
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2016	Yes	2016-2017	Digitized	4
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2016	Yes	2016-2021(5YFWP)	Digitized	2
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2015	Yes	2015-2016	Digitized	1
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2014	Yes	2014-2015	Digitized	1
ROTTOCK BAY CONSOLIDATED-portion of Aria Vanu Blk 2	TP 14_02	WNB	FMA	2013	Yes	2013-2014	Digitized	2

ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2009	Yes	2009-2010	Digitized	2
ROTTOCK BAY CONSOLIDATED (Variation Plan)	TP 14_02	WNB	FMA	2008	Yes	2006-2011(5YFWP)	Digitized	2
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2006	Yes	2006-2011(5YFWP)	Digitized	2
ROTTOCK BAY CONSOLIDATED	TP 14_02	WNB	FMA	2007	Yes	2007-2008	Digitized	1
VANU TAMU	TP 14_02	WNB	FMA	2008	Yes	2008-2009	Digitized	2

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
VANU TAMU	TP 14_02	WNB	FMA	2007	Yes	2007-2008	Digitized	2
ROTTOCK BAY CONSOLIDATED-INLAND RAUTO	TP 14_02	WNB	FMA	2008	Yes	2018-2019	Digitized	4
ROTTOCK BAY CONSOLIDATED-INLAND RAUTO	TP 14_02	WNB	FMA	2008	Yes	2008-2009	Digitized	2
LOLO BLOCK 1	LFA 14_02	WNB	LFA	2018	Yes	2018-2019	Digitized	1
LOLO BLOCK 1	LFA 14_02	WNB	LFA	2017	Yes	2017-2018	Digitized	2
LOLO BLOCK 1	LFA 14_02	WNB	LFA		Yes		Digitized	2

PAKALUA INTEGRATED AGRICULTURE	FCA 14_02	WNB	FCA	2018	Yes	2018-2019	Digitized	1
PAKALUA INTEGRATED AGRICULTURE	FCA 14_02	WNB	FCA	2018	Yes	2018-2023	Digitized	1
LOLO BLOCK 2	LFA 14_02	WNB	LFA	2019	Yes	2019-2020	Digitized	1
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2018	Yes	2018-2019	Digitized	2
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2017	Yes	2017-2018	Digitized	1
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2016	Yes	2016-2017	Digitized	1
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2015	Yes	2015-2016	Digitized	2

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2011	Yes	2010-2011	Digitized	1
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2011	Yes	2011-2012	Digitized	2
LOLO BLOCK 2	LFA 14_03	WNB	LFA	2011	Yes	2010-2015	Digitized	1
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2018	Yes	2018-2022(5YFWP)	Digitized	3

ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2018	Yes	2018-2019	Digitized	1
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2017	Yes	2017-2018	Digitized	2
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP		Yes	2016-2020	Digitized	2
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2015	Yes	2016-2021(5YFWP)	Digitized	1
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2016	Yes	2016-2017	Digitized	2
ANIA KAPIURA(SBLC PLANTATION)	TP 14_03	WNB	TRP	2013	Yes	2013-2014	Digitized	3
PULIE ANU	LFA 14_04	WNB	LFA	2018	Yes	2018-2021	Digitized	1
PULIE ANU	LFA 14_04	WNB	LFA	2018	Yes	2018-2019	Digitized	1
ANU AUMBIT	LFA 14_05	WNB	LFA	2018	Yes	2018-2019	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
ANU ALIMBIT	LFA 14_05	WNB	LFA	2018	Yes	2018-2020	Digitized	1
ANU ALIMBIT	LFA 14_05	WNB	LFA	2017	Yes	2017-2020	Digitized	1

ANU-ALIMBIT	LFA 14_05	WNB	LFA	2017	Yes	2017-2018	Digitized	1
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2016	Yes	2016-2017	Digitized	1
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2013	Yes	2013-2014	Digitized	1
ANU ALIMBIT	LFA 14_05	WNB	LFA	2011	Yes	2011-2012	Digitized	1
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2010	Yes	2010-2011	Digitized	2
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2008	Yes	2008-2009	Digitized	2
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2007	Yes	2007-2008	Digitized	2
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2006	Yes	2006-2007	Digitized	1
ANU-ALIMBIT	LFA 14_05	WNB	LFA	2005	Yes	2005-2006	Digitized	1
ARIA VANU BLK 1	LFA 14_06	WNB	LFA	2016	Yes	2016-2017	Digitized	2
ARIA VANU BLK 1	LFA 14_06	WNB	LFA	2015	Yes	2015-2016	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**

ARIA VANU BLK 1: Variation of ALP 2014-2015	LFA 14_06	WNB	LFA	2015	Yes	2014-2015	Digitized	2
ARIA VANU BLK 1	LFA 14_06	WNB	LFA	2015	Yes	2014-2015	Digitized	1
ARIA VANU BLK 1	LFA 14_06	WNB	LFA	2013	Yes	2013-2014	Digitized	1
ARIA VANU BLK 1	LFA 14_06	WNB	LFA	2008	Yes	2008-2011(3YFWP)	Digitized	1
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2017	Yes	2018-2019	Digitized	1
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2016	Yes	2016-2017	Digitized	1
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2015	Yes	2015-2016	Digitized	1
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2011	Yes	2011-2012	Digitized	3
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2010	Yes	2010-2013(3YFWP)	Digitized	1
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2009	Yes	2009-2010	Digitized	2
AUTOVO EXTENSION	LFA 14_07	WNB	LFA	2008	Yes	2008-2009	Digitized	2
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2018	Yes	2019-2022	Digitized	1

ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2018	Yes	2018-2019	Digitized	1

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2018	Yes	2018-2019	Digitized	1
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2017	Yes		Digitized	1
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2016	Yes	2016-2017	Digitized	1
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2012	Yes	2012-2013	Digitized	1
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2006	Yes	2006-2007	Digitized	3
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2003	Yes	2003-2004	Digitized	3
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2000	Yes	2000-2001	Digitized	2
ALIMBIT-ANDRU	LFA 14_08	WNB	LFA	2011	Yes	2011-2012	Digitized	2
AWIO AMGEN	LFA 14_09	WNB	LFA	2018	Yes	2018-2019	Digitized	1
AWIO AMGEN	LFA 14_09	WNB	LFA	2017	Yes	2017-2018	Digitized	1

AWIO AMGEN	LFA 14_09	WNB	LFA	2016	Yes	2016-2018(2YFWP)	Digitized	1
AWIO AMGEN	LFA 14_09	WNB	LFA	2016	Yes	2016-2017	Digitized	1
AWIO AMGEN	LFA 14_09	WNB	LFA	2015	Yes	2015-2016	Digitized	1

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
AWIO AMGEN	LFA 14_09	WNB	LFA	2011	Yes	2011-2012	Digitized	1
AWIO AMGEN	LFA 14_09	WNB	LFA	2009	Yes	2009-2010	Digitized	1
AWIO AMGEN	LFA 14_09	WNB	LFA	2000	Yes	2000-2001	Digitized	1
ANDRU JOHANNA	LFA 14_09	WNB	LFA	2018	Yes	2018-2019	Digitized	1
ANDRU JOHANNA	LFA 14_10	WNB	LFA	2010	Yes	2010-2011	Digitized	2
ANDRU JOHANNA	LFA 14_10	WNB	LFA	2008	Yes	2009-2010	Digitized	2
ANDRU JOHANNA	LFA 14_10	WNB	LFA	2007	Yes	2008-2009	Digitized	4
ANDRU JOHANNA	LFA 14_10	WNB	LFA	2006	Yes	2006-2007	Digitized	2

ANDRU JOHANNA	LFA 14_10	WNB	LFA	2005	Yes	2005-2010(5YFWP)	Digitized	1
PASSISMANUA INLAND EXTENSION	LFA 14_10	WNB	LFA	2018	Yes	2018-2019	Digitized	2
PASSISMANUA INLAND EXTENSION	LFA 14_10	WNB	LFA	2016	Yes	2016-2019 (3YFWP)	Digitized	1
PASSISMANUA BLK 1	LFA 14_11	WNB	LFA	2016	Yes	2016-2017	Digitized	3
PASSISMANUA BLK 1	LFA 14_11	WNB	LFA	2016	Yes	2015-2016	Digitized	

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
PASSISMANUA BLK 1	LFA 14_11	WNB	LFA	2013	Yes	2013-2014	Digitized	
PASSISMANUA BLK 1	LFA 14_11	WNB	LFA	2000	Yes	2000-2003	Digitized	1
PASSISMANUA BLK 1	LFA 14_11	WNB	LFA	2000	Yes	2000	Digitized	2
Lolo Block 2 Extension	LFA 14_12	WNB	LFA	2013	Yes	2013-2014	Digitized	2
Lolo Block 2 Extension	LFA 14_12	WNB	LFA	2011	Yes	2011-2012	Digitized	1
Lolo Block 2 Extension	LFA 14_12	WNB	LFA		Yes	2010-2011	Digitized	1

ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2018	Yes	2018-2019	Digitized	1
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2017	Yes	2017-2018	Digitized	1
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2017	Yes	2017-2018	Digitized	1
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2016	Yes	2016-2017	Digitized	1
ARIA VANU BLK 2	LFA 14_13	WNB	LFA	2011	Yes	2011-2016	Digitized	1
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2009	Yes	2010-2011	Digitized	2
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2006	Yes	2006-2010(4YFWP)	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2006	Yes	2006-2007	Digitized	2
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2005	Yes	2005-2007	Digitized	2
ANIA VANU BLK3	LFA 14_13	WNB	LFA	2005	Yes	2005-2006	Digitized	3
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2005	Yes	2004-2006(2YFWP)	Digitized	1

ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2004	Yes	2004-2005	Digitized	4
ARIA VANU BLK 3	LFA 14_13	WNB	LFA	2000	Yes	2000(AFWP)	Digitized	3
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2018	Yes	2018-2019	Digitized	2
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2017	Yes	2017-2018	Digitized	1
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2010	Yes	2010-2011	Digitized	2
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2009	Yes	2009-2010	Digitized	2
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2008	Yes	2008-2013(5YFWP)	Digitized	1
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2008	Yes	2008-2009	Digitized	2
PASSISMANUA INLAND EXTENSION	LFA 14_14	WNB	LFA	2005	Yes	2005-2006	Digitized	2

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
BADAKA/ MADEDUA/ EXTENDED MENGEN CONSOLIDATED	TP 14_41	WNB	TRP	2017	Yes	2017-2018	Digitized	1
BAKADA, MADEDUA, MADEDUA& MENGEN EXTN	TP 14_41	WNB	TRP	2005	Yes	2005-2006	Digitized	1

BAKADA, MADEDUA, MADEDUA& MENGEN EXTN	TP 14_41	WNB	TRP	2004	Yes	2004-2009(5YFWP)	Digitized	1
BAKADA, MADEDUA, MADEDUA& MENGEN EXTN	TP 14_41	WNB	TRP	2004	Yes	2004-2005	Digitized	1
BAKADA, MADEDUA, MADEDUA& MENGEN EXTN	TP 14_41	WNB	TRP	2001	Yes	2001-2006(5YFWP)	Digitized	1
ULAMONA COSOLIDATED	TP 14_43	WNB	TRP	2005	Yes	2005-2009(4YFWP)	Digitized	1
ULAMONA COSOLIDATED	TP 14_43	WNB	TRP	2005	Yes	2005-2006	Digitized	1
ULAMONA COSOLIDATED	TP 14_43	WNB	TRP	2001	Yes	2001-2006(5YFWP)	Digitized	2
ULAMONA COSOLIDATED-Annual Plan Variation	TP 14_43	WNB	TRP	2000	Yes	2000-2001	Digitized	1
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2011	Yes	2011-2012	Digitized	6
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2011	Yes	2010-2011	Digitized	5
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2010	Yes	2010-2011	Digitized	2

Project Name	License No.	Province	Concession Type	Published Year	Map availability	ALP Year	Scan/Digitized	No of Map/Plans
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2010	Yes	2009-2010	Digitized	2

KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2006	Yes	2006-2009(3YFWP)	Digitized	1
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2006	Yes	2006-2007	Digitized	7
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2005	Yes	2005-2010	Digitized	1
KUPULUK & EXTENSION	TP 14_50	WNB	TRP	2003	Yes	2003-2008(5YFWP)	Digitized	1
KUPULUK & EXTENSION-Variation Plan	TP 14_50	WNB	TRP	2002	Yes	2000-2005(5YFWP)	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2018	Yes	2018-2019	Digitized	4
ANIA KAPIURA FULLERBORN CONSOLIDATE-Variation Plan	TP 14_52	WNB	TRP	2018	Yes	2017-2020(3YFWP)	Digitized	2
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2017	Yes	2017-2018	Digitized	3
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2017	Yes	2017-2019(2YFWP)	Digitized	2
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2014	Yes	2014-2015	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2014	Yes	2013-2014	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2012	Yes	2012-2014(2YFWP)	Digitized	2

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2013	Yes	2012-2013	Digitized	3
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2011	Yes	2011-2014	Digitized	4
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2011	Yes	2011-2012	Digitized	2
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2010	Yes	2010-2011	Digitized	6
ANIA KAPIURA CONSOLIDATED	TP 14_52	WNB	TRP	2009	Yes	2009-2014(3YFWP)	Digitized	4
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2006	Yes	2006-2007	Digitized	4
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2005	Yes	2005-2006	Digitized	2
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2004	Yes	2004-2005	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATE-Variation Plan	TP 14_52	WNB	TRP	2004	Yes	2003-2004	Digitized	2
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2003	Yes	2003-2004	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2004	Yes	2002-2007(5YFWP)	Digitized	2

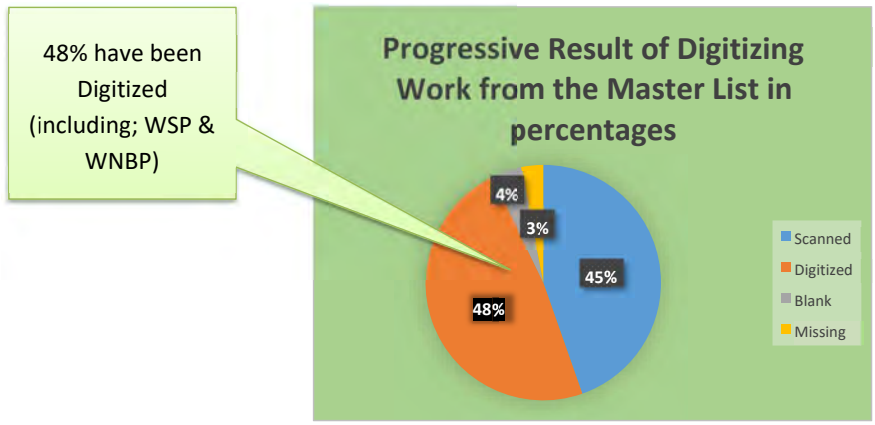
ANIA KAPIURA FULLERBORN CONSOLIDATED	TP 14_52	WNB	TRP	2002	Yes	2002-2003	Digitized	1
ANIA KAPIURA FULLERBORN CONSOLIDATE-Variation Plan	TP 14_52	WNB	TRP	1999	Yes	1999-2004	Digitized	4

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
WEST ARAWA	TP 14_53	WNB	TRP	2017	Yes	2017-2018	Digitized	3
WEST ARAWA	TP 14_53	WNB	TRP	2001	Yes	2012-2013	Digitized	2
WEST ARAWA	TP 14_53	WNB	TRP	2011	Yes	2011-2012	Digitized	2
WEST ARAWA	TP 14_53	WNB	TRP	2010	Yes	2010-2011	Digitized	3
WEST ARAWA	TP 14_53	WNB	TRP	2009	Yes	2009-2010	Digitized	3
WEST ARAWA	TP 14_53	WNB	TRP	2005	Yes	2005-2006	Digitized	4
WEST ARAWA	TP 14_53	WNB	TRP	2003	Yes	2003-2004	Digitized	6
WEST ARAWA	TP 14_53	WNB	TRP	2002	Yes	2002-2003	Digitized	3
WEST ARAWA	TP 14_53	WNB	TRP	2001	Yes	2001-2006(5YFWP)	Digitized	1
WEST ARAWA	TP 14_53	WNB	TRP	2001	Yes	2001-2002	Digitized	2
WEST ARAWA	TP 14_53	WNB	TRP	1996	Yes	1996-2001(5YFWP)	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2018	Yes	2018-2019	Digitized	2
CENTRAL ARAWA	TP 14_54	WNB	TRP	2017	Yes	2017-2020	Digitized	1

CENTRAL ARAWA	TP 14_54	WNB	TRP	2017	Yes	2017-2018	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2010	Yes	2010-2014	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2007	Yes	2007-2008	Digitized	3
CENTRAL ARAWA	TP 14_54	WNB	TRP	2006	Yes	2006-2011(5YFWP)	Digitized	1

Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
CENTRAL ARAWA	TP 14_54	WNB	TRP	2005	Yes	2005-2006	Digitized	2
CENTRAL ARAWA	TP 14_54	WNB	TRP	2004	Yes	2003-2004	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2002	Yes	2002-2006(4YFWP)	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2001	Yes	2001-2002	Digitized	1
CENTRAL ARAWA	TP 14_54	WNB	TRP	2000	Yes	2000-2001	Digitized	2
CENTRAL ARAWA	TP 14_54	WNB	TRP	1997	Yes	1997-2002	Digitized	1
EAST ARAWA	TP 14_55	WNB	TRP	2018	Yes	2017-2020(3YFWP)	Digitized	1

EAST ARAWA	TP 14_55	WNB	TRP	2017	Yes	2017-2018	Digitized	1
EAST ARAWA	TP 14_55	WNB	TRP	2011	Yes	2011-2012	Digitized	2
EAST ARAWA	TP 14_55	WNB	TRP	2007	Yes	2007-2008	Digitized	2
EAST ARAWA	TP 14_55	WNB	TRP	2006	Yes	2006-2009(3YFWP)	Digitized	2
EAST ARAWA	TP 14_55	WNB	TRP	2005	Yes	2005-2006	Digitized	3
EAST ARAWA	TP 14_55	WNB	TRP	2004	Yes	2004-2005	Digitized	1
EAST ARAWA	TP 14_55	WNB	TRP	2001	Yes	2015-2016	Digitized	1
EAST ARAWA	TP 14_55	WNB	TRP	2011	Yes	2011-2012	Digitized	2
MOSA LEIM	TP 14_57	WNB	TRP	2010	Yes	2010-2011	Digitized	1
Project Name	**License No.**	**Province**	**Concession Type**	**Published Year**	**Map availability**	**ALP Year**	**Scan/Digitized**	**No of Map/Plans**
MOSA LEIM	TP 14_57	WNB	TRP	2010	Yes	2010-2011(Amended 2YFWP)	Digitized	1
MOSA LEIM	TP 14_57	WNB	TRP	2011	Yes	2011-2012	Digitized	2
MOSA LEIM	TP 14_57	WNB	TRP		Yes	2008-2009	Digitized	
Maututu Blk 1 & 2	TP 14_58	WNB	TRP	2007	Yes	2007 -2008	Digitized	2
							Total	**528**



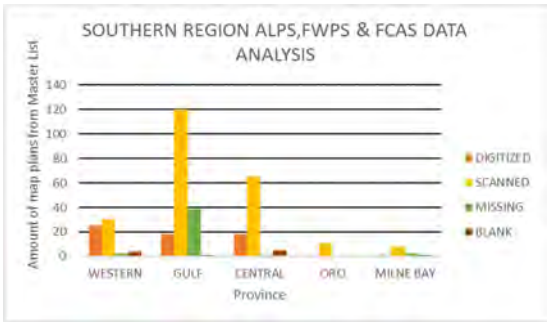
Updated Statistical Summary of Logging Projects Nationwide.

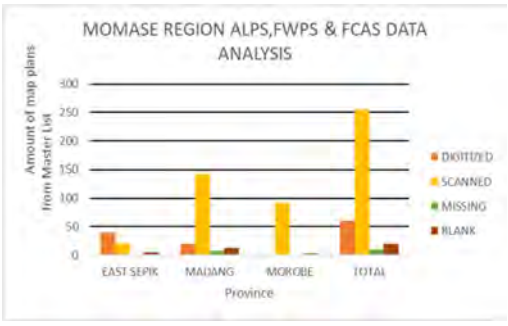
Project Types	**Existing/Missing ALPs,FWPs & FCAs**	**Total Number of sheets/Maps**
ALPs,FWPs & FCPs (FMA,TRP, LFA & FCA)& Others (Bulolo Plantation)		
	Existing (Scanned, Digitized & Not Scan/Digitized)	**1574**
	Missing (NA/Missing Maps)	49
	Scanned (include Maps Not Available but scanned)	724

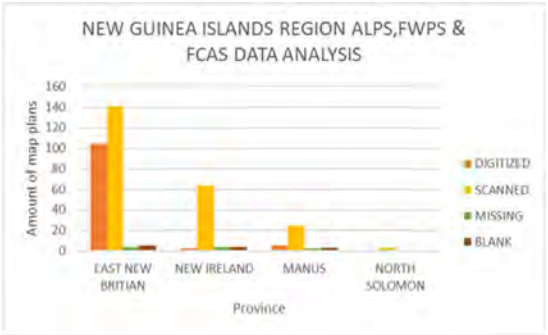
	Digitized (include Maps Not Available but digitized)	783
	Yet to scan/digitized (Blank)	67

Pilot Provinces Data Analysis (West Sepik Province and West New Britain Province)

All Regions Data Analysis







Annex 27

Minutes of Meeting on Data Management of Plantations in PNG-FRIMS

Meeting on data management of plantation in FRIMS (Record)

1: Date and time: 13th Oct, From AM 10:05 to 11:30.
@ FPPD meeting room

2: Participant:
Constin Bigol, Ledino Saega, Jehu Antiko, Patrick laa,
Kadowaki, Koyama

3: Background

- As the plantation area in some provinces shown in Forest Base Map 1.1 and materials by the plantation branch are different (Pls. see the table).

(unit: ha)

	CEN	MIL	MOR	MAD	ENG	EHY	SHY	WHY	WNB	ENB	NIR	ARB	TOTAL
Forest Base Map 2012 V1.1	18,179	1,214	17,719	4,893	25	4,911	319	1,474	0	17,931	0	7	66,672
Plantation Branch PNGFA(2015)	2,706	1,500	12,764	14,123		5,873	440	2,100	12,000	16,385	570		68,461

- According to the consultation between Mr. Vilamur and Mr. Kadowaki held at the beginning of this Oct., the plantation branch can't explain the reason of the differences and pointed out that figures of plantation area in the country are outdated in materials by the branch and the necessity of the updating those figures through ground survey by plantation staff with GPS etc...
- To discuss how to deal with the issue, this meeting was held.

4: Summary

1) Technical observation on this issue.
   - Vegetations including Forest plantation were interpreted from satellite images together with provincial officers based on their local knowledge during the 1st project.
   - As officers from some provinces didn't join in the interpretation, it might affect correctness of vegetation map in the provinces.
   - The plantation branch didn't join in the interpretation work at that time.
   - Some plantation areas data in FRIMS have been made by digitizing

those plantation map. As those maps are old, the current boundaries of the plantation areas may be different from those in FRIMS.

- Plantation data is recorded in "plantation layer" in FRIMS. Revising the layer is not technically difficult if there are data.
- Ground survey is one of the solutions to improve data correctness of plantation areas in FRIMS. But it takes much time.

2) Future direction

- As the difference of plantation area between FRIMS and the plantation branch's data could adversely affect decision making by PNGFA management and would undermine the credibility of FRIMS, this issue should be tackled in cooperation with the Plantation branch as much as possible before the Project ends.
- If most of the plantation staff attend the training to be held in Goroka, the officers would help to get point data for boundaries of plantation plots with using GPS without IM's assistance. Cartographers can then overlay the points on to satellite imagery and verify/demarcate which areas are still plantation or not.

3) The way forward

Holding a meeting in this November between the IM branch and the plantation branch to identify our necessary actions.

Expected agenda items;

a) Current data management of forest plantation area in FRIMS
b) Obtaining Map and data from private companies such as SBLC
c) Classification of ex-state plantation in forest base map. Is it classified as plantation area if land owners continue plantation management?
d) Actions and schedule.

Preparation for the meeting

Cartographer will prepare;

- Breakdown of figures of plantation area in MOR, CEN and MAD
- Prepare FBM1.1 for MOR, CEN, MAD with color of Qf is tentatively changed to other than Yellow.

4) Other: Color of legend of Qf and Qa in FRIMS

It is more useful for PNGFA staff to perform their task if Qf color is not same with Qa's color. It is not difficult to technically change color of the legend. So, Cartographer will consider the best timing to change Qf's color in consultation with KKC team at its next assignment.

(END)

Annex 28

Upgrade of AAC Calculation Function

First verification of the results of AAC calculation

Modifications to AAC calculation through review by C/P

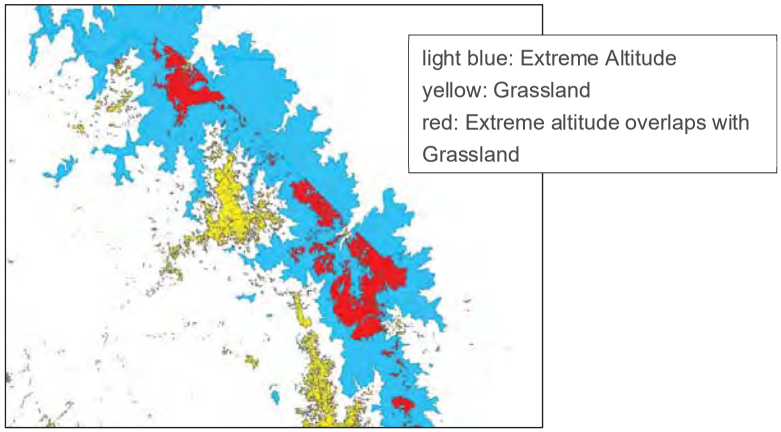
Verification of the second results of AAC calculation

Issus on the first results

1. Land Area for each provinces and the Total Land Area for the country does not correspond.
2. Forest Areas for each of the provinces and the Gross Forest Area for the country also does not correspond to the Base Map. We are reporting estimated 37 million but our calculation is over 39 million.
3. There are also inconsistency in the areas of Forest Plantation, Grassland and Other Areas. For example, the Forest Plantation area in Morobe Province according to the Base Map is 17,719 ha; the Grassland and Other Areas in Western Province according to the Base Map is 1,010, 957 ha and 438, 225 ha.
4. There have be some updating on the constraint areas. Are we using the updated or from the old ones as these may have some effect on the calculations.

Cause of issues on the first results

The previous tool starts to calculate from Protection Forest, which includes"Extreme Slope", "Extreme Altitude", "Extreme Karst", "Extreme Inundation", "Mangrove" and "Protected Area".
The Protection Forest covers not only Forest Area but also Non-forest area, Grassland and Other Areas. Please find the attached imagery.



Improvement of the calculation procedure

(previous calculation order)
Protection Forest > Forest Plantation > Grassland > Other Areas > Production Forest > Potential Forest > Reserve Forest
(new calculation order)
Grassland > Other Areas > Protection Forest > Forest Plantation > Production Forest > Potential Forest > Reserve Forest

Remarks

- Current estimated timber volume is not accurate because logged over areas have not been finished digitizing.
- Estimated timber volume by FIMS is larger than the volume by AAC calculation tool. Because FIMS does not distinguish constraints from forest production area.

Items to be confirmed

- Where does Permitted Cut Under Projects (2013) come from?
- What kind of estimated timber volume do you use for planning National Forest Plan and Provincial Forest Plan?

Provinces	Total Land area (ha) (a) ((b)+(h)+(i))	Gross Forest area (ha) (b) ((c)+(d)+(e)+(f)+(g))	Production Forest *1 (ha) (c)										Potential Production Forest *2 (ha) (d)			Reserve Forest *3 (ha) (e)			Protection Forest *4 (ha) (f)		Forest Plantations (ha) (g)	Grassland (afforestation potential) (ha) (h)	Other Areas (ha) (i)
				FMA		TRP		LFA		TA - 01													
				Un-logged area	Logged-over area	Un-logged area	Logged-over area	Un-logged area	Logged-over area	Un-logged area	Logged-over area	Logged-over area		Un-logged area	Logged-over area		Un-logged area	Logged-over area		Mangrove			
Western	9,819,990	8,364,382	1,044,498	576,561	467,937	409,869	1,386	166,692	466,551				2,918,192	2,596,050	322,142	2,707,170	2,680,219	26,951	1,694,522	117,962		1,013,922	441,686
Gulf	3,471,859	3,294,705	1,203,287	772,423	430,864	696,588	186,205	75,835	244,659				409,870	409,701	169	557,762	479,770	77,992	1,123,786	241,239		72,942	104,212
Central	2,955,783	2,505,148	321,928	232,561	89,367	112,724	21,986	92,061	63,569	27,776	3,812		323,383	323,094	289	1,440,567	1,243,858	196,709	401,319	52,657	17,951	272,517	178,118
Milne Bay	1,416,665	1,024,540	71,405	62,359	9,046	49,494		12,865	9,046				111,946	108,857	3,089	720,941	556,682	164,259	119,035	46,699	1,213	122,672	269,453
Northern(ORO)	2,263,370	1,933,848	147,183	132,907	14,276	117,088	7			15,819	14,269		847,092	845,334	1,758	551,940	466,341	85,599	387,633	15,266		154,870	174,652
Southern Highlands	1,504,750	1,194,947	87,510	87,510	0	87,510							276,930	276,930		283,089	269,715	13,374	547,100		318	64,915	244,888
Eastern Highlands	1,114,675	674,061	0	0	0								129,148	129,148		355,847	346,909	8,938	184,156		4,910	194,983	245,631
Simbu	613,340	424,723	296	296	0	296							71,455	71,455		186,515	186,515		166,457			37,107	151,510
Western Highlands	432,998	181,259	0	0	0								0			99,665	77,658	22,007	80,121		1,473	22,764	229,975
West Sepik	3,592,766	3,307,841	888,338	785,071	103,267	776,060	77,386			9,011	25,881		987,843	981,106	6,737	998,029	730,151	267,878	433,631	668		110,673	174,252
East Sepik	4,368,599	3,155,349	252,101	224,318	27,783	216,145				8,173	27,783		622,604	614,107	8,497	938,731	904,362	34,369	1,341,913	17,782		615,682	597,568
Madang	2,890,325	2,118,870	290,726	209,614	81,112	175,353	10,070	34,261	71,042				158,228	155,980	2,248	1,289,008	1,190,954	98,054	376,408	277	4,500	172,812	598,643
Morobe	3,368,621	2,497,031	159,559	113,551	46,008	83,901	18,881	29,650	27,127				426,878	397,560	29,318	1,332,362	1,229,829	102,533	572,197	3,149	6,035	324,902	546,688
West New Britain	2,034,000	1,713,584	955,127	415,704	539,423	257,297	6,862	71,741	281,316	86,666	251,245		1,444	780	664	508,284	138,397	369,887	248,729	8,299		32,069	288,347
East New Britain	1,529,424	1,280,928	18,629	8,447	10,182			8,447	10,182				238,873	176,511	62,362	553,970	214,399	339,571	451,526	2,636	17,930	17,536	230,960
New Ireland	939,695	815,272	103,591	30,480	73,111			30,480	73,111				143,779	108,908	34,871	416,431	132,608	283,823	151,471	14,622		24,994	99,429
Autonomous Bougainville Government(ABG)	946,254	808,698	38,871	38,871	0			38,871					0			674,792	633,663	41,129	95,029	2,729	6	41,277	96,279
Manus	193,076	178,432	38,943	13,412	25,531			11,204	19,105	2,208	6,426		102,362	98,492	3,870	15,501	8,333	7,168	21,626	3,755		5,789	8,855
Enga	1,173,438	781,692	0	0	0								55	55		324,365	291,561	32,804	457,248		24	69,827	321,919
National Capital District	26,114	12,441	0	0	0								0			7,192	7,192		5,249	304		6,394	7,279
Hela	1,055,592	817,169	0	0	0								21,994	21,994		455,552	455,552		339,623			47,300	191,123
Jiwaka	480,522	300,119	0	0	0								2,864	2,864		209,068	160,447	48,621	88,187			12,944	167,459
Total	*5 46,191,856	*6 37,385,039	5,621,992	3,704,085	1,917,907	2,982,325	322,783	572,107	1,265,708	149,653	329,416	0	7,794,940	7,318,926	476,014	14,626,781	12,405,115	2,221,666	9,286,966	528,044	54,360	3,438,891	5,367,926

***1: Area already acquired for FMA, TRP, LFA and TA**
***2: Area under acquisition and allocation process for FMA or TRP**
***3: Area not yet classified**
***4: Area under WMA extreme constraints and Mangrove**
***5: Cause of calculation inconsistency to be found out**
***6: Gross Forest Area in this table includes Woodland, Scrub and Savanna in Forest BaseMap 2012**

Calculation Example 1 Net Production Area = Production Forest

Appendix 5a_1: Annual Allowable Cut for PNG in NFP 2015 - 2020

Provinces	Net Production Area (ha) (c)	Logged Over Area in Net Production Area (ha) (k)	Un-logged Area in Net Production Area (ha) (l) ((c)-(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)	Permitted Cut Under Projects (2013) (q)	Balance AAC (2013) (r) ((p)-(q))	Projected AAC 2015 - 2019 (000 m^3)				
										2015	2016	2017	2018	2019
Western	1,044,498	467,937	576,561	6,779,738	18,116,357	24,896,095	711,317	826,000	-114,683	736	736	736	736	736
Gulf	1,203,287	430,864	772,423	4,901,957	22,152,619	27,054,576	772,988	1,186,000	-413,012	1,046	1,046	1,046	1,046	1,046
Central	321,928	89,367	232,561	1,054,756	4,879,271	5,934,027	169,544	270,000	-100,456	343	343	343	343	343
Milne Bay	71,405	9,046	62,359	77,712	1,987,692	2,065,404	59,012	58,000	1,012	109	109	109	109	109
Northern(ORO)	147,183	14,276	132,907	70	3,412,403	3,412,473	97,499	288,000	-190,501	153	153	153	153	153
Southern Highlands	87,510	0	87,510	0	3,028,881	3,028,881	86,539		86,539					
Eastern Highlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Simbu	296	0	296	0	14,486	14,486	414	0	414	0	0	0	0	0
Western Highlands	0	0	0	0	0	0	0		0					
West Sepik	888,338	103,267	785,071	540,457	23,520,193	24,060,650	687,447	907,200	-219,753	554	554	554	554	554
East Sepik	252,101	27,783	224,318	0	10,119,570	10,119,570	289,131	397,000	-107,869	150	150	150	150	150
Madang	290,726	81,112	209,614	1,147,045	7,581,379	8,728,424	249,384	568,000	-318,616	418	288	288	138	138
Morobe	159,559	46,008	113,551	507,704	3,687,920	4,195,624	119,875	185,000	-65,125	241	241	241	241	241
West New Britain	955,127	539,423	415,704	4,474,159	12,709,873	17,184,032	490,972	2,538,700	-2,047,728	2,434	1,704	1,549	1,549	1,549
East New Britain	18,629	10,182	8,447	116,637	244,942	361,579	10,331	562,500	-552,169	380	380	380	380	380
New Ireland	103,591	73,111	30,480	1,344,665	666,078	2,010,743	57,450	180,000	-122,550	180	180	180	60	60
Autonomous Bougainville Government(ABG)	38,871	0	38,871	0	779,391	779,391	22,268	0	22,268	0	0	0	0	0
Manus	38,943	25,531	13,412	242,355	460,907	703,262	20,093	212,000	-191,907	146	146	132	132	132
Enga	0	0	0	0	0	0	0	0	0	0	0	0	0	0
National Capital District	0	0	0	0	0	0	0		0					
Hela	0	0	0	0	0	0	0		0					
Jiwaka	0	0	0	0	0	0	0		0					
Total	**5,621,992**	**1,917,907**	**3,704,085**	**21,187,255**	**113,361,962**	**134,549,217**	**3,844,264**	**8,178,400**	**-4,334,136**	**6,890**	**6,030**	**5,861**	**5,591**	**5,591**

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

Forest Information used for AAC Calculation

Forest Information		Note
Vegetation	ForestBaseMap2012	New Vegetation Map
	FMU (Forest Mapping Unit)	OLD Vegetation Map stored in FIMS.
Logging Information	Concession Area	Operational Concession Areas (FMA, TPR and LFA) and Proposed Concession (PFD and Proposed PFD).
	Logged Over Area (Logged_NotLandUse)	Areas logged and left to regenerate. Currently, this layer is being updated using ALPs. In the future, Set-Ups boundaries can be identified.
	Logged Over Area (Logged_LandUse)	Areas logged and subsequently converted to other forms of non-forest forms of land use.
Constraints (Protection Forests)	Extreme Altitude	Land over 2400m altitude. (Based on SRTM30)
	Extreme Inundation	Land permanently or near permanently inundated extending over more 80% of the area of that land. (Based on PNGRIS2008)
	Extreme Karst	Land with polygonal karst landform.
	Extreme Slope	Land with over 30 degree dominant slope. (Based on SRTM30)
	Mangrove	Land covered by mangroves. (Extracted form ForestBaseMap2012)
	Protected Area	Wildlife Management Area, etc. (From CEPA)
	Serious Inundation	*50-80% permanent or near permanent inundation. (Based on PNGRIS2008). AAC calculation ignores the Serious Innundation.*
	Serious SlopeRelief	*Land with dominant slope of 20-30 degrees and sub-dominant slope over 30 degrees and with high to very high relief. AAC calculation ignores the Serious SlopeRelief.*
Plantation	Forest Plantation	(Extracted form ForestBaseMap2012)
Grassland	FCA (Forest Clearance Boundary)	FCA boundary has not been prepared.

Vegetation Type and Forest Classification

- Forest Base Map 2012

Vegetation Code (New Map)		Description	Classification
1	P	Low altitude forest on plains and fans - below 1000 m	Forest
2	H	Low altitude forest on uplands - below 1000 m	Forest
3	L	Lower montane forest - above 1000 m	Forest
4	Mo	Montane forest - above 3000 m	Forest
5	B	Littoral forest	Forest
6	D	Dry seasonal forest	Forest
7	Fri	Seral forest	Forest
8	Fsw	Swamp forest	Forest
9	M	Mangrove	Protection
10	W	Woodland	Forest
11	Sa	Savanna	Forest
12	Sc	Scrub	Forest
13	G	Grassland and herbland	Grassland
14	Ga	Alpine grassland - above 3200 m	Grassland
15	Gi	Subalpine grassland - above 2500 m	Grassland
16	O	Cropland/Agriculture land	Other Area
17	Qa	Plantation other than forest plantation	Other Area
18	Qf	Forest plantation	Forest Plantation
19	Z	Bare area	Other Area
20	U	Larger urban centre	Other Area
21	E	Waterbody	Other Area
22	Es	Sea	Other Area

- FMU (OLD Vegetation Map stored in FIMS)

Vegetation Code (Old Map)		Description	Classification
1	Pl	Large to medium crowned forest	Forest
2	Po	Open forest	Forest

Vegetation Code (Old Map)		Description	Classification
3	Ps	Small crowned forest	Forest
4	Hl	Large crowned forest	Forest
5	Hm	Medium crowned forest	Forest
6	HmAr	Medium crowned forest with Araucaria common	Forest
7	Hmd	Medium crowned depauperate/damaged forest	Forest
8	Hme	Medium crowned forest with an even canopy	Forest
9	Hs	Small crowned forest	Forest
10	Hse	Small crowned forest with an even canopy	Forest
11	HsAv	Small crowned forest with Araucaria common	Forest
12	HsCa	Small crowned forest with Castanopsis	Forest
13	HsCp	Small crowned forest with Casuarina papuana	Forest
14	HsN	Small crowned forest with Nothofagus	Forest
15	HsRt	Small crowned forest with Rhus taitensi	Forest
16	L	Small crowned forest	Forest
17	LAr	Small crowned forest with Araucaria common	Forest
18	LN	Small crowned forest with Nothofagus	Forest
19	Lc	Small crowned forest with conifers	Forest
20	Ls	Very small crowned fores	Forest
21	LsCp	Very small crowned forest with Casuarina papuana	Forest
22	LsN	Very small crowned forest with Nothofagus	Forest
23	Mo	Very sma!! crowned forest	Forest
24	D	Dry evergreen forest	Forest
25	B	Mixed forest	Forest
26	Bce	Foresl wilh Casuarina equiselifolia	Forest

Vegetation Code (Old Map)		Description	Classification
27	BMl	Foresl wilh Melaleuca leucadendron	Forest
28	Fri	Riverine mixed successions	Forest
29	FriCg	Reverine successions with Casuarina grandis	Forest
30	FriK	Riverine successions with Eucalyptus deglupta	Forest
31	Fritb	Riverine successions with Terminalia brassii	Forest
32	Fv	Volcanic successions	Forest
33	Fsw	Mixed swamp forest	Forest
34	FswC	Swamp forest with Campnosperma	Forest
35	FswMl	Swamp forest with Melaleuca leucadendron	Forest
36	FswTb	Swamp foresl with Terminalia brassii	Forest
37	W	Woodland	Forest
38	Wri	Riverine successions dominated by woodland	Forest
39	WriCg	Riverine successions with Casuarina grandis woodland	Forest
40	Wv	Volcanic successions dominated by woodland	Forest
41	Wsw	Swamp woodland	Forest
42	WswMl	Swamp woodland with Melaleuca leucadendron	Forest
43	Sa	Savanna	Forest
44	Saf	Savanna with galley forest	Forest
45	SaMl	Savanna with Melaleuca leucadendron	Forest
46	Sc	Scrub	Forest
47	ScBc	Scrub with Bambusa and Cyathea	Forest
48	Scv	Volcanic successions dominated by scrub	Forest
49	G	Grassland	Grassland
50	Ga	Alpine grassland	Grassland

Vegetation Code (Old Map)		Description	Classification
51	Gi	Subalpine grassland	Grassland
52	Gf	Grassland with some forest	Grassland
53	Gr	Grassland reverting to forest	Grassland
54	Grf	Grassland reverting to forest with some forest	Grassland
55	Gsw	Swamp grassland	Grassland
56	Gri	Riverine successions dominated by grass	Grassland
57	Gv	Volcanic successions dominated by grass	Grassland
58	Hsw	Herbaceous swamp	Grassland
59	M	Mangrove	Protection
60	O	PNGRIS agricultural land use intensity classes 0-4	Other Area
61	E	Lakes and large rivers	Other Area
62	Z	Bare areas	Other Area
63	U	Larger urban centres	Other Area

Appendix 2

Appendix 2: Forest Classification of PNG

Provinces	Total Land Area (ha) (a) ((b)+(h)+(i))		Gross Forest area (ha) (b) ((c)+(d)+(e)+(f)+(g))	Production Forest*1 (ha) (c)										Potential Production Forest*2 (ha) (d)			Reserve Forest*3 (ha) (e)			Protection Forest*4 (ha) (f)		Forest Plantations (ha) (g)	Grassland (afforestation potential) (ha) (h)	Other Areas (ha) (i)
					FMA		TRP		LFA		TA - 01														
					Un-logged area	Logged-over area	Un-logged area	Logged-over area	Un-logged area	Logged-over area	Un-logged area	Logged-over area			Un-logged area	Logged-over area		Un-logged area	Logged-over area		Mangrove				
Western	*5	9,819,987	5,927,342	*1,221,000*										*1,735,488*			*265,104*			*2,705,750*			*1,014,055*	*3,892,645*
Gulf		*3,471,860*	3,095,690	*2,238,137*										*230,386*			*0*			*627,167*			*72,990*	*303,180*
Central		*2,975,504*	2,212,554	*360,432*										*434,763*			*757,657*			*659,702*			*272,554*	*490,396*
Milne Bay		*1,416,665*	1,011,139	*113,720*										*125,351*			*557,179*			*214,889*			*122,689*	*282,837*
Oro		*2,263,371*	1,670,623	*221,000*										*503,191*			*208,337*			*738,095*			*154,898*	*437,850*
SHP		*2,560,344*	1,997,252	*98,750*										*334,444*			*70,735*			*1,493,323*			*112,339*	*450,753*
Enga		*1,173,438*	781,656	*0*										*82,856*			*0*			*698,800*			*69,833*	*321,949*
WHP		*913,520*	481,176	*0*										*54,708*			*119,602*			*306,866*			*35,715*	*396,629*
Simbu		*613,341*	424,638	*0*										*59,474*			*107,599*			*257,565*			*37,112*	*151,591*
EHP		*1,114,676*	674,042	*0*										*40,000*			*19,256*			*614,786*			*194,994*	*245,640*
Morobe		*3,368,621*	2,444,932	*195,941*										*347,891*			*771,185*			*1,129,915*			*324,928*	*598,761*
Madang		*2,890,325*	2,020,680	*384,986*										*129,342*			*479,194*			*1,027,164*			*172,842*	*696,803*
East Sepik		*4,368,599*	2,475,341	*521,500*										*116,529*			*0*			*1,837,312*			*615,703*	*1,277,555*
Sandaun		*3,592,766*	3,240,601	*1,055,627*										*993,650*			*437,970*			*753,354*			*110,684*	*241,481*
Manus		*193,076*	178,420	*32,667*										*42,035*			*82,131*			*21,587*			*5,789*	*8,867*
New Ireland		*939,696*	795,080	*209,115*										*155,767*			*246,591*			*183,607*			*24,986*	*119,630*
ENB		*1,529,425*	1,278,398	*215,689*										*210,314*			*341,444*			*510,951*			*17,545*	*233,482*
WNB		*2,034,000*	1,679,527	*657,799*										*0*			*366,448*			*655,280*			*32,075*	*322,398*
AGB		*946,255*	782,559	*46,720*										*0*			*634,923*			*100,916*			*41,282*	*122414*
Total	*5	***46,185,469***	*6	**33,171,650**	***7,573,077***									***5,596,189***			***5,465,355***			***14,537,029***			***3,433,013***	***10,594,861***

Source: Original table and figures are prepared for NFB on 19th Nov. 2015 based on FIMS Database

***1: Area already acquired for FMA, TRP, LFA and TA**

***2: Area under acquisition and allocation process for FMA or TRP**

***3: Area not yet classified**

***4: Area under WMA, extreme constraints and Mangrove**

***5: Cause of calculation inconsistency to be found out**

***6: Gross Forest Area in this table includes Woodland, Scrub and Savanna in Forest BaseMap 2012**

Figures in italic indicates original values copied from the draft prepared for NFB on 19th Nov. 2015

Appendix2

Item			Description	Calculation Order
a	Total Land Area		The total area of Forest Base Map other than "Sea (code = Es)" by province. (b)+(h)+(i)	1
b	Gross Forest area		(c)+(d)+(e)+(g)	9
c	Production Forest		The forest area in the operational Concession Areas with FMA, TRP, LFA and TA-01 other than the area overlapping with Protection Forest and Grassland.	6
	Total	Un-logged area	The total forest area in the operational concession areas that have not been harvested.	
		Logged-over area	The total forest area in the Logged Over Areas in operational concession areas. Logged-over area includes two GIS layers. (1) 'Logged_NotLandUse', which are areas logged and left to regenerate. (2) 'Logged_LandUse', which are areas logged and subsequently converted to other forms of non-forest forms of land use. Re-growth does not happen in 'Logged_LandUse'.	
	FMA	Un-logged area	The total forest area in the operational FMAs not covered by Logged Over Area.	
		Logged-over area	The total forest area in operational FMAs overlapping with Logged Over Area.	
	TRP	Un-logged area	The total forest area in the operational TRPs not covered by Logged Over Area.	
		Logged-over area	The total forest area in the operational TRPs overlapping with Logged Over Area.	
	LFA	Un-logged area	The total forest area in the operational LFAs not covered by Logged Over Area.	
		Logged-over area	The total forest area in the operational LFAs overlapping with Logged Over Area.	
	TA01	Logged-over area	No data for now. Field Services has coordinates information of the center of each TA-01 on the map. It can be available to estimate forest area.	

Item			Description	Calculation Order
d	Potential Production Forest		The forest area in Proposed Concession Areas other than the area overlapping with Protection Forest and Grassland. Proposed Concession for AAC calculation means PFD (Potential Forest Development) and Proposed PFD listed in Provincial Forest Plans. This calculation excludes the concession data having the attributes which are 'Status=proposed' ,and 'Remarks= tentative' or " Remarks = cancellation".	7
		Un-logged area	The total forest area in the proposed concession areas not covered by Logged Over Area	
		Logged-over area	The total forest area in the proposed concession areas overlapping with Logged Over Area	
e	Reserve Forest		The forest area in the expired concession areas, and the forest area that has never been designated and planned as concession area.	8
		Un-logged area	The total forest area in the reserved forest not covered by Logged Over Area	
		Logged-over area	The total forest area in the reserved forest overlapping with Logged Over Area. This calculation regards whole area of expired concession as Logged-Over Area. Because it is too difficult to search for old maps recording logging history of expired concession, especially TRP.	
f	Protection Forest		Includes "Extreme Slope (> 30 degree)", "Extreme Altitude (> 2,400m)", "Extreme Karst", "Extreme Inundation (over more 80% permanent)", "Mangrove" of Forest Base Map, and "Protected Area". *Protection Forest excludes "Serious Inundation (50-80% permanent)" and "Serious Slope (20-30 degree)".*	2→**4**
		Mangrove	Pick out the area of Mangrove (Code = M) included in Forest Base Map	
g	Forest Plantation		Pick out the area of Forest Plantation (Code = Qf) included in Forest Base Map	3→**5**

	Item	Description	Calculation Order
h	Grassland (afforestation potential)	The area of Grassland other than the area overlapping with Protection Area. The area of FCA (Forest Clearance Boundary) other than the area overlapping with Protection and Grassland.	4→**2**
i	Other Areas	Pick out the area of Other area other than the area overlapping with Protection Area (Code = O, Qa, Z, U and E)	5→**3**

Appendix5a_1

Calculation Example 1 Net Production Area = Production Forest

Appendix 5a_1: Annual Allowable Cut for PNG in NFP 2015 – 2020

Province	Net Production Area (ha) (c)	Logged Over Area in Net Production Area (ha) (k)	Un-logged Area in Net Production Area (ha) (l) ((c)-(k))	Rerowth Volume in Logged Over Area (m³) (m)	Volume in Un-logged Area (m³) (n)*1	Gross Merchantable Volume (m³) (o) ((m)+(n))	AAC (m^3) (p) ((o)/ 35)	Permitted Cut Under Projects (2013) (q)	Balance AAC (2013) (r) ((p)-(q))	Projected AAC 2015-2019 (000 m^3)				
										2015	2016	2017	2018	2019
Western	1,221,000					0		*826,000*	*817,793*	*736*	*736*	*736*	*736*	*736*
Gulf	2,238,137					0		*1,186,000*	*-348,997*	*1,046*	*1,046*	*1,046*	*1,046*	*1,046*
Central	360,432					0		*270,000*	*583,194*	*343*	*343*	*343*	*343*	*331*
Milne Bay	113,720					0		*58,000*	*228,773*	*109*	*109*	*109*	*109*	*109*
Oro	221,000					0		*288,000*	*422,728*	*153*	*153*	*153*	*153*	*153*
Morobe	195,941					0		*185,000*	*925,885*	*241*	*241*	*241*	*241*	*141*
Madang	384,980					0		*568,000*	*178,338*	*418*	*288*	*288*	*138*	*138*
East Sepik	521,500					0		*397,000*	*428,252*	*150*	*150*	*150*	*150*	*150*
Sandaun	1,055,627					0		*907,200*	*226,154*	*554*	*554*	*554*	*554*	*554*
Manus	32,667					0		*212,000*	*-177,880*	*146*	*146*	*132*	*132*	*132*
New Ireland	209,115					0		*180,000*	*-46,985*	*180*	*180*	*180*	*60*	*60*
E.NB	215,689					0		*562,500*	*-243,788*	*380*	*380*	*380*	*380*	*380*
WNB	657,799					0		*2,538,700*	*-2,307,765*	*2,434*	*1,704*	*1,549*	*1,549*	*1,549*
AGB	46,720					0		*0*	*254,716*	*0*	*0*	*0*	*0*	*0*
SHP	98,750					0		*80,000*	*924,292*	*80*	*80*	*80*	*80*	*80*
EHP	0					0		*0*	*385,002*	*0*	*0*	*0*	*0*	*0*
Simbu	0					0		*0*	*213,179*	*0*	*0*	*0*	*0*	*0*
WHP	0					0		*0*	*266,584*	*0*	*0*	*0*	*0*	*0*
Enga	0					0		*0*	*508,097*	*0*	*0*	*0*	*0*	*0*
Total	**7,573,077**	**0**	**0**	**0**	**0**	**0**		***8,258,400***		***6,970***	***6,110***	***5,941***	***5,671***	***5,559***

Source: Original table and figures are prepared for NFB on 19th Nov. 2015 based on FIMS Database

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

Figures in italic indicates original values copied from the draft prepared for NFB on 19th Nov. 2015

Appendix5a_1 Net Production Area = Production Forest (c)

Item		Description
c	Net Production Area	Net Production Area = Production Forest
k	Logged Over Area in Net Production Area	Logged over area in Production Forest
l	Un-logged Area in Net Production Area	(c)-(k) (As same as Un-logged area of (c))
m	Regrowth Volume in Logged Over Area	[Production Forest (c)] The volume of Logged Over Areas (of 'Logged_NotLandUse' layer) in the operational Concession Areas is calculated. The target Concession types are FMA and TRP except for LFA. Regrowth does not happen in LFA. (Option 1)The volume of the Logged Over Area with harvested year will recover over the 35 years linearly based on the harvested year per each polygon data of the logged over area. (Option 2) If Logged Over Areas in the operational concession area have no harvested year, the sum total area of the Logged Over Areas will be divided equally by elapsed years from the purchased year. The area divided will recover over the next 35 years linearly. The elapsed years increase up to 35. As of August 2017, Option2 is adopted because of no harvesting year in Logged Over Area.
n	Volume in Un-Logged Area	The formula is as below. Volume per unit area of each vegetation type * area of each vegetation type inside Un-Logged Area.
o	Gross Merchantable Volume	(m) + (n)
p	AAC (m^3)	(o) / 35
q	Permitted Cut Under Projects (Year)	Permit Cut Volume that is managed by Project Branch will be entered. The year shown in the table will be designated by the editor of the Appendix 5a.
r	Balance AAC (Year)	(p) – (q) The year shown in the table will be designated by the editor of the Appendix 5a.

Item		Description
	Projected AAC	Projected AAC Volume will be entered by the editor of the Appendix 5a. The years shown in the table will be according to the planning year of the title.

Calculation Example 2 **Net Production Area = Production Forest + Potential Production Forest + Reserve Forest**

Appendix 5a_2: Annual Allowable Cut for PNG in NFP 2015 – 2020

Province	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))	Rerowth Volume in Logged Over Area (㎥) (m)	Volume in Un-logged Area (m^3) (n)*1	Gross Merchantable Volume (㎥) (o) ((m)+(n))	AAC (m^3) (p) ((o)/ 35)	Permitted Cut Under Projects (2013) (q)	Balance AAC (2013) (r) ((p)-(q))	Projected AAC 2015-2019 (000 m^3)				
										2015	2016	2017	2018	2019
Western	3,221,592					0		*826,000*	*817,793*	*736*	*736*	*736*	*736*	*736*
Gulf	2,468,523					0		*1,186,000*	*-348,997*	*1,046*	*1,046*	*1,046*	*1,046*	*1,046*
Central	1,552,852					0		*270,000*	*583,194*	*343*	*343*	*343*	*343*	*331*
Milne Bay	796,250					0		*58,000*	*228,773*	*109*	*109*	*109*	*109*	*109*
Oro	932,528					0		*288,000*	*422,728*	*153*	*153*	*153*	*153*	*153*
Morobe	1,315,017					0		*185,000*	*925,885*	*241*	*241*	*241*	*241*	*141*
Madang	993,516					0		*568,000*	*178,338*	*418*	*288*	*288*	*138*	*138*
East Sepik	638,029					0		*397,000*	*428,252*	*150*	*150*	*150*	*150*	*150*
Sandaun	2,487,247					0		*907,200*	*226,154*	*554*	*554*	*554*	*554*	*554*
Manus	156,833					0		*212,000*	*-177,880*	*146*	*146*	*132*	*132*	*132*
New Ireland	611,473					0		*180,000*	*-46,985*	*180*	*180*	*180*	*60*	*60*
E.NB	767,447					0		*562,500*	*-243,788*	*380*	*380*	*380*	*380*	*380*
WNB	1,024,247					0		*2,538,700*	*-2,307,765*	*2,434*	*1,704*	*1,549*	*1,549*	*1,549*
AGB	681,643					0		*0*	*254,716*	*0*	*0*	*0*	*0*	*0*
SHP	503,929					0		*80,000*	*924,292*	*80*	*80*	*80*	*80*	*80*
EHP	59,256					0		*0*	*385,002*	*0*	*0*	*0*	*0*	*0*
Simbu	167,073					0		*0*	*213,179*	*0*	*0*	*0*	*0*	*0*
WHP	174,310					0		*0*	*266,584*	*0*	*0*	*0*	*0*	*0*
Enga	82,856					0		*0*	*508,097*	*0*	*0*	*0*	*0*	*0*
Total	**18,634,621**	**0**	**0**	**0**	**0**	**0**	**0**	***8,258,400***		***6,970***	***6,110***	***5,941***	***5,671***	***5,559***

Source: Original table and figures are prepared for NFB on 19th Nov. 2015 based on FIMS Database

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

Figures in italic indicates original values copied from the draft prepared for NFB on 19th Nov. 2015

Improving Calculation on Annual Allowable Cut Volume 17 August 2017
Appendix5a_2 Net Production Area = Production Forest (c) + Potential Production Forest (d) + Reserve Forest (e)

Item		Description
j	Net Production Area	Net Production Area = Production Forest (c)+Potential Production Forest (d)+Reserved Forest (e)
k	Logged Over Area in Net Production Area	Logged over Area of (c) + Logged over area of (d) + Logged over area of (e)
l	Un-logged Area in Net Production Area	(j)-(k) (as same as Un-logged are of (c) + Un-logged area of (d) + Un-logged area of (e))
m	Regrowth Volume in Logged Over Area	[Production Forest (c)] As same formula as Appendix5a_1 [Potential Production Forest (d)] Regrowth is not taken into consideration for now. There are no harvested year information for Logged Over Area in Proposed Concession. After Logged Over Area will be created according to new data specification, Regrowth volume can be calculated. [Reserve Forest (e)] This calculation regards whole area of expired concession as Logged-Over Area. Constant logging rate is adopted during the contract of TRP. **(see the following figures and formulas)**
n	Volume in Un-Logged Area	The formula is as below. Volume per unit area of each vegetation type * area of each vegetation type inside Un-Logged Area. The Un-Logged Areas are in Production Forest (c), Potential Production Forest (d) and Reserve Forest (e).
o	Gross Merchantable Volume	(m) + (n)
p	AAC (m^3)	(o) / 35
q	Permitted Cut Under Projects (Year)	Permit Cut Volume that is managed by Project Branch will be entered. The year shown in the table will be designated by the editor of the Appendix 5a.
r	Balance AAC (Year)	(p) – (q) The year shown in the table will be designated by the editor of the Appendix 5a.
	Projected AAC	Projected AAC Volume will be entered by the editor of the Appendix 5a. The years shown in the table will be according to the planning year of the title.

Improving Calculation on Annual Allowable Cut Volume 17 August 2017

Example of Re-growth calculation. The volume of the logged-over area will recover over the next 35 years linearly.

Example: Logging started in 2000 over the next 35 years

2000	2001	2002	2003	2004	2005	2006
2007	2008	2009	2010	2011	2012	2013
2014	2015	2016	2017	2018	2019	2020
2021	2022	2023	2024	2025	2026	2027
2028	2029	2030	2031	2032	2033	2034

Recovery ratio as of 2001 (2nd Year).

3%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%

Recovery ratio as of 2002 (3rd Year).

6%	3%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%

Recovery ratio as of 2034 (35th Year).

97%	94%	91%	89%	86%	83%	80%
77%	74%	71%	69%	66%	63%	60%
57%	54%	51%	49%	46%	43%	40%
37%	34%	31%	29%	26%	23%	20%
17%	14%	11%	9%	6%	3%	0%

Recovery ratio as of 2035 (36th Year).

100%	97%	94%	91%	89%	86%	83%
80%	77%	74%	71%	69%	66%	63%
60%	57%	54%	51%	49%	46%	43%
40%	37%	34%	31%	29%	26%	23%
20%	17%	14%	11%	9%	6%	3%

Recovery ratio as of 2036 (37th Year).

100%	100%	97%	94%	91%	89%	86%
83%	80%	77%	74%	71%	69%	66%
63%	60%	57%	54%	51%	49%	46%
43%	40%	37%	34%	31%	29%	26%
23%	20%	17%	14%	11%	9%	6%

Improving Calculation on Annual Allowable Cut Volume 17 August 2017

Recovery ratio as of 2068 (69th Year).

100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	97%

Recovery ratio as of 2069 (70th Year).

100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%
100%	100%	100%	100%	100%	100%	100%

Calculating Formula of Regrowth Volume for 2034 ('V' = Forest Volume in the concession area before logging operation starts)

(V×1/35×97/100)+(V×1/35×94/100)+(V×1/35×91/100)+・・・+(V×1/35×3/100)+(V×1/35×0/100)

Calculating Formula of Regrowth Volume for 2035

(V×1/35×100/100)+(V×1/35×97/100)+(V×1/35×94/100)+・・・+(V×1/35×6/100)+(V×1/35×3/100)

Calculating Formula of Regrowth Volume for 2036

(V×1/35×100/100)+(V×1/35×100/100)+(V×1/35×97/100)+・・・+(V×1/35×9/100)+(V×1/35×6/100)

Calculating Formula of Regrowth Volume for 2068

(V×1/35×100/100)+(V×1/35×100/100)+(V×1/35×100/100)+・・・+(V×1/35×100/100)+(V×1/35×97/100)

Forest volume recovery starts after each harvest year.

Annex 29

Examination of the Usage of Drones as a Forest Monitoring Tool

Possible application of drone in PNGFA

Draft suggestion for introducing drone in PNGFA

Possible Application of Drone in PNGFA

29th June 2018

Mr. Charles Pakure

Co-writers:
Mr. Constin Bigol, Mr. Francis Vilamur, Mr. Charles Pakure, Mr. Lyall Umbo, Mr. Andrew Aopo, Mr. Gewa Gamoga, Mr. John Orabi, Mr. Beno Ningisere, Mr. Aino Manidu, Mr. Perry Malan, Mr. Patrick Laa, Mr. Jehu Antiko, Ms. Elizabeth Kaidong, Ms. Everlyn Paul

1st day: Field trip

- Demonstration of drone flight at Kuriva plantation /Compartment4 & Picnic area

Two day's workshop

Objectives
- Obtaining knowledge of drone technology
- Considering application to PNGFA's operations

Date
- 18th and 19th June 2018

Participants
- 18/June: 14 officers
- 19/June: 11 officers

This workshop was enforced as part of drone training of PNGFA/JICA project.
5 trainees of drone training are included in participants each day.

Outcomes: Drone specialty

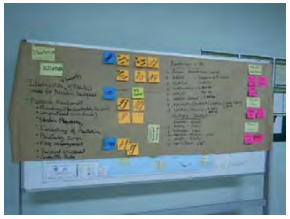
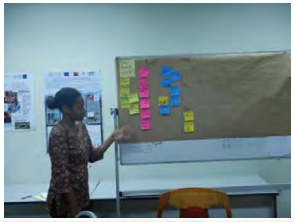
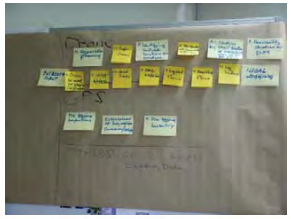
- **Functions**
  - Taking photos
  - Shooting videos
  - Making ortho maps using software
- **Specifications (Model: DJI Phantom4 pro)**
  - Flight time: 20min/battery
  - Capturable area (automated flight): ±10ha/battery
  - Effective transmission distance: 500m (for safety)
- **PROs and CONs**

PROs		CONs	
Timing	: Whenever we can get updated info.	**Cost**	: High cost is required than GPS.
Accuracy	: High-resolution info is available.	**Weather**	: We cannot use in windy/rainy.
Remote	: We can observe inaccessible areas.	**Expertise**	: Specialized skill is needed than GPS.

2nd day: Group discussion

- Drawing up proposal toward introducing drone in PNGFA



Outcomes: Application to **plantations**

Main objective:
Strengthening capacity of plantation management contributing to increase timber production and economic growth in PNG.

Applicable/Possible activities:

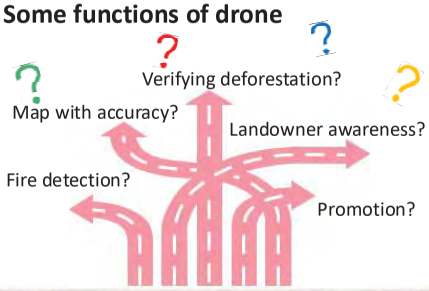
- ✓ Identification & security of potential areas for plantation development
- ✓ Plantation management
  - Roading (Plan, construction, inspection)
  - Compartment (Sub-division)
  - Station planning
  - Buffer zone
  - Fire management
  - Inventory of plantation
  - Survival assessment
  - Rough growth rate estimation

} Verification is needed by forest research

Outcomes: Selection and concentration of scopes

- Drone has potential of multi-applicability for forestry sector using its fundamental functions: taking photos, shooting videos and making maps.
- The application of drone technology is still premature in forestry. Thus, practical application to determine the potential use of drone is needed.
- Selection and concentration of scopes are required to invest effort in accordance with PNGFA's policy priority.

Some functions of drone

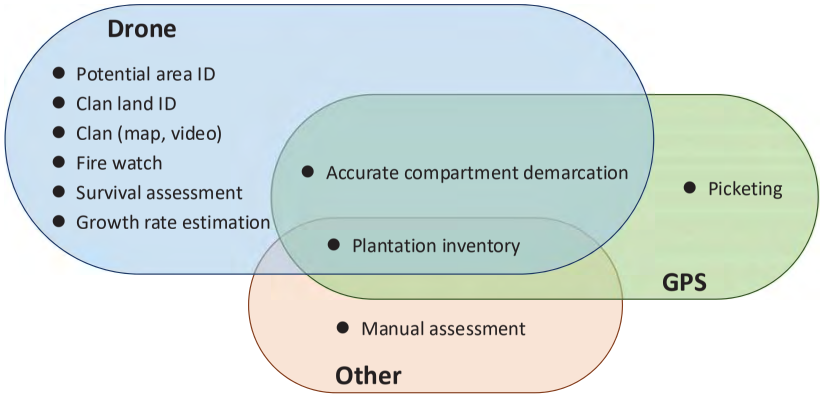


Priorities for drone in PNGFA are:

- ➢ **Plantations**
- ➢ **Natural forest monitoring**
- ➢ **Forest research (inc. NFI)**

Outcomes: Application to **plantation**

Role comparison with other method of monitoring:



Outcomes: Application to **natural forest monitoring**

Main objective:
Improving efficiency and accuracy of forest monitoring in coordination with drone and other existent method in order to fully operationalize practicing LCoP/PMCP.

Applicable/Possible activities:

- ✓ Natural forest monitoring based on LCoP
  - Set up inspection (Log landings, skid tracks, road, buffer zone)
  - Confirmation of exact location of infrastructures as per plan
- ✓ Planning
  - Establishment of Log pond plans, base camp plans
  - Regeneration planning
  - Identifying suitable locations for infrastructures (inc. bridges)
  - Feasibility studies or DOS (Development Option Study)
- ✓ Site detection
  - Identification of degradation sites for rehabilitation
  - Encroachment sites
  - Illegal logging sites

Outcomes: Application to **forest research (inc. NFI)**

Main objective:
Through research oriented activity, clarifying availabilities of drone to enrich and promote Plantation, Natural forest monitoring and NFI.

Applicable/Possible activities:

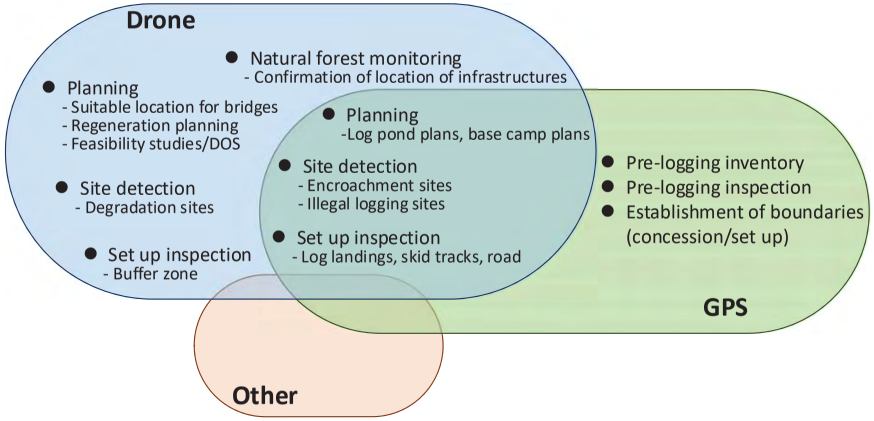
Plantation
- ✓ Health check (Pests/Diseases)
- ✓ Area calculation
- ✓ Volume estimation
- ✓ Survival assessment
- ✓ Growth rate evaluation

Natural forest monitoring
- ✓ Thresholds of re-entry
- ✓ Rate of forest recovery
- ✓ Invasive species/alien
- ✓ Spectral signature of trees/plants species
- ✓ Re-measurement of PSP at logged-over

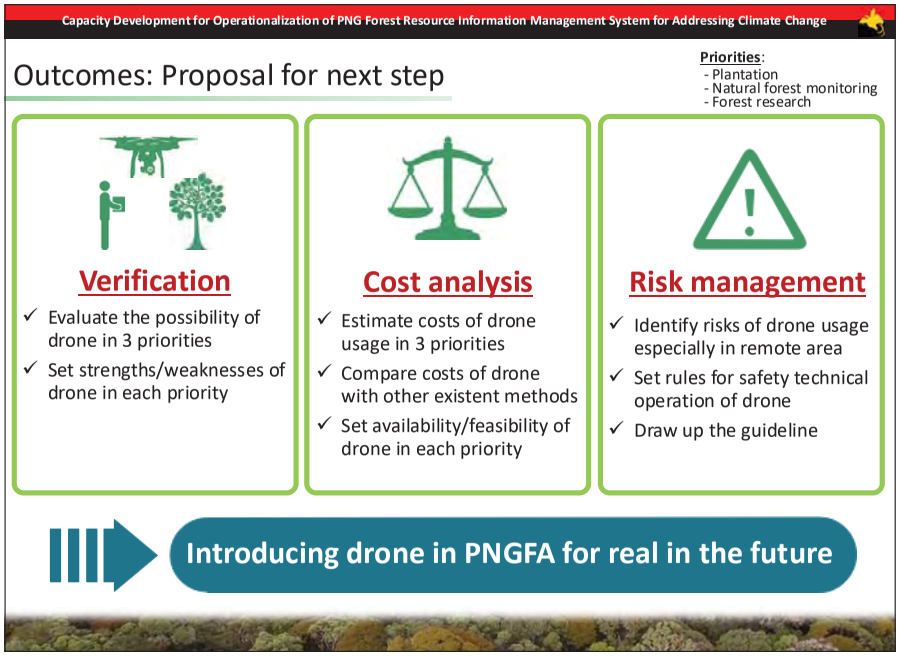
NFI
- ✓ Planning (site, accessibility, village)
- ✓ Verification of vegetation types
- ✓ Measurement of disturbance level
- ✓ Determine crown cover, forest health
- ✓ Species identification

Outcomes: Application to **natural forest monitoring**

Role comparison with other method of monitoring:



Outcomes: Issues



29th June 2018

PNGFA/JICA project

(Draft)

Suggestion for introducing drone in PNGFA

Challenge for Forest Monitoring in PNG

1) Global issue for forest monitoring

Based on political decisions under constitution and forestry act 1991, Papua New Guinea Forest Authority (PNGFA) has intently engaged in its missions required under section6, forestry act 1991. Responsibility for sustainable forest management and steady timber supply are not only for - domestic requirement, but for international accountability or demand.

Furthermore, with the shift in climate change issues such as REDD+ and timber legality, necessity of accurate forest monitoring and management is increasing more and more recently. In light of this situation, PNGFA has to assume principle role to promote improving efficiency and accuracy of its operations.

2) Efficient task management by promotion of streamlining

Regardless of sufficient legislative framework to evaluate sustainability and legality of forest, deficient human resources, logistics and infrastructures limit the satisfied performance of this framework. To handle these constraints, PNGFA has been exploring new technology to contribute to efficient and accurate forest monitoring and management such as remote sensing.

Currently PNGFA has strengthened capacity of forest monitoring and management utilizing GSP, GIS and Forest Resources Information Monitoring System (PNG-FRIMS). Nevertheless, PNGFA should engage both steady operation of these existent techniques and continuous updating of information, because technology of remote sensing is a constantly advancing field.

Current situation and problem of Drone for Forest Monitoring

1) Drone as monitoring tool

In forest monitoring and management, terrain condition, inaccessibility from road, steeply dipping structure, riotous bush and so on, has been a challenge for forestry personnel. To conduct ground survey all target forests are distant, and to get high-resolution satellite images is of a significant cost. With the introduction of drone and is expected as a strong monitoring tool in forestry; to overcome terrain condition of forest and monitor forest resources through aerial photo which is relatively high

efficiency than other existent remote sensing methods. Drone also has potential of multi-applicability for forestry sector using its fundamental functions, taking photos, shooting videos and making ortho maps.

2) Immaturity and contingency
Although there are high expectations for drone, methodology to monitor forest using drone is not yet still consolidated. In addition, because drone is a intricately designed precision mechanical equipment, it is necessary for users of drone to treat with caution to reduce risk of accident. If PNGFA decides introducing drone for actual implementation, it should consider use application (specific objective/task) of drone and accord a certain level of risk.

3) Feasibility study and availability verification of drone
Considering the uncertainty of drone, for PNGFA's operations to monitor forest in a practical level, contributions of drone should be examined multi-directionally such as verification of possibility and cost performance. And risk management should be considered as well for safety.

4) Optimization of monitoring efficiency integrated with existent methods
The full potential of drone is yet to be realized for effective forest monitoring and other existing methods of monitoring should be integrated or utilized collectively in remote sensing technology.

A Key Principle of Introducing Drone in PNGFA

1) Goal
Drone technology is utilized as a part of forest monitoring framework in PNGFA, and accuracy and efficiency of forest monitoring is improved.

2) Selection and concentration
To search effective usage in accordance with PNGFA's policy priority, selection and concentration to invest effort into specific field is needed. With regard to the priority of PNGFA, "Plantation", "Natural forest monitoring" and "National Forest Inventory (NFI)" are made a selection as priorities for drone in PNGFA. Each objectives of priorities are as below;

Plantation:
Strengthening capacity of plantation management contributing to increase timber production and economic growth in PNG.

Natural forest monitoring:
Improving efficiency and accuracy of forest monitoring in coordination with drone and other existent method to fully operationalize practicing LCoP/PMCP.

NFI:
Through research oriented activity, clarifying availabilities of drone can be used to enrich and promote Plantation, Natural forest monitoring and NFL.

3) Verification of possibility
PNGFA should clarify what drone can do for forest monitoring and identify where strengths/weaknesses of drone is than GSP and other monitoring method.
Proposed activities are;
- Evaluate the possibility of drone in priorities
- Set strengths/weaknesses of drone comparing with other existent methods in each priority

4) Cost analysis
PNGFA should consider cost performance of drone to evaluate whether drone is more attractive than other existent methods or not.
Proposed activities are;
- Estimate costs of drone usage in forest monitoring in priorities
- Compare costs of drone with other existent methods
- Set availability/feasibility of drone in each priority

5) Risk management
PNGFA should reduce the accident when officers use drone regarding logging concessions that are in extremely remote area.
Proposed activities are;
- Identify risks of drone usage especially in remote area
- Set rules for safety technical operation of drone
- Draw up the guideline

Annex 30

Practical Utilization of Drones for Forest Monitoring

Practical utilization of drone based on example at Amanab in West Sepic

Participants: Kallan Ramute, Steven Saki (Sundaun Provincial Office), Jehu Antiko (Headquater), Margaret Tongo, Hirokazu Takahashi (KKC, JICA project)
20th to 24th May 2019, at Amanab 1-4

1. Utilization of drone image

After the training of drone usage in HQ and Kupiano, it is expected to clarify the purpose of drone utilization for forest monitoring in PNGFA. This report is aiming to show some examples of drone utilization in field monitoring.

2. Drone image capturing flow

Drone image capturing operation is conducted by “GSpro” which is automated fight plan application for iPad. It is possible to upload kml file or shape file to “GSpro”, so we can prepare the flight plan before field monitoring. When you captured drone images, it is good to organize your data the same day with your fresh memories. Then you start processing with Pix4D to get ortho image. This process takes a few hours, so you can leave processing overnight. Once you get ortho image of your set-up site, it is easily to calculate distance, or area with your GIS.

3. Utilization of tablet or smart phone with GIS data

When exact set-up location is needed, tablet or smart phone application shall be powerful tool with GIS data. Currently some of officer use “Locus map”. This is the useful application for Android and iOS (iPhone). If it is possible to get maps data from logging company, this app works very well. But in case that it is difficult to get them, let me show “Avenza map” here, which can use photomap made by satellite image (drone image, too) is really useful map for forest monitoring.

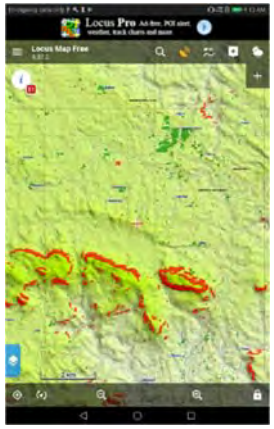


Figure 2 Locus map (Free version)

Figure 1 Avenza map (Free version)

GIS map data should be converted to geotiff (or geoPDF) for Avenza map. We can make Geotiff file with QGIS or ArcGIS. It is needed to determine where you will go for field survey. This geotiff shall be download from your Google drive or SD card (or just connect to computer directly) to use at Avenza map.

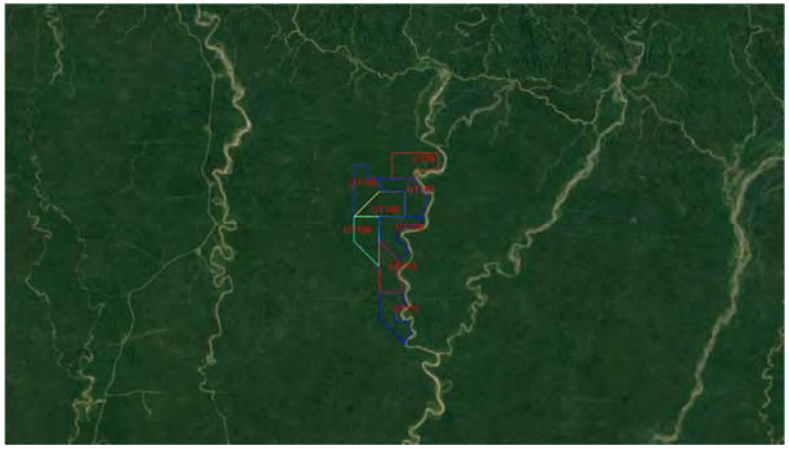


Figure 3 Geotiff data image used at this forest monitoring.

4. Pre-logging

Pre-logging image is not only useful for grasping current situation for inspection, but also for logging company. You can discuss about logging plan with logging company.

Figure 4 Pre-logging MU83 (2018-19) ortho image, captured by Mr. Kallan Ramute.

5. Active-logging

Active-logging site is suitable for drone image analysis, because we can grasp situation of the ongoing logging such as width of logging road or situation of gaps and skid trail with ortho image and GIS software. This information is not only helpful for inspection, but also improve our communication with logging company. This information leads us better selective logging management in near future.

Figure 5 Active-logging UT110 (2018-19) ortho image, captured by Mr. Kallan Ramute.

6. Post-logging

At post-logging site, drone image is better tool to check regeneration of log pond, skid trail, gap and so on. But when it is needed to know the situation of skid trail and gap, it is better to capture images as soon as logging is over.

Figure 6 Post-logging UT98 (2018-19) ortho image, 7 months after logging, captured by Mr. Steven Saki.

7. Time series images of set-up

Comparison of drone images captured at different periods is valuable information for grasping logging site. For example, comparison of post-logging (Figure **6**) and active-logging (Figure **7**) will tell us regeneration situation of the post-logging.

Figure 7 UT98 (2018-19) ortho image at different period. The image Above is taken in Oct 2018. And Figure 3 is taken in May 2019.

8. After-logging site

After-logging site image show progress of regeneration. The images below (Figure **8**: 5 years after logging, Figure **9**: 10 years after logging) show regeneration is in progress. The Side space of logging road or felling gaps made by logging is almost closed. It is already difficult to distinguish skid trail.

Figure 8 After logging WA54 ortho image, 5 years after logging (2013-2014), captured by Mr. Kallan Ramute.

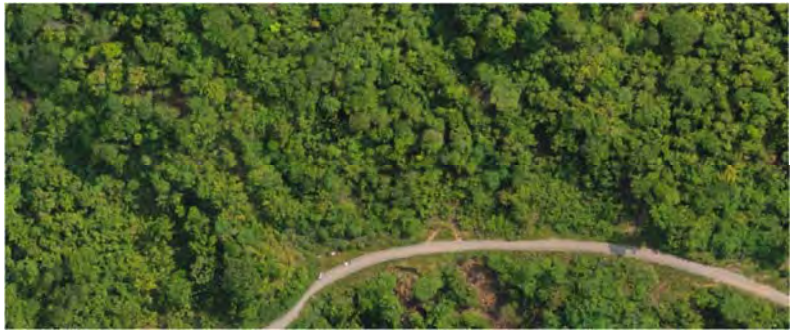


Figure 9 After logging site FF03 ortho image, 10 years after logging(2009-2010), captured by Mr. Steven Saki.

9. Palm oil Plantation

Drone image is not only useful for selective logging monitoring, but also for plantation monitoring. Oil palm plantation compartment has dense road network

and palm tree is not such high as natural forest, so you can easily fly drone for capturing images. Also you can set flight plan at the field using location information of drone. Once let drone fly over your AOI (area of interest like plantation site), then tap iPad, you can easily make flight area. It can work if you shoot photo where is like Palm oil plantation or clearance site with clear view of boundary. Once you made ortho image of plantation, you can grasp the growth situation. This information can be utilized when you discuss with plantation company.

Figure 10 Palm oil plantation ortho image, at WSP, captured by Mr. Jehu Antiko.

Annex 31

Simulation on Land Use Change Using Land Change Modeler

Examine Utilization of PNG-FRIMS for Provincial Forest Plan (PFP):

Simulation of Deforestation and Forest Degradation Using Land Change Modeler

To examine the possibility of using Land Change Modeler (Clark Labs, Clark University) as a forest management and planning tool, the short-term expert team studied a land use change simulation using it.

(a) Simulation of Deforestation and Forest Degradation – Simulation of the Effects of the Enlargement of a Plantation and Agricultural Field

Land Change Modeler enables the estimation of the drivers of deforestation through the comparison of land use at two points in time and enables the simulation of a case in which deforestation continues at the current pace (a 'business-as-usual' (BAU) case). In this section, the flow of the simulation on the effects of the enlargement of plantations and agricultural fields around Kimbe, West New Britain Province, is described.

An area (of approx. 4,870 km^2) in the pilot province of West New Britain, where the developments of plantations along with population growth have been causing rapid deforestation, was used in the simulation. A 2011 Forest Base Map and a 2014 Forest Cover Map, which were created by comparing the forest base map with a LANDSAT Greenest Pixel and a corrected base map of the changes detected in the comparison, were used as the land use maps of two points in time (Figure 1).

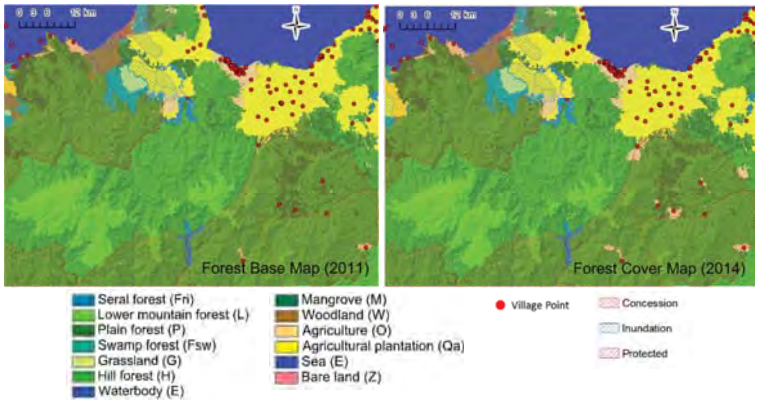


Figure 1 Forest Maps of Two Points in Time Used in the Land Change Modeler Simulation

In the beginning, the 2011 and 2014 maps were compared to elucidate what types of land use increased and what types of land use decreased between 2011 and 2014 (Figure 2). The comparison revealed that the

areas of agricultural plantations (Qa) and subsistence farmland (O) had increased and the areas of lowland forest (P), hill forest (H), wetland forest (Fsw), open woodland (W) and grassland (G) had decreased between 2011 and 2014. Therefore, the development of agricultural plantations and subsistence farmland was selected as the driver of deforestation and their distribution in the future (in the year 2030) was estimated. The elevation (SRTM, resolution of 30 m), slope, distance from the sea, population density (kernel analysis), the boundaries of reserves, wetland and active concession areas, and the 2011 land use boundaries, were used as the model parameters.

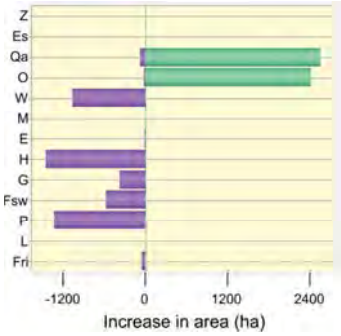


Figure 2 Changes in Land Use between Two Points in Time

The accuracy of the model of agricultural plantations was estimated at 80.83%. Because this figure is larger than the threshold of 80% for sufficient accuracy, this model is considered a valid model (Table 1). The boundaries of the inundation area are the parameters that have the largest influence on the accuracy of the model, followed by, in descending order, the following: the land use boundaries for 2011 (base map), protected area boundaries, active concession boundaries, elevation (SRTM, resolution of 30 m), distance from the sea, population density and slope.

Table 1 Influence Each Parameter Has on the Accuracy of the Model of Agricultural Plantations

Model	Accuracy (%)	Skill measure	Influence order
With all variables	**80.83**	**0.787**	N/A
Without SRTM_30 m	69.44	0.6605	5
Without slope	78.38	0.7598	8 (Least influential)
Without distance from sea	69.69	0.6632	6
Without population density	75.02	0.7224	7
Without protected area	46.72	0.408	3
Without inundation area	40.69	0.341	1 (Most influential)
Without concession area	65.03	0.6115	4
Without base map	43.97	0.3775	2

The accuracy of the model of subsistence farmland was estimated at 81.73%. Because this figure is larger than the threshold of 80% for sufficient accuracy, this model is considered a valid model (Table 2). The boundaries of the inundation area are the parameters that have the largest influence on the accuracy of the model, followed by, in descending order, the following: active concession boundaries, protected area boundaries, the land use boundaries for 2011 (base map), distance from the sea, elevation (SRTM, resolution of 30 m), population density and slope.

Table 2 Influence Each Parameter Has on the Accuracy of the Model of Subsistence Farmland

Model	Accuracy (%)	Skill measure	Influence order
With all variables	**81.73**	**0.7564**	**N/A**
Without SRTM_30m	73.75	0.6499	6
Without Slope	80.91	0.7454	8 (Least influential)
Without Distance from sea	66.4	0.5521	5
Without Population density	77.8	0.704	7
Without Protected area	60.86	0.4781	3
Without Inundation area	60.68	0.4758	1 (Most influential)
Without Concession area	60.7	0.4761	2
Without Base map	63.94	0.5193	4

A forest cover map for 2030 was created in the simulation using these models (Figure 3). The map predicts increases in the areas of agricultural plantations and subsistence farmland by 17.7% and 124.9%, respectively, and decreases in the areas of lowland forest, hill forest, wetland forest, open woodland and grassland by 16.7%, 2.8%, 31.8%, 64.6% and 26.6%, respectively (Table 3). This map is considered representative of the land use pattern in 2030 if the current trend in deforestation and forest degradation (BAU) continues until 2030.

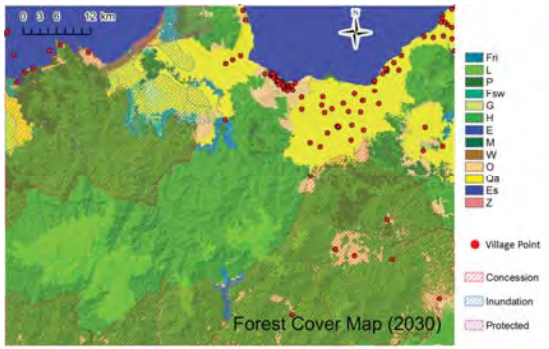


Figure 3 Forest Cover Map for 2030 Simulated with Land Change Modeler

Table 3 Influence that Each Parameter Has on the Accuracy of the Model of Subsistence Farmland

Land use	Area 2011 (ha)	Area 2014 (ha)	Area 2030 (ha)	Change in area comparing 2014 and 2030 (%)
P	39,564	38,232	31,848	-16.7
H	271,024	269,568	261,913	-2.8
Fri	4,131	4,070	4,070	0
Fsw	8,373	7,791	5,314	-31.8
W	6,010	4,942	1,749	-64.6
L	32,018	32,018	32,018	0
M	108	108	108	0
G	5,879	5,503	4,039	-26.6
Z	51	51	51	0
E	1,505	1,497	1,497	0
Es	60,864	60,864	60,864	0
Qa	51,572	54,054	63,606	17.7
O	6,907	9,307	20,930	124.9

The biomass of the vegetation in the area concerned was estimated by multiplying the area of each land cover type on the map by IPCC default factors (Table 4). All the agricultural plantations in this area were assumed to be oil palm plantations. The biomass of the vegetation in this area was estimated to decrease by 4.1 Mt in the period between 2014 and 2030. This figure corresponds to 7.5 Mt CO_2-eq and, thus, a loss of approximately US$ 37 million, on the assumption that 1t CO_2-eq is worth US$ 5.

Table 4 Comparison between Biomass in 2014 and Estimated Biomass in 2030

Land use	Biomass 2014 (Mt)	Biomass 2030 (Mt)	Change in biomass comparing 2014 and 2030 (Mt)
P	11.5	9.6	-1.9
H	80.9	78.6	-2.3
Fri	1.2	1.2	0
Fsw	2.3	1.6	-0.7
W	0.6	0.2	-0.4
L	4.5	4.5	0
M	0	0	0
G	0	0	0
Z	0	0	0
E	0	0	0
Es	0	0	0
Qa	7.4	8.7	1.3
O	0	0	0
Total	108.4	104.3	-4.1

The area of agricultural plantations is expected to increase by 9,552 ha between 2014 and 2030. If this area is assumed to increase at a constant rate in this period, the cumulative area increase will be 81,192 ha × year. If the yield of palm oil per unit area is assumed at 3.74 t ha^{-1} $year^{-1}$ [1] and its price is assumed at US$ 562 t^{-1} [2], the revenue from the sales of palm oil is expected to increase by US$ 170 million in this period. The total area of lowland and hill forests is expected to decrease by 14,040 ha in the same period. If this area is assumed to decrease at a constant rate, the cumulative area loss will be 119,348 ha × year. If the harvesting period and price per unit volume of timber are assumed for 35 years at US$ 142m^{-3} [3], respectively, a loss of approximately US$ 17 million is expected from the area loss. In conclusion, an increase in revenue of US$ 116 million is expected from the deforestation and forest degradation on the BAU basis in the period between 2014 and 2030 (Table 5).

An estimation similar to the one mentioned in the preceding paragraph was conducted in cases in which 1) only open woodland and grassland could be converted to agricultural plantations and 2) only grassland could be converted to agricultural plantations. Increases in revenue of US$ 85.2 million and US$ 28 million in the period between 2014 and 2030 were expected in cases 1) and 2), respectively. As restrictions on the changes in land use increase, the extent to which revenue increases from such changes is reduced. The policy of the government on forest management will depend on whether it can find value in conserving the

[1] http://www.soyatech.com/Palm_Oil_Facts.htm (accessed on 03 April 2017)
[2] http://www.indexmundi.com/commodities/?commodity=palm-oil&months =300 (accessed on 09 June 2016)
[3] https://www.wageningenur.nl/upload_mm/5/c/1/b0b121e8-469b-4e65-9689-e4e6fd7c8d1e_WOt-technical%20report%2010%20web versie.pdf (accessed on 03 April 2017)

forests themselves without deforestation and forest degradation.

Table 5 Comparison of Revenue Increases between 2014 and 2030 with Different Scenarios

	Scenario 1	Scenario 2	Scenario 3
Net forest loss	19,711 ha	14,816 ha	11,623 ha
Net P&H loss	14,040 ha	11,623 ha	11,623 ha
Net plantation gain	9,552 ha	4,657 ha	1,464 ha
Price of increased carbon due to plantation development	-37.3 mil USD	2.00 mil USD	1.82 mil USD
Price of palm oil from newly developed plantation	171 mil USD	83.2 mil USD	26.2 mil USD
Price of increased timber due to developing oil palm plantations	-16.9 mil USD	0 mil USD	0 mil USD
Net increase in profit	116 mil USD	85.2 mil USD	28.0 mil USD

Note) Scenario 1: BAU; Scenario 2: Newly developing plantations are only allowed in W and G after 2014, increase in subsistence agriculture is BAU; Scenario 3: Newly developing plantations are only allowed in G after 2014, increase in subsistence agriculture is BAU

(b) Simulation of Deforestation and Forest Degradation – Simulation of Distribution of Deforestation and Forest Degradation

The flow of the simulation of the distribution of deforestation and forest degradation in West New Britain Province is described in this section.

The whole area of the pilot province of West New Britain (approximately 20,340 km^2) was used in the simulation. A 2011 Forest Base Map and a 2005 Forest Cover Map were used as the land use maps of two points in time. Information on drivers of forest degradation and deforestation were attached to each polygon in each map in advance. In this analysis, (1) forest land cover with drivers such as facility construction, road construction, forest plantation, perennial plantation, subsistence agriculture, “gardening” and selective logging was assumed as “degraded forest” and (2) forest land cover with drivers such as disasters and wood collection, or without any drivers, was assumed as “non-degraded forest” (Figure 4).

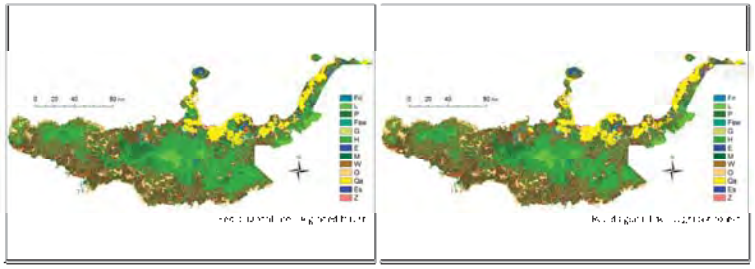


Figure 4 Forest Cover Map for 2005 (left) and Forest Base Map for 2011 (right)

In the beginning, the maps for 2005 and 2011 were compared to elucidate what types of land cover increased and what types of land cover decreased between 2005 and 2011. The comparison revealed that the main changes in land cover were the degradation of hill forest (H), plain forest (P) and woodland (W) and the conversion of P into perennial plantation (Qa) and subsistence agriculture fields (O) (Table 6). These land cover changes were put in a model to estimate land cover in 2026. The following were used as the model parameters: elevation (SRTM, resolution of 30 m), slope, distance from the sea, distance from rivers, distance from forest edge, distance from forest/perennial plantation, distance from subsistence agriculture field, distance from degraded forest (as of 2005), population density (kernel analysis), boundaries of reserves, wetland, active concession areas (as of 2005) and forest types.

Table 6 Five Major Land Cover Changes between 2005 and 2011 in West New Britain Province

Rank	Land cover in year 2005	Land cover in year 2011	Area (ha)
1	H	H (Degraded)	142,000
2	P	P (Degraded)	41,000
3	W	W (Degraded)	4,900
4	P (Degraded)	Qa	7,000
5	P (Degraded)	O	4,800

The accuracy of the model was estimated at 82.31%. Because this figure is larger than the threshold of 80% for sufficient accuracy, this model is considered a valid model (Table 7). The forest types are the parameters that have the largest influence on the accuracy of the model, followed by, in descending order, the following: distance from forest/perennial plantation, distance from subsistence agriculture field, distance from forest edge, active concession areas and distance from road.

Table 7 Influence Each Parameter has on the Accuracy of the Model

Model	Accuracy (%)	Skill measure	Influence order
With all variables	82.31	0.801	N/A
Population density	82.29	0.8007	15
Active concession area as of 2005	80.04	0.7755	6
Distance from Non-forest land use	74.88	0.7174	5
Distance from rivers	81.82	0.7955	12
Distance from roads as of 2011	80.37	0.7792	7
Distance from sea	82.26	0.8005	13
Inundation area	81.71	0.7943	11
Slope	82.31	0.801	16 (least influential)
Altitude	82.29	0.8007	14
Distance from CU points	81.27	0.7893	10
Distance from protected area	80.51	0.7807	8
Distance from "plantation"	70.29	0.6657	3
Distance from "Agricultural land use"	72.02	0.6852	4
Distance from Degraded forest	49.87	0.436	2
Distance from logged-over area	80.81	0.7841	9
Forest type	48.37	0.4192	1 (most influential)

A forest cover map for 2026 was created in the simulation using this model Figure 5). The map predicts increases in the areas of degraded H, degraded P and degraded W by 33.8%, 7.3% and 47.7%, respectively, and decreases in the areas of non-degraded H, non-degraded P and non-degraded W by 51.7%, 54.0% and 55.4%, respectively (Table 8). This map is considered representative of the land use pattern in 2026 if the current trend in deforestation and forest degradation (BAU) continues until 2026.

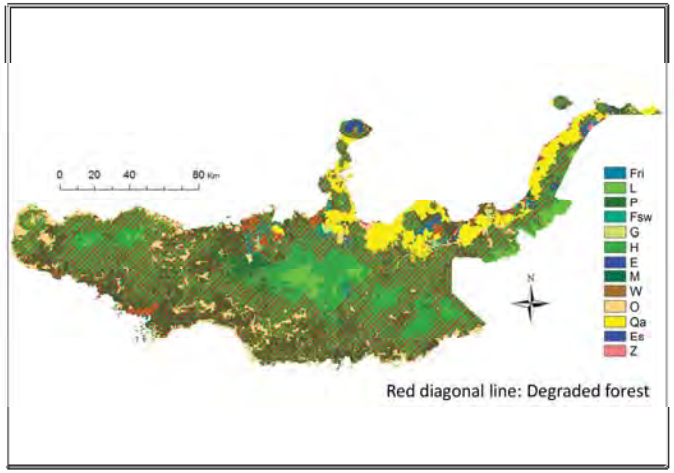


Figure 5 Simulated Forest Cover Map for 2026

Table 8 Changes in Areas of Each Land Cover

Change in area of Land cover other than degraded forest			
Land cover	Area in year 2011 (ha)	Aria in year 2026 (ha)	Change ratio
B	250	249	-0.40%
Fri	5000	5004	0.10%
Fsw	5587	5584	-0.10%
H	414485	200291	-51.70%
L	62089	62109	0.00%
M	4910	4905	-0.10%
P	103129	47430	-54.00%
Sc	112	113	0.50%
W	16732	7458	-55.40%
E+Es	14431	14433	0.00%
G	30721	30723	0.00%
O	122038	135033	10.60%
Qa	147766	160785	8.80%
U	651	652	0.20%
Z	1137	1135	-0.10%

Change in area of degraded forest			
Land cover	Area in year 2011 (ha)	Aria in year 2026 (ha)	Change ratio
B_deg	861	863	0.20%
Fri_deg	15366	15361	0.00%
Fsw_deg	18622	18606	-0.10%
H_deg	633555	847772	33.80%
L_deg	4224	4224	0.00%
M_deg	4643	4642	0.00%
P_deg	408523	438148	7.30%
Sc_deg	0	0	0.00%
W_deg	19471	28760	47.70%

This indicates that areas of non-degraded forest would decrease from about 612,000 ha in 2011 to 333,000 ha in 2026 and areas of degraded forest would increase from about 1,105,000 ha in 2011 to

1,358,000 ha in 2026. Pearson *et al.* (2014) suggests that carbon emissions from a unit area caused by forest degradation reaches 12% of that of deforestation. About 165,000 ha of area is simulated as experiencing forest degradation by logging between 2011 and 2026. Assuming average forest carbon stocks of 200 Mg C ha^{-1}, carbon emissions from forest degradation by logging during this period is estimated as the following:

165,000×200×0.12 = 396,000 (Mg C)

Further, assuming 1 t CO_2-eq = 5 USD, the estimated value of carbon emitted due to forest degradation by logging activity between 2011 and 2026 in West New Britain Province is estimated as the following:

396,000×(44/12)×5 = 7,260,000 (USD)

(c) Possible Location of Future Deforestation Simulated by Land Change Modeler

Estimates of possible locations that would experience deforestation in the future, and the drivers of this estimated deforestation, helps identify areas where forest conservation is a high priority and areas to be monitored intensely. It is very difficult to predict the exact location of deforestation in the future because it is dependent not only on geospatial conditions but also on social circumstances, such as traditional practices in the various habitats, changes in policy, and the activities of private companies. However, it is possible to predict locations with a high probability of deforestation because lands suitable for human activities tend to be distributed in areas with certain conditions, such as areas that are flat, warm, close to roads, and close to villages. This kind of information can be used to choose areas for protection, for example. In this section, conditions that affect deforestation are estimated and the probability of deforestation in each location is predicted in West New Britain Province.

Forest Cover Maps for the years 2005, 2011 and 2015 were used for the analysis. Firstly, deforested areas were identified with each driver of deforestation by comparing maps from two time points, namely 2005 and 2011, and 2005 and 2015. Then, two maps were obtained, one containing forest cover information for 2011 with deforestation information from 2005 to 2011, and another containing forest cover information for 2015 with deforestation information from 2005 to 2015 (Figure 6). These two maps were utilized for the analysis.

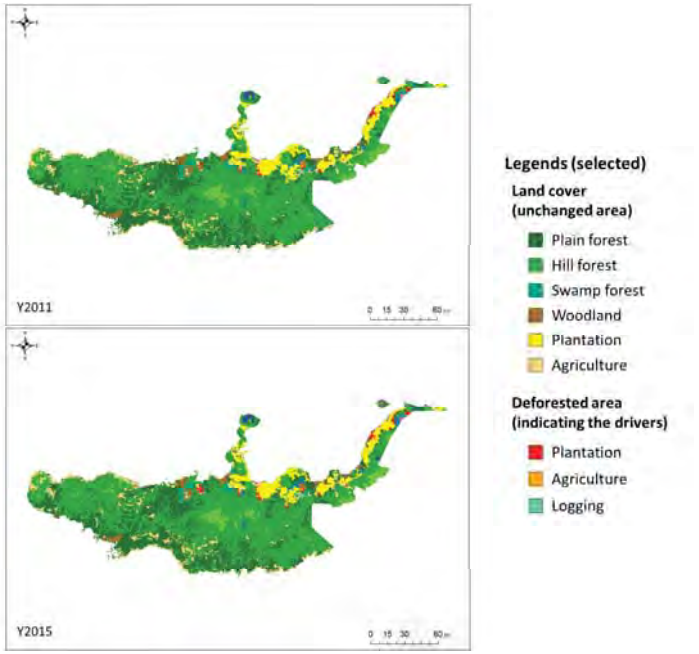


Figure 6 Forest Cover Map with Deforestation Information for Y2011 (top) and Forest Base Map for Y2015 (bottom)

The deforestation rates between 2005 and 2011 and 2005 and 2015 were 1.08% and 1.42%, respectively. Deforestation was caused by various drivers, such as agriculture, logging, wood collection, plantation, road construction and disasters. Among the drivers, plantation, agriculture and logging were the major drivers of deforestation. Deforestation occurred mainly in four types of forest, namely, hill forest, plain forest, woodland and swamp forest. In this analysis, simulations were performed for each type of land transition with an accumulated size between 2011 and 2015 that was larger than 200 ha in the whole of West New Britain Province. The simulated transitions are listed in Table 9.

Table 9 Seven Types of Land Transitions Simulated in this Analysis

Rank	Land cover in year 2011	Land cover in year 2015	Area (ha)
1	Plain forest	Deforested (Plantation)	1,813
2	Hill forest	Deforested (Plantation)	1,800
3	Woodland	Deforested (Plantation)	1,331
4	Swamp forest	Deforested (Logging)	435

5	Plain forest	Deforested (Logging)	310
6	Hill forest	Deforested (Agriculture)	294
7	Hill forest	Deforested (Logging)	255

There were 17 kinds of geospatial data stored in the PNG-FRIMS that were employed as the independent variables for establishing a model to predict land cover change potential. The variables are listed by order of influence on the model in Table 10. The total accuracy of the model was 76.04%. The most influential variable on the model was distance to plantation, followed by land cover for 2011, then timber volume, and the rest as shown in the table below.

Table 10 Variables Employed for the Analysis and Sensitivity of the Model to Forcing a Single Independent Variable to be Constant

Model	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 for 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
Standard Deviation of Elevation	76.04	0.7365	15
Population Density	76.04	0.7365	16
Distance to Agriculture	76.14	0.7375	17 (least influential)

Figure 7 shows the relationships between land change and the most influential independent variables. Most of the deforested areas were distributed within 5 km of the boundaries of plantations (Figure 7-a). Land cover change between 2011 and 2015 occurred intensely in woodland (4.1%) and swamp forest (2.4%) (Figure 7-b). Areas with high timber volume tended to experience major land cover change (Figure 7-c). The simulated model seemed to reflect the effects of these physiographic features.

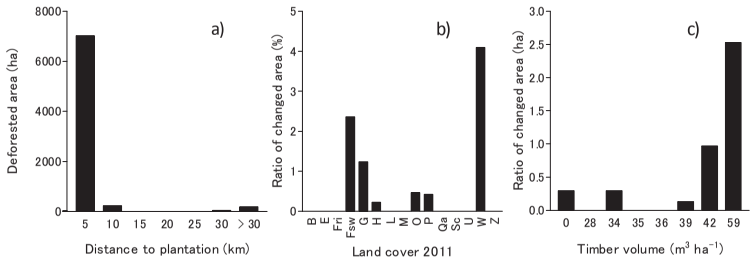


Figure 7 Relationships between Deforested Areas and Distance to Plantations (a), Land Cover in 2011 (b) and Timber Volume (c)

An estimate of the probability of land cover change in each location in the whole of West New Britain Province was performed using the simulated model. Figure 8 shows the result of the estimation in part of the western part of West New Britain Province. Lands with a high probability of land cover change are unevenly distributed. In comparison with Figure 9-a, it was found that areas with a high probability are located along the boundaries of plantations and roads. High probability areas are also related to the distribution of areas with high timber volume (Figure 9-b). In addition, the distribution of active concessions and village points, etc., may affect the result of the estimation. Meanwhile, along the boundaries of plantations, for example, there was difference in the possibility among the locations. This indicates that there are both highly and poorly susceptible areas to the effect of the operation of plantations. This sort of analysis to identify areas highly susceptible to deforestation would be useful for helping make decisions in forest management, such as setting protected areas. However, it is important to note that events not observed in the past cannot be simulated in this kind of future analysis.

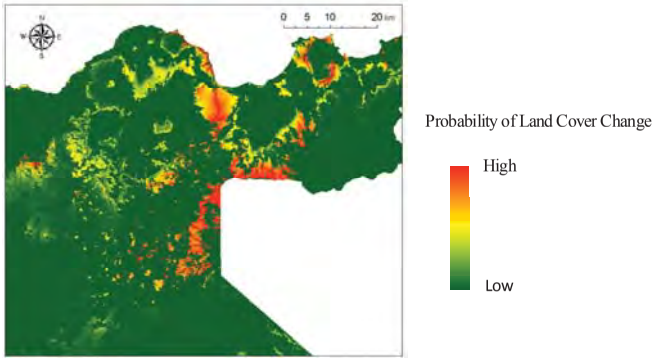


Figure 8 Probability of Land Cover Change in the Western Part of West New Britain Province

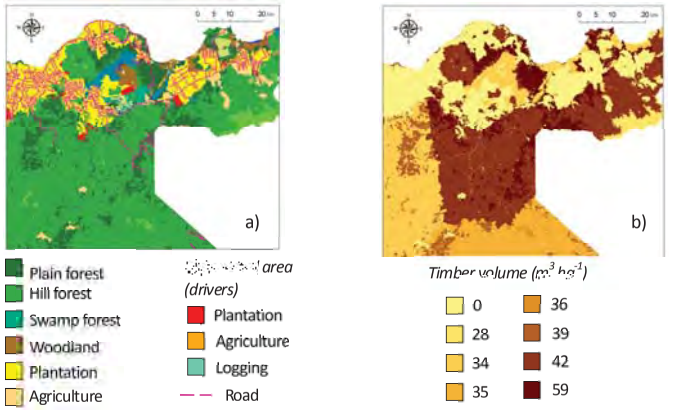


Figure 9 Land Cover and Roads (a) and Timber Volume Distribution (b) in the Western Part of West New Britain Province

Annex 32

Methodological Approaches Considered in PNG REDD+ Pilot Projects

PNGFA-JICA project: "Capacity Development Project for Operationalization of the PNG Forest Resource Information Management System (PNG-FRIMS) for Addressing Climate Change".

Methodological approaches considered in PNG REDD+ pilot projects – DRAFT version.

October 27th 2014

Background

The project Output 3 is to prepare forest information necessary to develop mitigation actions (REDD+ in particular) to address Climate Change issues in PNG. It participates to the creation of a data management system (FRIMS) that is able to offer the best support to measure forest carbon emissions and removals. The first interested party is PNG through 2 processes:

- The possibility to establish a scientifically solid Forest Reference Emission Level (FREL), and
- The potential multiplication of carbon projects in the Forestry sector

Within Output 3 activities, the activity 3.4 is considering to identify the information which PNGFA is able to provide by using PNG-FRIMS, regarding necessary forest resource information for project-based REDD+ activities.

As programmed in the Project Design Matrix, this activity implementation is articulated over three steps:
3.4.1: detailed review of data requirements from REDD+ project development methodologies. It corresponds to provide a clear and practical understanding of the main frameworks of performance-based payments and methodologies associated to project-based activities in PNG in the sector of LULUCF
3.4.2: detailed review of data available in FRIMS
3.4.3: identification of gaps by comparing information required for developing a Forestry Climate Change project *vs.* information available in FRIMS

The activity 3.4.1 includes two groups of sub-activity:
- Methodological approaches considered in PNG projects
  - Review (exhaustively) on-going and planned REDD+ projects in PNG: frameworks in which ER performances are valorized, associated methodologies and data requirements to apply to selected methodologies
  - Develop network of PNG-FA with REDD+ project developing organizations and contribute to extend the knowledge of developers on PNG-FA as a potential partner for methodology support
- International methodologies existing
  - Review main Carbon offset frameworks (CDM, REDD+, Voluntary, bilateral like JCM, etc.), follow the evolution internationally and in PNG
  - Continued network with organizations involved in Standards (OCCD, VCS, DOE, etc.) and invite methodology experts to REDD+ pilot project sites for broad evaluation, advices and lectures

This document shows methodological approaches considered in PNG projects. It will include a description of pilot projects existing in PNG, methodologies, associated data and parameters used in monitoring, analysis of findings and FA interactions with project developers.

The next step of the project will be a description of existing international methodologies, all Voluntary relevant methodologies and other than Voluntary.

1) Pilot projects in PNG

Five REDD+ demonstration sites have been identified in PNG by its Forest Authority. In two of them, preliminary studies conducted on forest conditions (field forest inventories) facilitated the introduction of a REDD+ project. Both of them chose to valorize their results from incentives created in the Carbon Voluntary market. A third REDD+ national pilot project is led but not yet engaged in a system of payments from international markets. Each of the three projects are described here with information on the project stakeholders, location, whether it is in a demonstration site or not, forest conditions, selected standard/methodology and benefits (climate and co-benefits).

a) Manus project

Title	Manus Village REDD forest Carbon within Ridge to Reef conservation programme
Developer	Wildlife Conservation Society (WCS: developer) The Nature Conservancy (TNC: partner)
Location / area	Manus province / island
REDD+ demonstration site	No
Forest conditions	- DD rate: 0.2% - DD drivers: surrounding logging (possible threaten from Rubber plantations) - Forest types dominant: primary forests and mangroves
Activity	Conservation in logging concessions. Community commitment: - No commercial logging in their lands for the next 2 year; - Realize a sustainable land use plan
Methodology	Own methodology
Status	First of 3 years project
Fund	NGO (WCS)
Climate benefits: potential C benefits	Avoiding degradation from logging Avoiding deforestation post logging
Co-benefits: community and biodiversity	Project commitment (in agreements): build or rehabilitate city hall, bridges, schools

b) Central Suau project

Title	Forest carbon project in Central Suau, PNG
Organizations involved	GIZ (German cooperation: proponent) OBF (Austria consultant: PDD developer) Secretariat of Pacific Communities (SPC: partner)
Location / area	Central Suau province, Milne Bay Project area: …
REDD+ demonstration site	Yes
Forest conditions	- DD rate: … - DD drivers: logging - Forest types dominant: primary (60%), croplands (30), secondary (5), mangrove (5)

Activity	Conservation in logging concessions
Methodology	Voluntary standards methodology: - VM0010: Improved Forest management: logged to protected forests v1.2
Status	Advanced draft of the PDD (Feb 2015)
Fund	Donor (German bilateral fund)
Climate benefits: potential C benefit	Avoiding degradation
Co-benefits: community and biodiversity	Biodiversity (high-spot) and Communities (to be detailed)

c) April Salumei project

Title	April Salumei sustainable forest management project
Organizations involved	Rainforest project management limited company (proponent) Pacific forest alliance (PDD developer) University of PNG, NGO PwM (partner)
Location / area	East Sepik province, April Salumei Project area: 600 000ha (boundary area: 300 000 ha; belt: 300 000 ha) Reference region: 2 million ha
REDD+ demonstration site	Yes
Forest conditions	- DD rate: … - DD drivers: logging (and Palm oil plantation in Peat land areas) - Forest types dominant: primary forests and peat swamp forest
Activity	Conservation in logging concessions
Methodology	Voluntary standards methodologies: - VM0007: REDD methodology modules v 1.3 - VM0010: Improved Forest management: logged to protected forests v1.2
Fund	Private (Rainforest project management Ltd. Co.)
Climate benefits: potential C benefit	Avoiding degradation: 1 million tCO2e / year
Co-benefits: community and biodiversity	- Education, health, enterprise (from 60% of carbon credit revenues managed by community organizations) - Capacity building: OCCD, PNG-FA, UPNG (organized by the project)

d) Summary of project methodologies used in PNG

Project	Manus	Central suau	April salumei
Fund	NGO	Private	Donor
Carbon Methodology	Own	VCS 0010	VCS 0010, VCS 0007
Community/biodiversity	No	Not yet	CCBS (Bd gold)

Although few PNG pilot projects show a large range and good representativity of fund source (public donor, NGO and private funds), methodology (own, unique and complex) and relation to CCB standards.

2) Types of data for developing a VCS project

Different types of data will be required in the project life, according to objectives: show evidence that the project fills eligibility criteria, feasibility criteria, and fills requirements for the monitoring.

a) Parameters used to show the project eligibility

Key issues in PDD development related data availability	Types of data to facilitate eligibility
Standard to choose	…
Leakage	Data indicating neighbor concession land cover change after project starts
Spatial boundaries of project site	FRIMS increased accuracy of administrative and concessions boundaries
Land eligibility for REDD+ (forest/non-forest, historic deforestation)	FRIMS increased accuracy of forest classes (typology and boundaries)

b) Parameters used to show the project feasibility

Key components of the methodology	Objective	Types of data to facilitate development
Applicability criteria and decision based on availability of data sources	All	FRIMS increased data availability from institutional (FA) source
Justification of selective logging	Baseline emissions calculation	Past logging data
Definition of project boundary	All project	National mapping and timber concessions
Accounting baseline carbon changes from logging	Net ER = BLem - PJem - LKem	Timber extraction data (collateral damages data?)
Accounting emissions due to project baseline other than logging and due to project scenario		Project infrastructure data (at least maps)
Leakage assessment		Neighbor concessions forest cover changes data

c) Data and parameters used in monitoring

So far, two methodologies are employed in PNG REDD+ projects VM0007 (REDD) and VM 0010 (logged to protected forests). Each one has a long list of data and parameters used in monitoring. Here the exhaustive list is given but only data / parameters obtained from Remote Sensing (FRIMS input) are detailed. See section “Sources of data” for details on different sources that can provide information. N.B: A to G between parentheses refer to monitoring components (see after section “sources of information”).

Data and parameters used in monitoring	Details / conditions	Source
VM OOO7 REDD Methodology framework		
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
VM OO10 IFM LtPF (other than for the methodology VM 0007)		
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

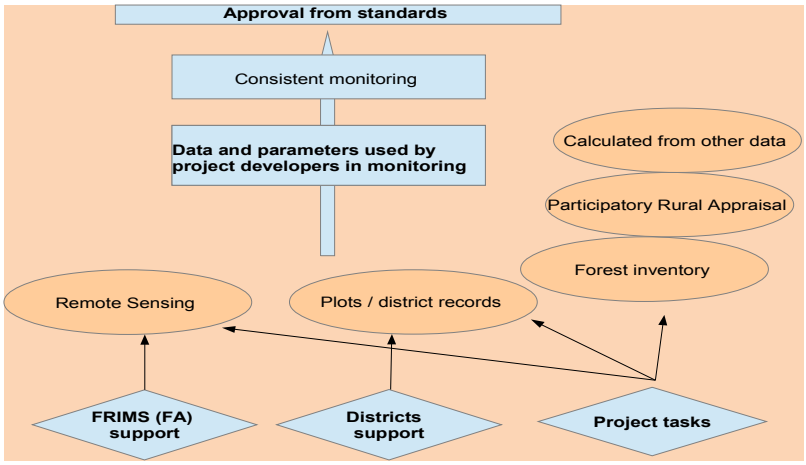
d) Data type - summary

+ *Forest condition*: Forest cover map, Area burnt, carbon stocks in trees, total area of a stratum
+ *Forestry / biomass data*: Volume extracted if possible by wood product and species (Gross volumes, not net volumes used commercially), merchantable biomass (% BM in tree > 15cm), merchantable biomass (% BM in tree > 50cm)
+ *Deforestation / Carbon data*: Carbon stocks in above and below ground biomass, Result of limited illegal logging survey, biomass carbon of trees cut and removed through illegal logging, total area of

illegal logging sample plots, Degradation, Result of limited degradation survey, Illegal logging (PRA), Area potentially impacted by illegal logging, Area of recorded deforestation in project area, area disturbed.

3) Sources of data

Data used by projects are coming from different sources of information. The following figure tries to summarize it.



Amongst data provided from Remote Sensing, six monitoring components exist:

Monitoring component	Activity	Frequency	Resources
A: boundary	Detect integrity of project boundary	1 y	ALOS (50m), LANDSAT (30m)
B: stratification	Land cover classification	1 y	ALOS (50m), LANDSAT (30m), field
C: land cover changes (deforest.)	Detect and appraise area of deforestation	1 y	Detect: LANDSAT (30m), Appraise area: high reso (5m)
D: logging (degradation)	Detect and appraise area of degradation	Continue	High reso (5m)
E: fire (deforestation)	Detect and appraise area of burning	Continue	MODIS imagery (mini 100m^2 detected)
F: forest carbon stocks	Species, H, DBH, (emission Factor)	10 y	Field
G: leakage	New logging or conversion permit in the region	1 y	Detect: LANDSAT (30m), Appraise area: high reso (5m)

4) Interactions with project developers

Manus project	Name: Ezra Organization: WCS Email:
April Salumei project	Name: Stephen Hooper Organization: Rainforest Email:
Central Suau project	Name: Organization: OBF Email:

Annex 33

Possible PNG-FRIMS Contribution in the Implementation of Institutional Initiatives Promoting Sustainable Forest Management

Working Draft/Internal Only

PNG Forest Authority (PNGFA) – JICA project

"Capacity development project for operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for addressing Climate Change"

Possible PNG-FRIMS contribution in the implementation of institutional initiatives promoting Sustainable Forest Management

Summary of activities in the project Output 3
May 2017

Objectives of the document

Working Draft/Internal Only

Project purpose: Enhance PNGFA capacities to update, operationalize and utilize PNG-FRIMS for promoting SFM and address CC (cf PDM).

Objective of the document: clarify, facilitate and increase the utilization of PNG-FRIMS in the planning and implementation from PNGFA of initiatives promoting Sustainable Forest Management and, production, environmental and climate benefits.

Specific objectives of the document:

1. Review of PNGFA activities (forest monitoring and planning) and initiatives (promoting the development of plantations, RIL and regeneration) that PNG-FRIMS can facilitate or enable, notably in light of new functions and capacities developed (Lan Map, GIS and GPS). *[Update of capacities in PNGFA]*

2. Facilitation of exchanges within the Project to clarify initiatives PNGFA is prioritizing notably in light of recent orientations in the Forestry sector. *[Update of priorities for PNGFA]*

3. Dissemination of improved forest management tools and capacities to stakeholders notably institutions of land sectors and REDD+ to facilitate PNGFA support to and from programmes for Conservation and/or land use based Climate Change mitigation.

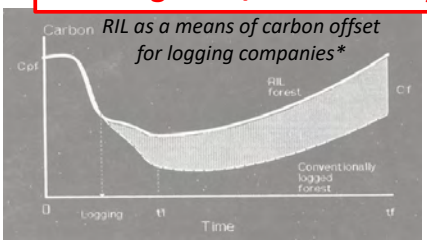
Orientations and current activities in PNGFA contributing to Sustainable Forest Management

Working Draft/Internal Only

Forest Policy and Planning (FPP) & Field Services

1- Productivity in selective logging: on-going process to update National and Provincial Forest Plans.

Papua New Guinea Forest Authority



2- Sustainability in selective logging: current revision of the Logging Code of Practices (based on Reduced Impact Logging practices) and PMC procedures.

Forest Development

3- Alternative sources of timber: activation of the country plantation program: regional workshops (4 in 2016), awareness raising tool kit provision, etc.

Eucalyptus plantation

Field Services

4- Rehabilitation of degraded areas: on-going nursery and planting activities in logged over areas.

FPP REDD & CC

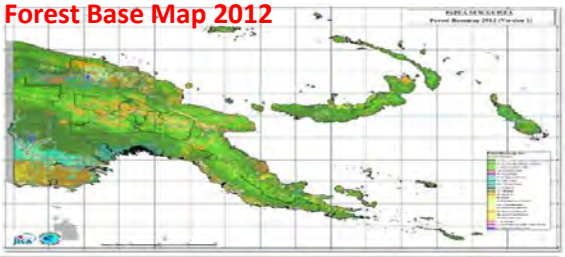
5- Climatic valorization of the SFM approach: development of capacities for monitoring forest degradation and measuring interventions' effects on forest carbon (REDD+ NFMS and FRL).

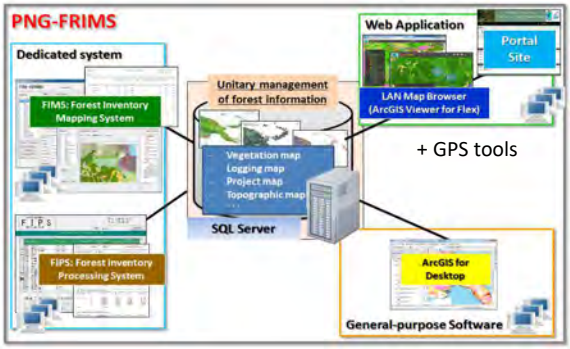
(Reference provided slide 9)*

Recent project advancements

Working Draft/Internal Only

Forest Base Map 2012





Achieved:

- **Update of the Forest Base Map (FBM):** 2012 ver. 1.1
- **Cleansing and expansion of PNG-FRIMS data**
  - FIMS: Forest Inventory Mapping System (estimation of timber volumes per situ)
  - FIPS: Forest Inventory Processing System (vol. inventoried before and after harvest)
  - Logging info (concession maps); Constraint areas (Conservation, clearance areas); Topo (road, river, DEM)
- **Setup LANMAP function** (software to view FBM in field offices)
- **Setup GPS & GIS functions:** position, distance, area, layers

On-going:

- **Add** timber V, C storage, Logged Over areas to the FBM
- **PINFORM** regrowth model
- **Detection of forest cover changes and drivers using RS:**

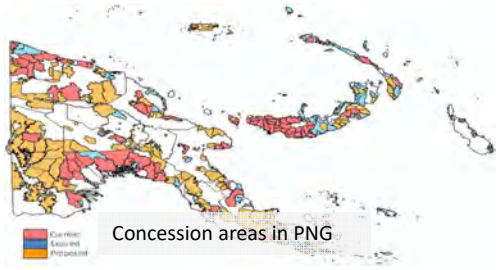
  RapidEye (5m), Landsat (30m), Palsar (10m, cloud free), CE
- **Develop Forest Base Map time series:** 2000, 2005, 2011
- **Projection** of future DD by using Land Change Modeler
- **Bring material/capacities in field** to use Lan Map, GIS and GPS

Possible contribution from PNG-FRIMS to SFM orientations

Working Draft/Internal Only

1- Possible support in land use planning and land suitability analysis

+ Activity: PNGFA planning of forestland uses regarding land potentialities and risks.


Concession areas in PNG

Development activities	*Zones sought*	*Consideration*
Selective logging	Lowland forest	Forest Management Agreements
Forest timber plantation	- Grasslands - Strongly degraded areas	Plantation zones
Forest regeneration	- Logged Over Areas - Other degraded forestlands	Priority areas for planting
Conservation	High value (Biodiversity, etc.)	Buffer/CA (with CEPA)

+ Possible support from PNG-FRIMS:

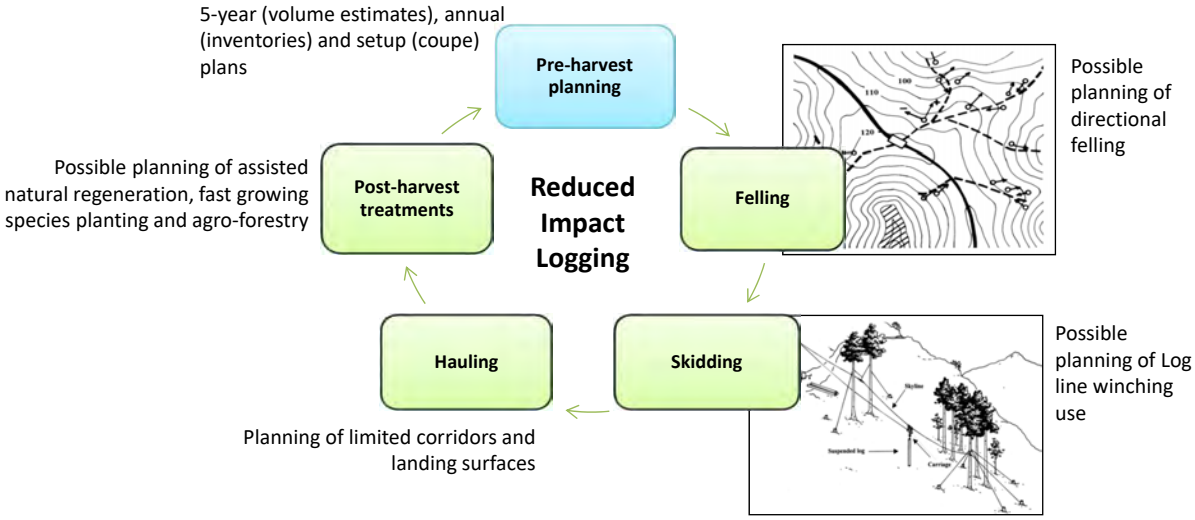
Info sought	Evaluation/monitoring methods	PNG-FRIMS functions used
Land potential (timber volumes per area)	Position and numerical info acquiring	**FIMS, Forest Base Map**
Environmental constraints (grassland, degraded)	Position acquiring and attributes	**Lan Map, GIS**
Maps of clan	Boundary position and area calculation	**Lan Map, GIS**
Deforestation and Degradation spots and drivers	Position acquiring and area calculation	**RS imagery**

Working Draft/Internal Only

2- Possible support in the planning of harvest operations (using RIL)

"Many guidelines and codes of practice contain elements for achieving Environmental benefits. However, more can be done to encourage implementation of GL and codes through planning, control and valorization of operations." (Wilkinson, 2012)

+ Activity: planning (by logging companies) and assessment (from PNGFA) of harvesting steps



2- Possible support in the planning of harvest operations (using RIL)

Working Draft/Internal Only

+ Possible support:

Information to demonstrate	Evaluation/monitoring methods	PNG-FRIMS functions used
Whether setup area < 150ha	Area calculation	Lan Map
Logged area < 1/7 of total log-able area	Area calculation	Lan Map
Conservation area > 10% concession area (excluding buffer zones)	Area calculation	Lan Map
Position of trees of interest	Position acquiring; picture	Lan Map, GPS
Remaining stump height < 30cm	Position acquiring; picture	GPS
Skid tracks area < 10% of setups area	Area calculation	GPS, GIS
Road corridor width < 40m	Distance measurement	GPS
Log landings < 3 and < 0.25 ha/setup	Position acquiring; Area calculation	Lan Map, GPS
Buffer zones not overlapped	Buffer position and distance to harvest	GPS, GIS
Post-harvest treatment provided (replanting)	Area calculation; Position acquiring	GPS, GIS

N.B: Possible utilization for supporting smallholders in **Small Scale logging** (tree position, buffer zones…)

Working Draft/Internal Only

3- Possible support in the development of forest plantation programs

+ Activity: development (PNGFA) and management (PNGFA or timber companies) of forest plantations.

Largest State-owned plantation

Priority areas:

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

After PWP document from Mr Vilamur, FDD, PNGFA

+ Possible support:

Info sought	Evaluation/monitoring methods	PNG-FRIMS functions used
Mapping and survey (update) of existing plantation boundaries inc. low yield zones	Acquiring position of existing plantations; area calculation	Lan Map, GIS, GPS
Mapping of land suitable for new plantations (ex.: grasslands, heavily degraded areas)	Acquiring position of grasslands and degraded areas; area calculation	Lan Map, GIS
Sketch plotting of possible project areas	Designing position; area calculation	Lan Map

Working Draft/Internal Only

4- Possible support in the regeneration of degraded zones

+ Activity: intervention (nursery, planting, etc.) in degraded areas from PNGFA (or logging companies)

Priority areas:

Logged Over Areas (LOA)
(DD driver: commercial logging)

Degraded mangrove areas
(DD driver: fuel and housing wood collect)

+ Possible support:

Info sought	Evaluation/monitoring methods	PNG-FRIMS functions used
Zones for planting native species	Acquiring position of young LOA (< 5 years)	RS analysis of logging road network => Delimitate LOA boundaries and Logging closure time
Zones for fast growing species.	Position of Heavily degraded LOA (any age)	
Zones where assistance is less necessary	Position of LOA > 5 year without heavy disturbance	

Info sought	Evaluation/monitoring methods	PNG-FRIMS functions used
Zones for interventions (Assisted Natural Regeneration) involving local communities	Acquiring positions of Mangrove boundary and degradation spots	- FBM for mangrove areas - Outsourced data for degradation (Google Earth, Maryland Uni...)

5- Possible support in the estimation of carbon benefits

Working Draft/Internal Only

+ Act. 1: monitoring forest cover changes possible from PNGFA

Info sought	Evaluation/monitoring methods	PNG-FRIMS functions used
Land classification and Forest stratification	Boundaries and attributes	Forest Base map
Deforestation and forest degradation in roads, skid trails, log landings	Position acquiring, area calculation	Remote sensing tools
Reforestation (plantations + regeneration)	Position acquiring, area calculation	RS, Lan Map, GIS

+ Act. 2: measuring intervention benefits possible from PNGFA

PNG-FRIMS support:

Lan Map, GIS, GPS

Only possible through Field inventory

	CONVENTIONAL LOGGING	REDUCED IMPACT LOGGING
Roads [m/ha]	24	20
Skid trails [m/ha]	205	71
Log landings [m2/ha]	103	57
Trees damaged [%]	56	29
	EF 2 Logged forest	EF 3 RIL forest

EF 1 Natural forest

Intervention example*:
PaMs fostering application of RIL within (country' or province') operators. Ex.: material support, incentives for good practices, etc.

*Reference: "Reduced Impact Logging Techniques as a Means for Carbon Offsets" by Pedro Moura-Costa Innoprise Corporation Sdn Bhd (ICSB), Sabah, Malaysia, and Oxford Forestry Institute, Oxford, United Kingdom. http://www.fao.org/3/a-w2809e/w2809e01.htm

Way forward

Working Draft/Internal Only

- Summary of initiatives that can be supported

* Country orientations
* Project contribution

NFP/PFP update*; Timber volumes, land class, forest strata and constraint areas*

Activities relevant for SFM — Land use planning — PNGFA

PNGFA and/or private logging companies

Initiatives relevant for SFM

Plantation areas	RIL concessions	Regeneration areas
Plantation programmes Update boundaries and identify suitable lands	LCoP / PMCP review Plan and Monitor logging roads extent	Regeneration programmes Identify LOA and their ages

Activities relevant for SFM — Estimation of emission reductions — PNGFA

National FRL; Province monitored and measured levels of emission

- Support to PNGFA in the 3 steps of development of SFM initiatives

Working Draft/Internal Only

PNG-FRIMS Support

Steps common to all SFM initiatives::
- RIL concessions
- Plantation
- Regeneration

DD locations → **1- Assessment of forest cover changes** → DD drivers

Potential locations → **2- Planning of interventions** → Potential ERs

Appropriate land use → **3- Implementation of interventions** → Emission reductions

Working Draft/Internal Only

- Simulation of utilizations by PNGFA in focus areas (pilot provinces)

Logging concessions map

Logged Over Area map

Under-exploited lands

Forest REFERENCE Level

\-

Suited concessions map

Regeneration map

Forest plantation map

Forest (EXPECTED) MEASURED Level

=

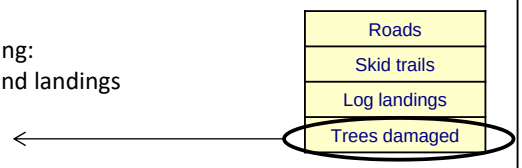
(Potential) Emissions Reduction

Working Draft/Internal Only

- Actions / Needs (in complement of existing activities)

- **Support PNGFA monitoring of logging impact on carbon** by supporting:
  - RS methods to monitor carbon loss from logging roads, trails and landings
  - Field methods to monitor carbon loss from trees damaged

  Needs to field carbon monitoring: staffs, vehicles, trainings, etc.



- **Workshop from the Forestry sector** gathering timber companies, authorities and NGOs to consider institutional, technical and commercial challenges and new tools in PNGFA to promote SFM activities.
- **Awareness raising in regions** from PNGFA to landowners and smallholders on benefits from plantations and to field operators on RIL benefits (worker safety, harvests value, profit margins…) plus on new forest management tools.
- **Manual and training provided by PNGFA** on practical steps to realize plantations and RIL practices (using FRIMS)
- **Research** activities in PNGFA (FRI) to respond to the need in data on RIL impact on C and biodiversity in PNG forests
- **Test in focus areas (pilot provinces)** PNGFA tools and capacities to plan, and measure effect from, interventions

<u>Some tracks of source to cover needs in budget:</u>

- Country and PNGFA internal budgets
- Private logging companies as a means to offset C footprint and enhance image
- T/C to cover Capacity building (including workshops) for RIL/SFM
- Grant aid to cover acquisition of car and new staff necessary for C monitoring
- Loan projects for the country to invest in large plantations
- RBP finance (REDD+ phase II) to finance integrated action for paradigm change

Annex 34

Review of Information Provided for REDD+ and SFM

(Including Logical Frame)

Ideas of Policies, Actions and Measures (PAM) for Sustainable Forest Management

---

Possible utilization in the new JICA or GCF project concept design process

Complement to the document:

« JICA 3rd Project Formulation (Draft)
Problem Analysis for Logical Frame
based on GCF Concept/Retreat & JICA Outputs
First Draft Material (Early Idea Note)
JICA Experts (Kadowaki, Koyama, Haraguchi)
25 January 2018 »

Objectives / limits

This document shows PAMs presented in the logical framework annexed (Excel file) in a more friendly/readable manner (Xls file: *"Logical framework SFM PAM").*

PAMs presented in the logical framework in relation with the management of logging in natural forests are from the Word paper also annexed *("PAM to reduce logging impact in natural forests and possible contribution from PNG-FRIMS")*

This latter paper has references from literature review, analysis of legal texts in PNG and informal discussions / interviews with PNGFA officers.

The document here has for main objective to be another material support to the formulation of project activities from PNGFA.

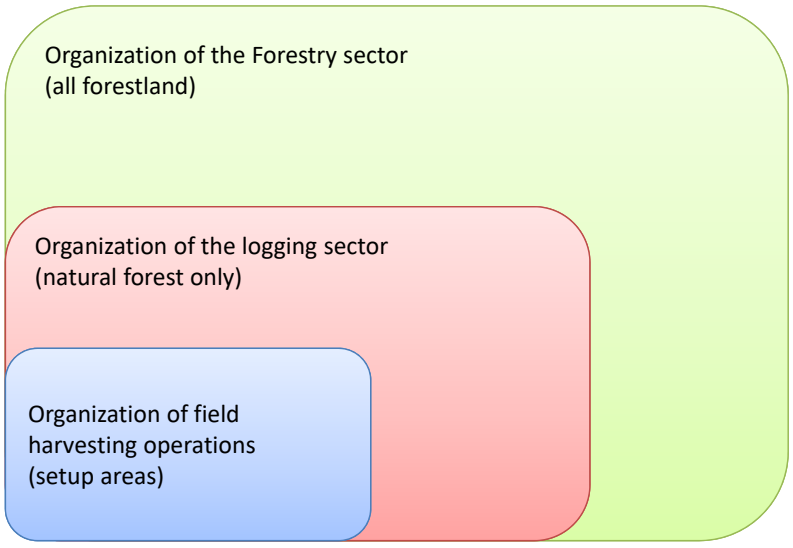
But, policy options presented along this document does not represent any JICA engagement nor preference.

Key message

1. Complement the support to planning at the national and provincial level with policies targeting actors of implementation: logging companies and supervisors of logging projects.
2. Promote Reduced Impact Logging practices.
3. Consider the options to use data collected during field assessment for carbon monitoring.
4. Experiment simple fiscal systems in pilot provinces or concessions.
5. Increase the actual application of post-harvest assessment (by supervisors) and treatment (by operators).
6. For plantations, (a) attract investors and valorize existing plantations, and (2) activate extension services with smallholders.
7. JICA seems more relevant to support activities building on previous JICA projects including those relating forest database, PNGFA internal management processes and related ICT activities. While GCF seems more relevant to support activities involving several sectors or institutions (ex.: LUP, fiscal, commercial PAM) or experiments in a programmatic approach (Feasibility studies of new taxes, test legislation amendments, etc.).

Introduction to the proposition of policy options for SFM

What is forest management, what levels of management?



Activities included

- Land use planning
- Logging in natural forest
- Forest plantations
- Commercial activities (wood value chain, small scale , processing, etc.)

- Planning (geographical repartition + regulative framework)
- Monitoring
- Control

- Pre-planning
- Hauling
- Skidding
- Felling

Three approaches for SFM

SFM holistic impact sought:
Limit the impact of production activities on forest carbon

Correspond to CGF component 2: "improved management of production forests"*

[Approach 1]
Reduce the impact of logging in natural forests

[Approach 2]
Switch logging out from natural forests

[Approach 3]
Valorize forest products

2.1 Strengthen capacities for sustainable forest management at national, provincial and local levels

2.3. Increasing Sustainable Production through Forest Plantations

2.2. Strengthen alternative approaches to timber production and processing

** Proposition in the draft GCF Concept Note (Jan, 2018)*

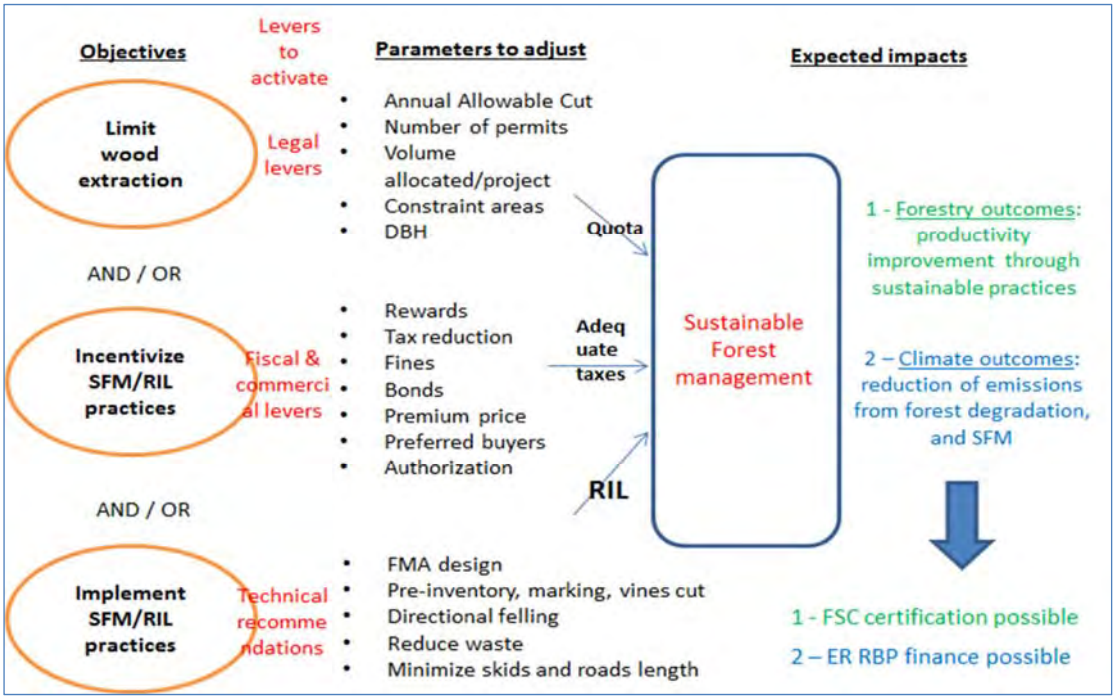
[Approach 1] Reduce the impact of logging in natural forests

Levers of emission reductions:

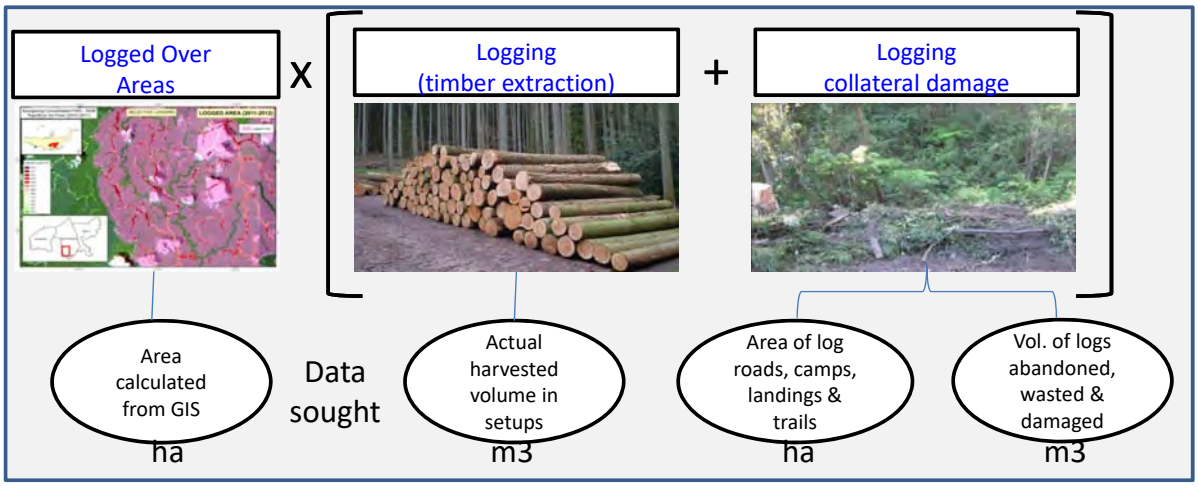
- **Forest management**
  - **Planning**
    - Land use planning*
      - National FP
      - Provincial FPs
      - FMA/FCA plans
    - 1.1] Regulations
      - Legal
      - Fiscal
      - Commercial
  - **Monitoring & Control**
    - 1.2] Monitoring
      - Remote Sensing method
      - Proxy method
      - Field method
    - 1.3] Control
      - Supervising conditions
      - Approval conditions

* In grey activities not included in the logical framework.

1.1] REGULATIONS conducive to SFM



1.2] MONITORING of carbon stock changes: proxy and RS methods



Improve RS method | Improve Proxy method | Improve Field method

PAM:

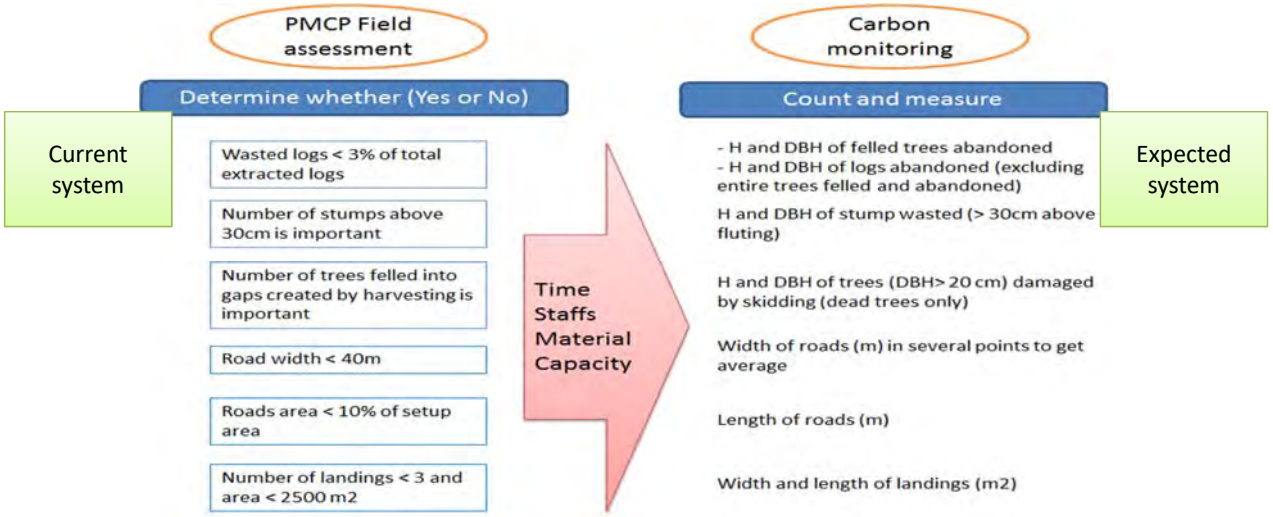
- FRIMS/DSS development
- Internet in provinces
- High resolution images
- Digitalize LOA maps in ALP

Ex.: Digitalize Actual harvested volumes data in ALP

See next slide…

1.2] MONITORING of carbon stock changes: field methods

Obj.: integrate carbon component into routine assessment of logging projects



Related PAMs:

- Provide FRIMS info (notably Lan Map access) and GPS to field assessors
- Foster the involvement of operators and communities (when relevant notably for social values of forest)
- Develop enabling conditions: funds, vehicles, training and review of PMCP documents

1.3] CONTROL: PAM options for improving the control of logging operations

Policy options	Examples of activities/measures
Independence of supervisors	- Housing/office for supervisors in each concession - Regular re-affectation of supervisors
Capacities of operators to respond to advices	- Nomination by companies of one focal point - Training to field workers
Increase post-harvest control	Operators contribution to post-harvest inventory & treatment
Make stricter procedures to increase the consideration of Recommendations from supervisors	Standardized response to non-compliance: 1. Notice to field managers 2. Notice to permit holders and fines 3. Temporary then definitive suspension of the permit
Compensate income loss due to the suspension of operations	Feasibility Studies of subsidy systems to compensate possible loss for the province or PNGFA (taxes, royalties, employments, etc.)

[Approach 2] Switch logging out from natural forests

PAMs for industrial plantations

- Increase state owned plantations to reassure investors fearing land tenure issues
- Promote awareness raising campaigns with landowners on plantation
- Propose double royalties for landowners accepting plantation projects
- State any abandoned plantations for selling purpose

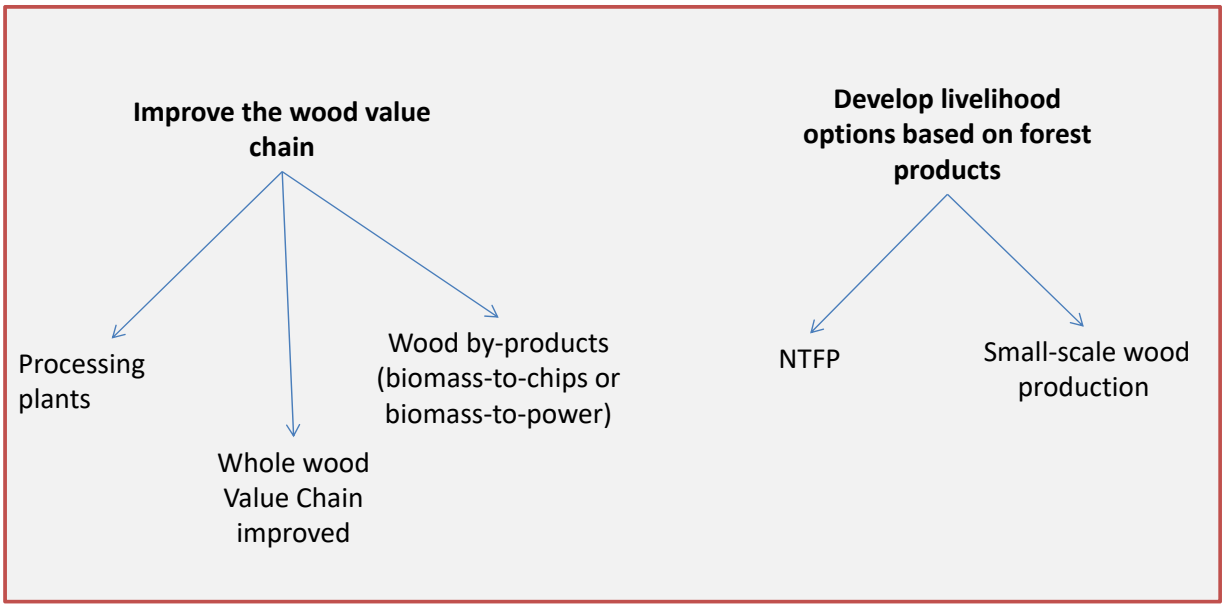
PAMs for smallholders

- Extension services: awareness, training on nurseries and plantations
- Propose incentives for example: half of seedlings/saplings provided

PAMs for both

- Access of demands in material, forest data and training for sustainable plantation management

[Approach 3] Valorization of wood products



SFM goal	Approaches	Sub-approaches	Objectives	PAMs	Possible supports (purely hypothetic)
Limit impact of Forestry activities on forest carbon Holistic approach for paradigm shift *(this corresponds to the GCF concept note [draft Jan 2018]: component 2. improved management of production forests)*	**[1] Reduce the impact of logging in natural forests** *(2.1: strengthen capacities for SFM)*	**Improve Planning of operations (zoning)**	*Maximize repartition of production activities*	*Land use planning*	*See GCF concept note Component 1*
		Improve Planning of operations (regulations)	Limit wood extraction through legal levers	Amendment of harvest quota (ex.: AAC, MMD)	JICA
			Incentivize good practices through fiscal levers	Experimentation of measures influencing practices (tax, fines, etc.)	GCF
			Incentivize good practices through commercial levers	Increase engagement of wood standard organizations	GCF / EU
			Support operators practices	Knowledge and know-how development of Reduced Impact Logging	AusAID
				PNGFA provision of data and planning tools	JICA
		Improve Monitoring of forest cover and carbon stock	Facilitate monitoring using Remote Sensing	Continue development of FRIMS and DSS database and management capacities	JICA / GCF
				Development of internet connection in provinces for monitoring purposes	JICA
				Acquisition of high resolution images	JICA
			Facilitate monitoring from data analysis	Facilitation of data sharing from operators (Actual harvested volumes)	JICA
			Facilitate field monitoring through integrating carbon parameters to routine assessment of logging projects	Provision of FRIMS info and GPS to field assessors	JICA
				Promotion of operators and communities' involvement in monitoring	GCF
				Development of enabling conditions: funds, staffs, training and review of 'field assessment sheet' document	GCF
		Improve Control of compliance of operations	Improve logistic aspects of control	Facilitation of the independence of supervisors (house, cars)	GCF
				Build operators capacities to respond to supervisors' advices (one focal point, trainings)	GCF
			Improve technical aspect of control	Engagement of operators in post-harvest treatment	GCF
			Activate legal levers for improving control	Hardening of procedures to increase operators consideration of supervisors recommendations	JICA
			Activate fiscal levers for improving control	Study of systems to compensate income loss due to operations suspension	GCF
	[2] Switch logging out from natural forests *(2.3: increase sustainable production through*	**Support development of forest plantation**	Develop smallholder plantations	Access of demands in material, forest data and training for managing plantations	GCF/JICA
				extension services (awareness raising, training on nursery or plantation management)	AusAID / other
				Propose incentives for example: half of seedlings provided	GCF
			Develop industrial plantations	Increase state owned plantations to reassure investors fearing land tenure issues	JICA
				Promote awareness raising campaigns with landowners on plantation	GCF
				Propose double royalties for landowners accepting plantation projects	GCF
				State any abandoned plantations for selling purpose	JICA
	[3] Valorize forest products *(2.2: promote alternative production and*	**Wood value chain approach**	Improve the Wood value chain	Analysis of the components of PNG wood Value Chain	International NGO?
				Favor multiplication of wood processing plants	GCF
				Valorization of wood plants' by-products (biomass-to-chips or biomass-to-power)	GEF (UNDP)
		Livelihood	Develop livelihood options based on forest products	Valorization of NTFPs though sensitization sessions	GCF
				Development of small-scale wood production (and PNGFA record system)	GCF
					GCF / JICA

Legend:

JICA

GCF

Other

SFM goal	Approaches	Sub-approaches	Objectives	PAMs	Examples of project activities	Possible supporters
Paradigm shift needs an Holistic approach: " Limit impact of Forestry activities on forest carbon" (this corresponds to the GCF CN (draft Jan 2018): component 2. improved management of production forests)	**Reduce the impact of logging in natural forests** (2.1: strengthen capacities for SFM)	Planning (repartition of activities)	*Maximize repartition of wood production activities*	*Land use planning*	*National and Province Forest Plans (NFP, PFP, FMP)*	*GCF concept note Component 1*
		Planning (regulation of activities)	Limit wood extraction through legal levers	Amendment of harvest quota (ex.: AAC, MMD)	Support PNGFA in adjusting harvest quota (ex.: AAC, MMD) by providing relibale data and methods and consulting stakeholders notably logging companies	JICA
			Incentivize good harvesting practices through fiscal levers	Test of fiscal measures influencing harvest practices	Study feasibility (stakeholders and costs/benefits) associated to fiscal arrangements such as fines, taxes, subsidies, bonds, etc.	GCF
					Experiment most suited systems (most efficient and easy) in focus provinces	GCF
			Incentivize good harvesting practices through commercial levers	Develop activities from wood trade standard organizations	Support development of commercial standards by involving them in the country's strategic decisions (ex.: LCoP review) and promote them in logging companies	GCF / EU
			Support operators practices	Disseminate knowledge on Reduced Impact Logging practices	Develop research, awareness raising and training programs for logging operators on Reduced Impact Logging practices and benefits (inc. financial benefits).	AusAID
				Enhance data/tools support for field harvesting	Support operators in planning and implementing field harvest (5-year, annual and setup plans) by providing data and planning tools (Lan Map, GPS, RS)	JICA
		Monitoring	Enhance monitoring of forest cover and carbon stock changes (RS	Continue development of FRIMS and DSS	Reinforce interrelations and specific roles between PNGFA's FRIMS and DSS systems	JICA / GCF
				Development of internet connection in provinces for monitoring purposes	Install logistic for internet in province offices for facilitating the use of Lan Map for monitoring and reporting	
				Develop Remote Sensing methods by acquiring high resolution images	Remote sensing method: cost estimation of high resolution images; evaluation of the capacity for detecting logging degradation; procurement of internet on the field (for FRIMS and Lan Map use)	JICA
			Enhance monitoring of forest cover and carbon stock changes (proxy	Report harvested volumes data	Forest data and Proxy method: regroup all data indicating wood volumes extracted (ex.: actual harvested volume located in Annual Logging Plan)	JICA
			Enhance monitoring of forest cover and carbon stock changes (Field	Monitor carbon damages collateral to timber extraction	Field method: facilitate and strengthen the accuracy of field assessment of logging impacts realized by project supervisors by bringing useful tools such as Lan Map, GIS and GPS	JICA
		Control	Improve the control of the compliance of logging operations	Fill internet connection, housing and vehicles needs for harvesting operations' control	Facilitate supervisors' reporting (by ICT procurement), moving (vehicles), independence (housing and regular re-affectation). And improve consideration of their assessment through increase strictness of countermeasures in case of non-compliance	GCF
	2.2: switch logging out from natural forests (2.3: increase sustainable production through plantation)		Prepare stakeholders (small and large scale) for plantations	Raise awareness on forest plantations	Build on on-going efforts to enhance awareness of landowners on plantation opportunities and of industrial logging companies (currently operating in natural forest or not) on attractiveness of PNG plantations	GCF
				Training for plantation management	Provide training on sustainable management of plantations: nursery management, longer rotation, agroforestry intercropped, local species,...	AusAID / other
			Support implementation and maintenance of industrial plantations	Meet demand in material and planning tools for developing plantations	Provide the support from PNGFA planning tools such as GPS and Lan Map for the installation and maintenance of industrial plantations (build on tool kit)	JICA
			Accompany small holders in developing plantations	Develop extension activities to small-holders for plantations	Provide training, seeds, agriculture material, etc. to develop small scale landowner own based plantations	GCF
	2.3: valorize forest products (2.2: promote alternative production and processing)		Wood value chain approach	Analyze the wood Value Chain	Review of data existing on the wood value chain and new small complementary analysis	GCF
				Dissemination of domestic wood processing plants	Foster the diffusion of sawmills thanks to incentives to private operators or, as organized and managed by PNGFA	GCF
				Valorization of wood plants' by-products (biomass-to-chips or biomass-to-power)	Facilitate sustainable production (ex.: process wood waste) and evaluate the possibility for power co-generation (feasibility study)	GEF (UNDP)
			Develop livelihood options based on forest products	Valorization of NTFP	Collect data, map priority areas and promote NTFP extraction activities as sustainable local livelihood (honey, butterfly farm, etc.)	GCF
				Development of small-scale wood production (and PNGFA record system)	Raise awareness of local communities to small scale logging compared to leases for industrial production	GCF
					Build on timber permit categories for registering small scale logging activities and evaluate best options to monitor and control such activities	GCF / JICA

Project idea 1: Improve management of control and monitoring of logging operations in natural forests		
[Objectives]	**[Needs]** Policies to achieve objectives	**[Requested support]** Project activities to support policies implementation
MONITORING		
Facilitate monitoring using Remote Sensing	Continue development of FRIMS and DSS database and management capacities	Reinforce interrelations and specific roles between PNGFA's FRIMS and DSS systems
	Development of internet connection in provinces for monitoring purposes	Install logistic for internet in province offices for facilitating the use of Lan Map for monitoring and reporting
	Acquisition of high resolution images	
Facilitate monitoring from data analysis	Facilitation of data collecting from operators (ex.: Actual harvested volumes from the ALP)	Strengthen capacities of collecting data from private companies and reporting into FRIMS
Facilitate field monitoring (of collateral damage)	Provision of FRIMS info (FBM, Lan Map) and GPS to field assessors	Bringing monitoring tools such as Lan Map, GIS and GPS to project supervisors and develop capacities to use
	Promotion of operators and communities' involvement in monitoring	Extension activities to explain and try to involve private companies and communities in monitoring
	Development of enabling conditions	Evaluate and provide necessary funds/staffs and review of 'field assessment sheet' document when necessary
CONTROL		
Improve logistic aspects of control	Facilitation of the independence of supervisors: vehicles, accomodations	housing and regular re-affectation
	Reporting of the control	ICT procurement
	Train PNGFA field officers to support operators in responding to supervisors' advices (one focal point, trainings, etc.)	
Improve technical aspect of control	Foster engagement of operators in post-harvest treatment	
Activate legal levers for improving control	Hardening of procedures to increase operators consideration of supervisors recommendations	
Activate fiscal levers for improving control	Study of systems to compensate income loss due to operations suspension	

Project idea 2: Development of forest plantations		
[Objectives]	**[Needs]** Policies to achieve objectives	**[Requested support]** Project activities to support policies implementation
Develop industrial plantations		
landowner negotiation	Access of demands in material, forest data and training for managing plantations including provision of drone	
analyze suitability of lands	Increase state owned plantations to reassure investors fearing land tenure issues	
maintenance of plantations	Promote awareness raising campaigns with landowners on plantation	
incentive propositions	State any abandoned plantations for selling purpose	
etc.	Propose double royalties for landowners accepting plantation projects	
Develop smallholder plantations		
	extension services (awareness raising, training on nursery or plantation management)	
	Propose incentives for example: half of seedlings provided	

Annex 35

Review of Information Provided from PNG-FRIMS for Provincial Forest Plan

Provincial Forest Plans

Content as suggested in Guidelines

PNGFA-JICA project, KKC, Feb 2018

Content of PFP

Part 1: introduction

Part 2: potential uses of the existing forest

Part 3: current forest uses

Part 4: forest development goals and GL

Part 5: future development of forests

Part 6: social forestry

Part 7: provincial action program

Part 8: Validity

Summary of PFP

Sections	Summary
1- Introduction	Gen obj, forest policy principles, persons producing and consulted
2- Potential uses of the existing forest	Definition services/products, service uses, product uses, land uses
3- Current forest uses	Protected Areas: status, activities; Production Areas: status, activities
4- Forest development goals and GL	Province goals using forests, priorities, safeguards
5- Future development of forests	Forest resources map, proposition of new PA: potential, priority. Proposition of new production areas: potential, priority
6- Social forestry	Current and expected extension activities : location, activities, actors
7- Provincial action program	Program, projects, activities, timeline
8- Validity	5 years

Part 1: introduction

Objectives (Forestry Act, 1991)

- Sustainable management and conservation
- PNG participation
- Economic growth
- Research, education and training

Principles (PNG national forest policy)

- Forestland conversion only if alternatives provide higher benefits
- Sustainable production for ecosystem services and timber resources (balance regeneration and extraction)

Stakeholders

Producers: Provincial government (Executive Council, Parliament, government organizations)

Consulted persons:

- Government officers, PFMC
- DEC, PNGFA
- Local government
- Landowner organizations
- NGOs

Part 2: potential uses of the existing forest

Definition
- Forest services: benefits from keeping forest
- Forest products**:** benefits from the removal of forest items

Service uses
- Protection of soils, water
- Conservation of ecosystems, biodiversity
- Low impact recreation

Product uses:
- Low impact: small amount or non-wood products (NTFP)
- High impact: high amount or industrial wood products

Priority in case of conflict: services > products

Land uses:

(1) Protected areas under different Acts (National parks, Fauna, Conservation, Water resources)

(2) Industrial wood production FMA: contract between PNGFA and landowners; PMC and LCoP

(3) Forest conversion: for agriculture or infrastructure land use (high pop density)

Part 3: current forest uses

Existing Protected Areas (PA): Name, Area, Reason for protection

Economic activities in PA
- Lodge
- Ecotourism tour
- Small activity (butterfly farm)

Existing production areas
- Unallocated TRP
- Allocated FMA:
  - ✓ Name, area, expiry date
  - ✓ Permitted cut (AAC for next 5 years with name and AAC = x m3 / annum)

Economic activities in FMA
- Domestic processing; Company, products, log input, log sources

Part 4: forest development goals and GL

Goals (that the province government is attempting to meet through the use of forests)

- Forest cover
- Livelihood
- Soil and water quality
- Biodiversity
- Employment
- Meets province demand in wood
- Export in PNG or abroad
- Production increase through plantations

Three priority goals should be set out

Guidelines = Safeguards

- Balance conservation and production
- Consult owners
- Minimize conversions

Part 5: future development of forests

Forest resource map for planning

- Areas not suited to commercial logging: slope > 30d, karst, inundated, cleared
- Areas suited to commercial logging: unallocated, allocated areas

Proposition of new PA

- Map of biodiversity values
- Priority areas: according to ecosystem services, genetic and bio diversity, cultural and economic opportunities through conservation
- Summary of forest resources

Proposition of new Production areas

- Map of timber values
- Priority areas

Features of priority areas for developing logging

- Identified areas submitted for consideration in the NFP
- Large enough with AAC > 30 000 m3 / 35 years (1000m3/y)

Merchantable volume available (m3/ha)	Minimum area (ha)
10 m3/ha	120 000 ha
30 m3/ha	40 000 ha

Part 6: social forestry

Current extension activities

- Information: location, activities, mapping
- Extension bodies: PNGFA, government, NGO, donors

Wished extension activities in the future

- Information: location, reason, activities, mapping
- Examples: nursery, technical support (RIL), forest plantation for landowners

Part 7: provincial action program

Set out a program of activities to implement PFP

Ex.: Workshop including ILG; Nurseries; Employ new extension workers

PAP: Prioritization of PFP objectives and associated strategies. One project plan for each objective need to be developed with:

- A work plan
- Resources
- Timeline

Validity

- Validity: 3 years : Review: before 3 years

Provincial REDD+ Action Plans
- Content -

PNGFA-JICA project, KKC, Feb 2018

Content of PRAP

Introduction

Part 1: Socio-economic situation

Part 2: Land covers and Land uses

Part 3: Deforestation / Degradation situation

Part 4: PRAP interventions

Part 5: Budget and funds

Part 6: Operational and institutional arrangements

Summary of PRAP

Sections	Content
Introduction	Period, goals, obj., legal text, accounting area
1: Socio-economic situation	Location, geography, economy, population, poverty
2: Land covers and Land uses	Past forest cover changes, current forest land uses, land tenure
3: Deforestation / Degradation situation	F cover changes by F type, DD areas and %, DD drivers and underlying factors
4: PRAP interventions	Protection, forestation, ANR, sustainable plantation management, reduction of fire wood, livelihood improvement, Awareness raising
5: Budget and funds	Activities, budget, sources of finance
6: Operational and institutional arrangement	Activities/timeline, involved organizations

Introduction

To ensure alignment with government plans

Planning period: 5 years

Goals
- Climate change mitigation
- Ecosystem services
- Biodiversity
- Climate resilient Forestry industry
- Livelihoods

Objectives
- Reduce deforestation in Protection Areas
- Reduce forest degradation in natural forest
- Forestation
- Sustainable plantation management

Legal decision underlying PRAP

Accounting area
- Accounting area: the entire province
- Participants: districts, communes, large forest owners

Name and position of staff preparing PRAP

Part 1: socio-economic situation

To understand socio-economic context

Administrative situation

Geography

Economy:
- Growth
- Annual revenues
- GRDP
- Key sectors
- Forestry sector details / incomes

Population
- Province
- Per district

Poverty rate

Part 2: land covers and land uses

To identify rates and locations of forest loss

Past forest cover changes
- Natural forest cover changes
- Plantation forest cover changes
- Etc.

Current forest land uses
- Forest vs. non forest
- Types of forest uses: special use, protection, production

Forest ownership and management by forest types

Part 3: Deforestation / Degradation situation

To identify the main drivers to be addressed by the provincial PAMs

Global trend
forest cover changes
Forest cover type: natural, plantations, etc.

DD values
DD rates per location (area 1)
Etc.

DD drivers and underlying factors
Driver 1: with underlying factors
Driver 2: etc.

Part 4: PRAP interventions

To elaborate Policies Actions and Measures PAMs which are:

- Realistic, implementable and link to drivers (sector and cross-sector)
- Based on conceptual models and theory of change

Example in VN

Site specific

- Protection
- Forestation
- Natural forest regeneration
- Sustainable Plantation Management
- Reduction of fire wood and biogas
- Livelihood improvement

Not site specific

- Replacement planting for areas deforested by infrastructure
- Awareness raising on REDD+, PRAP, SFM

Part 5: budget and source

To understand existing funds and additional funds required

Activities

- Forest management: protection, regeneration, forestation, SPM
- Socio-environmental activities: biogas, livelihood, awareness raising
- Management capacity building, monitoring and evaluation

Budget:

- Total: 65 MUSD
- Priorities:
  - Forestation
  - SPM
  - Protection
  - Regeneration

Potential sources of finance

- Province
- Specific provincial/national funds
- International donors

Part 6: operational and institutional arrangements

Prioritize and schedule PAM

Clarify institutions involved in PRAP implementation

Example in VN

Approval agency
Ex.: province committee

Executive agency
Ex.: Department of Agriculture and Rural Development

Other programmes to integrate

Executive agency intern branches involved

Other key agencies for implementation

Provincial Forest Plans

Guidelines

PNGFA-JICA project, KKC, Feb 2018

Content of PFP in Guidelines (1995)

Sections	Summary
1- Introduction	Gen obj, forest policy principles, persons producing and consulted
2- Potential uses of the existing forest	Definition services/products, service uses, product uses, land uses
3- Current forest uses	Protected Areas: status, activities; Production Areas: status, activities
4- Forest development goals and GL	Province goals using forests, priorities, safeguards
5- Future development of forests	Forest resources map, proposition of new PA: potential, priority. Proposition of new production areas: potential, priority
6- Social forestry	Current and expected extension activities : location, activities, actors
7- Provincial action program	Program, projects, activities, timeline
8- Validity	5 years

Adds-on in PFPs designed in 2008 (compared to 1995 GL)

Provinces	Adds-on in PFP content compared to PFP GL (1995)
New Ireland (2001)	
East Sepik (2001)	
Bougainville (2001)	Stakeholders feedback; SWOT analysis
Morobe (all 2008)	Review and maintenance
Oro	
Central	Province profile
Western highland	
Simbu	
Eastern highland	
Southern highland	
Sandaun (WNS)	Review and maintenance
Milne Bay	Background info; Overview of Forestry; Review and maintenance
Enga	
Manus	State of the province; Governance; Carbon trading; Provincial forest administration
Gulf	Agroforestry; Training; Workshop; Seminars
Western	Seminars; Review and maintenance
WNB	Future development (carbon trading, plantations, RD, community forestry, natural regeneration); Review and maintenance
ENB	Provincial profile
Madang	State of the province; Stakeholders feedback; Plantations, PAM, Carbon, Com Forestry

In addition, all provinces chose to make "Analysis of current situation" originally in the chapter 'Future development' a single chapter

Position of new sections in PFP 2008 versions

No	Adds-on = new sections	Position in the GL's table of content
1	Provincial profile; Background; State	After "Intro"
2	Stakeholder feedback	After "Current forest uses" or before "Development goals"
3	SWOT analysis	After "Stakeholder feedback"
4	Analysis of the current situation; Current status of Forest resources; Forest resources summary	Extracted from "Future development" and showed before
5	Governance; Province forest administration	After "Future development" and after "PAP"
6	Carbon trading; Forestation (plantation, regeneration); Community forestry; R/D; Policies and Measures	Part of or after "Future development"
7	Seminar; Workshop; Training; Agroforestry	Part of "Social forestry"
8	Monitoring; Review and maintenance of action plan	After "PAP"

Content of new sections 1/2

No	Adds-on	Content
1	Provincial profile; Background; State	- Location - Soil and Climate - Vegetation - Demography - Economy (general and Forestry)
2	Stakeholder feedback	- Consultation activities and organizers - Landowner and government objectives
3	SWOT analysis	- Strengths and weaknesses: people, resources - Opportunities and threats: political, economical
4	Analysis of the current situation; Current status of Forest resources; Forest resources summary	- Forest resource map for planning : • Areas not suited to commercial logging: constraint areas (slope > 30d, karst, inundated, cleared) • Areas suited to commercial logging - Forest resource status: unallocated, allocated areas ,…

Content of new sections 2/2

No	Adds-on	Content
5	Governance; Province forest administration	Needs in: - Technical staff for monitoring, reforestation, extension - Administrative staff
6	<u>SFM initiatives other than Protected Areas and FMAs</u> Carbon trading; Forestation (plantation, regeneration); Community forestry; R/D; Policies and Measures	1 – Carbon opportunities (CDM AR, REDD, PES). Existing & proposed areas for: - Plantation: species, area - Natural regeneration (in natural production forests) - Community forestry: activities with rural communities • Small scale sawmill, province Timber Market Unit • Woodlot planting: smallholders plantation 2 – Others: - Research & Development; - Policies Actions and Measures development
7	Seminar; Workshop; Training; Agroforestry	- Small scale sawmill, logging, plantation, agroforestry - Biodiversity management, FSC guidelines, RIL, REDD+, etc.
8	Monitoring; Review and maintenance of action plan	- Three years after the start of the Province Action Plan - By PFMC (Province) with support from NFS (PNGFA)

Suggestions of content in new guidelines

Introduction + Potential uses of the existing forest

1. **Province profile + Stakeholders feedback and SWOT analysis**
2. **Current forest uses**
3. **Forest development goals and safeguard**
4. **Analysis of the situation** (suitability analysis)
   - Forest resources map
   - Not suited vs. suited areas for logging (environmental suitability/constraints)
   - Not suited vs. suited areas for logging (status)
5. **Future development of forests:**
   - Proposition of PA: potential areas, priority areas
   - Proposition of FMA: potential timber, priority areas
   - Proposition of Forest plantations: potential, priority
   - Proposition of further initiatives promoting SFM and REDD+ objectives
6. **Social forestry** (seminar, workshop, training)
   - Current extension activities (actors, locations)
   - Proposed extension activities
7. **Provincial action program**
   - Programme, projects, activities and timelines
   - Needs in technical and administrative staff
8. **Validity, Monitoring & Evaluation**

Content in new GL = content in 1995 GL + new content in 2008 PFPs

In black unchanged;
In red new positions;
In blue new sections.

Simulation PFP GL 2018

Sections	Content
Introduction	Objectives, principles, stakeholders, Potential uses of the existing forest
1- Province profile	Location, Soil and Climate, Vegetation, Demography, Economy, Stakeholders feedback, SWOT analysis
2- Current forest uses	Protected Areas: status, activities; Production Areas: status, activities
3- Forest development goals and GL	Province goals using forests, priorities, safeguards
4- Analysis of the situation (land suitability analysis)	Forest resources map, areas not suited to logging, areas environmentally suited, status of areas
5- Future development of forests	Proposition of potential and priority areas for new Protected Areas, FMAs, plantations and other
6- Social forestry	Current and expected extension activities (location, activities, actors) including seminar, workshop, training
7- Provincial action program	Program, projects, activities, timeline; needs in human resources
8- M & E	Validity of the plan, monitoring and evaluation act scheduled

PFP Guideline 1995	New Ireland	East Sepik	Bougainville	Morobe
	2001-200	2002-200	2001-201	2008-201
Introductio	Introductio	Introductio	Introductio	Introductio
Potential Uses of the Existing Fores	Potential Uses of the Existing Fores	Potential Uses of the Existing Fores	Bougainville Government Forest Objectiv	Potential Uses of the Existing Fores
Current Forest Use	Current Forest Use	Current Forest Use	Potential Uses of the Existing Fores	Current Forest Use
Province Development Goals and Guidelin	NIP Forest Development Goals and Guidelin	ESP Forest Development Goals and Guidelin	Current Forest Use	Provincial Forest Development Goals and Guidelin
Future Development of Forest in Provinc	Analysis of Current Situatio	Analysis of Current Situatio	Stakeholder Feedbac	Analysis of Current Situatio
Social Forestry	Future Development of Forest in NI	Future Development of Forest in ESI	Strengths; Weaknesses; Oportunities; Threa	Future Development of Forest in MI
Provincial Action Program	Social Forestry	Social Forestry	B Forestry Development Guideline	Social Forestry
Validity	Provincial Action Program	Provincial Action Program	Future Development of Forest in	Provincial Action Program
	Validity	Validity	Social/Extension Forestry	Review and Maintenanc
			B Forestry Sector Implementation Action Progra	Validity
			Validity	

Oro	Central	Western Highland	Simbu	Eastern Highland
2008-201	2008-201	2008-201	2008-201	2008-201
Introductio	Introductio	Introductio	Introductio	Introductio
OP Forest Development Goals and Guidelin	Provincial Profile	Potential Uses of the Existing Fores	Potential Uses of the Existing Fores	EHP Forest Development Goals and Guidelin
Analysis of Current Situatio	CP Forest Development Goals and Guidelin	Current Forest Use	Current Forest Use	Potential Uses of the Existing Fores
Potential Uses of the Existing Fores	Potential Uses of the Existing Fores	WHP Forest Development Goals and Guidelin	SP Forest Development Goals and Guidelin	Current Forest Use
Current Forest Use	Current Forest Use	Analysis of Current Situatio	Analysis of Current Situatio	Analysis of Current Situatio
Future Development of Forest Resourse in C	Analysis of Current Situatio	Future Development of Forest in WH	Future Development of Forest in S	Future Development of Forest in EH
Social Forestry	Future Development of Forests in C	Social Forestry	Social Forestry	Social Forestry
Provincial Action Program	Provincial Action Program	Provincial Action Program	Provincial Action Program	Provincial Action Program
Validity	Validity	Validity	Validity	Validity

Southern Highland	Sandaun Province	Milne Bay	Enga	Manus
2008-201	2008-201	2008-201	2008-201	2008-201
Introductio	Introductio	Introductio	Introductio	Introductio
SHP Forest Development Goals and Guidelir	Potential Uses of the Existing Fores	Back Ground Informatic	Potential Uses of the Existing Fores	State of the Provinc
Current Forest Use	Current Forest Use	An Overview of Forestry in MB	Current Forest Use	Governanc
Potential Uses of the Existing Fores	SP Forest Development Goals and Guidelin	Potential Uses of the Existing Fores	EP Forest Development Goals and Guidelin	Potential Uses of the Existing Fores
Analysis of Current Situatio	Analysis of Current Situatio	Current Forest Use	Analysis of Current Situatio	Current Forest Use
Future Development of Forest in SH	Future Development of Forest in S	Analysis of the Current Situatio	Future Development of Forest in E	MP Development Vision and Priorities
Social Forestry	Social Forestry	Future Development of Forest in MB	Provincial Action Program	MP Forest Development Guideline
Provincial Action Program	Provincial Action Program	Community Forestry	Validity	Analysis of Current Situatio
Validity	Review and Maintenanc	MBP Forest Development Goals and Guidelin	*"Social Forestry" and is included in item of Future	Future Development of Forests in MI
	Validity	Provincial Action Program	Development of Forest.	Social Forestry
		Plan Review and Maintenanc		Carbon Tradin
		Validity		Provincial Forest Administratio
				Provincial Action Program
				Validity

Gulf	Western
2008-201	2008-201
Introductio	Introductio
GP Forest Development Goals and Guidelin	Current Situation Analysis
Potential Uses of the Existing Fores	Future Development of Forest in W
Current Forest Use	WP Action Program
Analysis of Current Situatio	Forest Seminars
Future Development of Forest in G	Plan Review and Maintenanc
Social Forestry	Validity
Agro-Forestry	
Training Workshop	
Seminars	
Provincial Action Program	
Validity	

Table of Contents in PFP Guideline 1995	Required Information	Information Provide		Data/Information Necessity	Linkage with NFP	Potential of FRIMS	
		Province	PNGFA				
Introduction	-	-	-	-			
Plan Development	-	-	-	-			
Plan Production Offer by PNGFA	-	-	-	-			
Submission of the Completed Plan	-	-	-	-			
Glossary	-	-	-	-			
Draft of Provincial Forest Plan	-	-	-	-			
1. Introduction							
	Participant to complete this plan	*		must			
2. Potential Uses of the Existing Forest							
- Forest Services and Products							
- Protected Areas or Restrictions on Forest Use							
- Industrial Wood Production Through Forest Management Agreements							
- Forest Conversion							
3. Current Forest Uses							
- Gereral Forest Use	Information about any other current uses of the forests	*		must			
- Existing Protected Areas	Existing protected areas		*	will			
- Existing Economic Activity Based on Protected Areas	Information on the economic activities	*		must			
- Existing Industrial Wood Productions Areas	Unallocated areas (TRPs)		*	will			
	Allocated areas (TP/LFA)		*	will			
	Permitted volume by TP/LFA		*	will			
- Existing Economic Activity Based on Production Areas	Current domestic processing volume		*	will			
4. Province Development Goals and Guidelines							
- provincial Goals	Statement setting out the goals	*		must			
	Priority of the statement	*		must			
- Province Forestry Development Guidelines	Guidelines for any future forestry development	*		must			
5. Future Development of Forest in Province							
- Forest Resource Map for Plannning	Copy of forest resource map		*	will			
	A summary of area		*	will			
- Development of Further Protected Areas	Copy of CNAmap		*	will			
	Priority areas for conservation	*		may			
- Development of Further Industrial Wood Production	Priority areas for development of sustainable commercial forestry	*		may			
6. Social Forestry							
	Extension activities by Forest Authority		*	will			
	Forest extension activities be except for Forest Authority	*		should			
	Additional forest extension activities it would like to see set u	*		may			
7. Provincial Action Program							
	Activities to support the implementation of PFP	*		may			
8. Validity							
	Date the plan will be reviewed	*		must			

Information sought for planning			Most suited sources of info	Availavbility in PNG-FRIMS	
			Legend: PAD: project allocation directorate; FS: field services; PFO: Province Forest Officers; FDD: Forest Development Directorat; DSS: Decision Support System; CEPA: Conservation and Enviro protection authority	**Current situation:** **- To update if available but outdated** **- To integrate if not available yet**	**Recommended approach (to enhance FRIMS)**
I - Current forest uses	*1) Forest cover map*		Forest Cover Map 2015	To integrate	On-going design of FBM 2020
	2) Current Protected Areas (PA)	Area name, areas (ha), status, activities	CEPA	To update	From CEPA updates (Aug 2019) update PA in FRIMS
	3) Current Production Areas	Total potential productive area and volume	FRIMS (FIMS): - Adjusted Forest Area (estimated gross F area - constraints - PA areas) - Revised Gross Vol (gross forest vol - constraint area vol - PA area vol)	To update	Update constraints (Inundation and Karst) if there's possible method
		FMA status	- PAD, FS, ALP for info on the status (acquired/allocated) - FRIMS (FIMS) concessions list and maps for info on operations (logged/unlogged)	- To integrate status - To update LOA	- From PAD, FS data, input FRIMS on status - On-going digitalization of LOA (Evelyn) and clarification of proposed/logged area (Okada, Patrick)
		AAC permitted cut	PAD, FS	To integrate	Create new attribute to logging concessions
		Processing activities	Province, PFO, DSS	To integrate	Create new attribute to logging concessions
		TA (small areas)	PAD, FS	To integrate	Record permit and location
		Community Forerstry	PFO	To integrate	Record activities and location
		FCA	PAD and FRIMS only listing of FCA areas)	To update	From PAD and ground thruthing, list, status and map
		Forest plantations (project area, species, vol extracted)	FDD and FRIMS	To update	Ground thruthing (GPS), logging companies' info
II - Future development of forests	*1) Forest resources map*	Areas not suited to commercial logging (using bulldozer): slope, karst, inundated, LOA, PA,…	FRIMS/FBM/FCM2015 (constraints areas)	To integrate	New FBM 2020
		Areas suited to commercial logging with status	Total forest areas - constraint areas (FRIMS, FIMS) - PA areas - concession areas	To integrate	From logging companies info and PFO, update status and boundaries
	2) Proposition of new Protected Areas (PA)	Suited to conservation (Bd map)	CEPA assessment	To integrate	From CEPA, create a new layer in FBM
		Priority areas: Bd, cultural intel. heritage and economic opportunities	CEPA, Province or LLG	To integrate	From CEPA, create a new layer in FBM
	3) Proposition of new FMAs	Suited areas	Total forest areas - constraint areas (FRIMS, FIMS) - concession areas	To integrate	From logging companies info and PFO, update status and boundaries
		Priority areas S>120,000ha if gross vol = 10m3/ha S> 40,000ha if gross vol = 20m3/ha	FRIMS (FIMS): can be calculated from Revised Gross Vol (gross forest vol - constraint area vol)	To update	Based on timber estimated content, create a GIS layer for priority areas to logging
	3) Proposition of new Forest plantations	Suited areas (degraded LOA + grasslands)	- FBM gives grasslands - DD map gives heavily degraded areas	To update	Update DD map according to update of FCM
		Priority areas	Preferable soils and near economic centers	To integrate	From PNGRIS and NFI, create a GIS layer for soils
III - Non forest data	*1) Social Forestry*	Current extension activities such as woodlot settlement, nurseries, workshops, etc. (Location; Act)	PFO	To integrate	In priority integrate smallholder plantations support
		Suited areas for new extension activities	PFO	To integrate	In priority integrate smallholder plantations support
	2) Timber value chain	Annual harvest rates per concession	FS and Annual Logging Plan	To integrate	From ALP find "Actual Harvested Vol" and digitalize it
		Timber production	DSS, Province, Marketing branch	To integrate	Integrate in DSS or FRIMS? Data of logs extracted for each concessions to put in FRIMS
		PNG processing	PFO	To integrate	Add an attribute to logging concessions in FRIMS
		Log exports (shipped logs)	SGS	To integrate or not	Integrate in DSS or FRIMS? Data of logs extracted for each concessions to put in FRIMS
	3) Economic beneftis	Royalties	FS Royalty officers	To integrate	Add an attribute to land owners once created
		Revenues, taxes, fees, infrastructure, jobs	Province, PFO, DSS	To integrate or not	Integrate in DSS or FRIMS? Data of logs extracted for each concessions to put in FRIMS

Contribution of PNGFA-JICA project in the review process of Provincial Forest Plans

PNGFA-JICA project. 2018/03/02

Activities and objectives

Activities realized

Act. 1
Preliminary review of Guidelines

Act. 2
Analysis of data required to review PFP and FRIMS potential support

Achievements

- Summary of GL
- Proposition of content for new GL

- Evaluation of coordination systems for data collect
- Broad assessment of data sources
- Orientations for FRIMS improvement

Expected outcomes from future activities

→ New PFP GL to be used by PNGFA for advising provinces

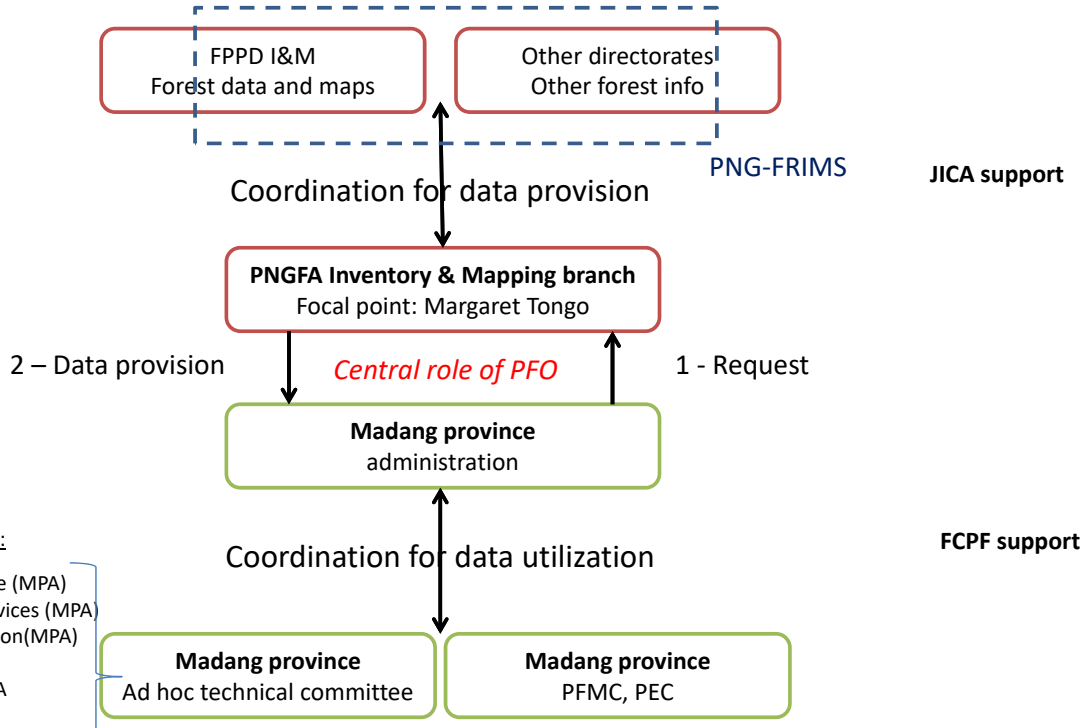
→ Identification of reliable forest data in Madang province

=> New (or revised) PFP for the Madang province

Planning orientations for NFP

Planning orientations for REDD+ provincial activities

Agencies coordination to review Guidelines and PFPs



Expected members:

1. Planning office (MPA)
2. Economic Services (MPA)
3. Forestry Division(MPA)
4. PFO Madang
5. Rep from CEPA
6. Rep from TNC
7. Rep from Industry
8. Local NGO Rep

Review of Guidelines for PFP (act. 1)

Focal point: Margaret Tongo (PNGFA FPPD I&M senior officer)

Content of PFP guidelines 1995

Sections	Summary
1- Introduction	Gen obj, forest policy principles, persons producing and consulted
2- Potential uses of the existing forest	Definition services/products, service uses, product uses, land uses
3- Current forest uses	Protected Areas: status, activities; Production Areas: status, activities
4- Forest development goals and GL	Province goals using forests, priorities, safeguards
5- Future development of forests	Forest resources map, proposition of new PA: potential, priority. Proposition of new production areas: potential, priority
6- Social forestry	Current and expected extension activities : location, activities, actors
7- Provincial action program	Program, projects, activities, timeline
8- Validity	5 years

Additional content found in PFPs designed in 2008

In black unchanged
In red new positions
In blue new sections

Introduction + Potential uses of the existing forest

1. **Province profile + Stakeholders feedback; SWOT analysis**
2. **Current forest uses**
3. **Forest development goals and safeguard**
4. **Analysis of the situation** (suitability analysis)
   - Forest resources map
   - Not suited vs. suited areas for logging (environmental suitability/constraints)
   - Not suited vs. suited areas for logging (status)

1. **Future development of forests:**
   - Proposition of PA: potential areas, priority areas
   - Proposition of FMA: potential timber, priority areas
   - Proposition of Forest plantations: potential, priority
   - Proposition of further initiatives promoting SFM and REDD+ objectives

1. **Social forestry** (seminar, workshop, training)
   - Current extension activities (actors, locations)
   - Proposed extension activities

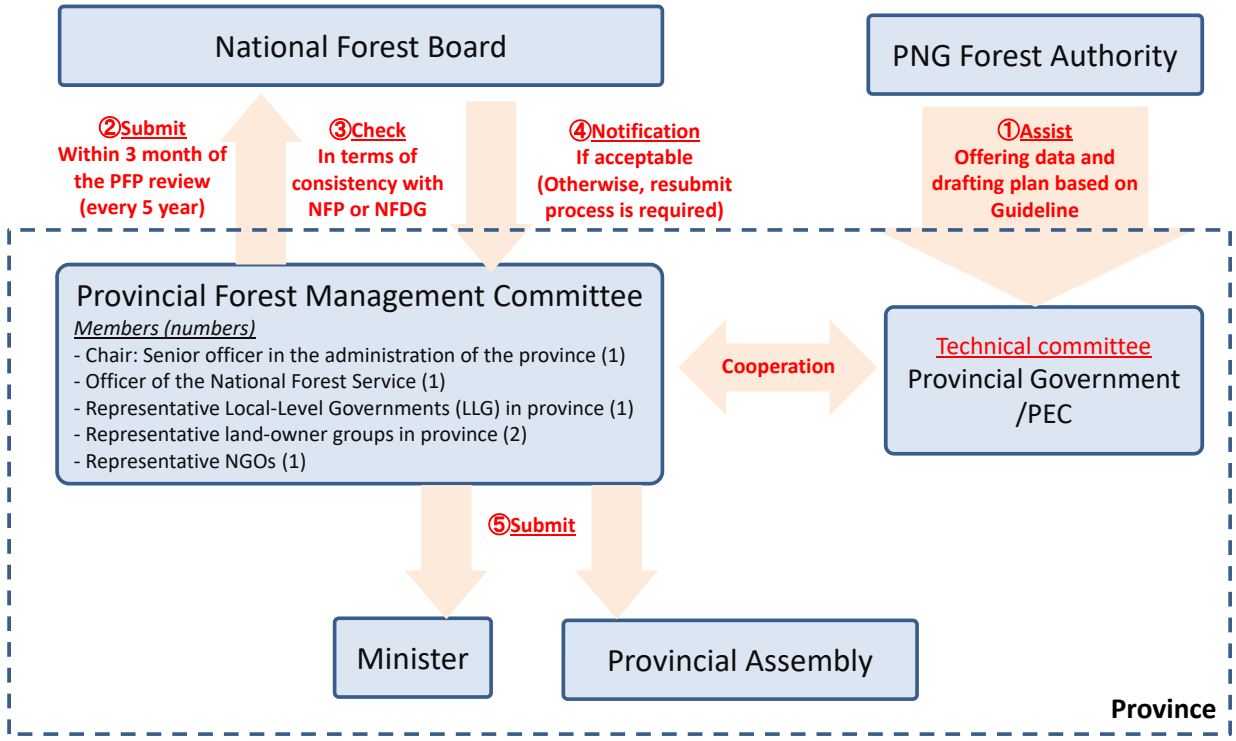
1. **Provincial action program**
   - Programme, projects, activities and timelines
   - Needs in budgets, and technical and administrative staff

1. **Validity, Monitoring & Evaluation**

What PFP GL 2018 would look like?

Sections	Content
Introduction	Objectives, principles, stakeholders, Potential uses of the existing forest
1- Province profile	Location, Soil and Climate, Vegetation, Demography, Economy, Stakeholders feedback, SWOT analysis
2- Current forest uses	Protected Areas: status, activities; Production Areas: status, activities
3- Forest development goals and GL	Province goals using forests, priorities, safeguards
4- Analysis of the situation (land suitability analysis)	Forest resources map, areas not suited to logging, areas environmentally suited, status of areas
5- Future development of forests	Proposition of potential and priority areas for new Protected Areas, FMAs, plantations and other
6- Social forestry	Current and expected extension activities (location, activities, actors) including seminar, workshop, training
7- Provincial action program	Program, projects, activities, timeline; needs in human resources
8- Budget and source of funding	Cost estimation (act./budget), possible funds (province, PNGFA, external)
9- M & E	Validity of the plan, monitoring and evaluation act scheduled

Approval process of Provincial Forest Plans



Review of data required for PFP (act. 2)

Focal point: Jehu Antiko (PNGFA FPPD I&M cartographer)

Types of information required to design PFPs

Strategic orientations

- Province goals through using forest
- Safeguards (guidelines)
- PoA to implement the provincial forest plan
- Other practical information (extension officers…)

Formulated by the provincial government

Support from FCPF 2 project

+

Forest data

- Current forest uses
- Data to plan future development
- Extension services and economic data

N.B: data such as requested from:
- GL of 1995
- PFP designed in 2008
- FCPF request in 2018

Requested by the province to PNGFA

Support from JICA project

=

Design Province Forest Plans in line with economic and environmental/climatic country's perspectives

Finding most updated data 1/2

Information sought	Most updated sources	Possible ways of improving FRIMS
1) To describe current forest uses		NB: these options need examination of technical and budget feasibility
Existing Protected Areas (PAs)	CEPA, FRIMS	To update based on CEPA update Aug 2019
Existing production areas: Total	FRIMS (FIMS): - Adjusted Forest Area - Revised Gross Volume	Update constraints (Inundation and Karst) if there is possible method
FMA	- FMA status: PAD, FS - Logged Over Areas: FRIMS	- To integrate in FRIMS - To update
AAC	PAD	To integrate in FRIMS
Processing activities	Province, PFO, DSS	To integrate in FRIMS
TA	PD/FS	To integrate in FRIMS
FCA	PAD, FRIMS	To update
Community forestry	PFO	To integrate in FRIMS
Plantations	FDD, FRIMS	To update

Legend: PAD: Project Allocation Directorate; FS: Field Services; PFO: Province Forest Officers; FDD: Forest Development Directorate; DSS: Decision Support System; CEPA: Conservation and Enviro Protection Authority

Finding most updated data 2/2

Information sought	Most updated sources	Possible ways of improving FRIMS
2) To plan future development of forest		NB: these options need examination of technical and budget feasibility
Forest resources map	Forest Cover Map 2015	On-going design of FCM 2020
Suited and priority areas for PA (biodiversity and other values)	CEPA assessment, Province or LLG	To integrate in FRIMS
Suited and priority areas for FMA (constraint, timber density, etc.)	FRIMS/FIMS	To update
Suited and priority areas for plantations (degraded forest and grasslands, soil)	Forest Base Map, DD map PNGRIS and NFI for update	To update
3) Non forest data		
Existing and proposed extension activities and locations	PFO	To integrate in FRIMS
Timber value chain: Annual harvest rates	FS, data in ALP: "Actual harvested volume"	To digitalize in FRIMS
Timber production	DSS, marketing branch, prov	To integrate in FRIMS
Log export	SGS, Export branch	No integration expected
Royalties	FS royalty officers	No integration expected
Revenues, taxes, fees, infrastructures, jobs	Province, PFO, DSS	No integration expected

Legend: PAD: Project Allocation Directorate; FS: Field Services; PFO: Province Forest Officers; FDD: Forest Development Directorate; DSS: Decision Support System; CEPA: Conservation and Enviro Protection Authority

Way forward

Needs:

1. **Consideration of resource limitation** within PNGFA and PNGFA/JICA project especially for the work of PFP review initiated by provinces with FCPF support
2. **Coordination with different directorates/branches of PNGFA** for data collect
3. **Coordination with PNGFA-JICA project** (PNGFA cartographers and KKC IT experts) for maximizing PNG-FRIMS potential in providing data [under project limitations]
4. **Identify reasons preventing some provinces from endorsing** and implementing their PFP
5. **Evaluate the replicability to all other provinces** of efforts involved in the pilot provinces: new GL, identification of reliable data sources, inter-agencies collaboration, etc.

Some preliminary suggestions for new guidelines:

1. **Not too complex** (ex.: avoid accurate analysis of deforestation drivers) and fitting with institutional capacities in PNGFA and provincial administrations
2. **Consultation to embrace and reflect in GL the variety of contexts and needs in provinces** especially those with a significant part of their economy coming from the Forestry/logging sector
3. **Appropriate to the new context of PNG** in terms of technologies, business opportunities, new weather patterns, REDD+,…

Details available in annexes

Annex 1: summary PFP guidelines 1995 (Ppt)

Annex 2: summary guidelines PRAP (Ppt)

Annex 3: evolution of PNG PFP guidelines (Ppt)

Annex 4: comparison of the content of 2008 PFPs (Xls)

Annex 5: required data and data sources for PFP review (Xls)

Annex 36

Contribution of Spatial Information for Identifying HCV / HCS Forest (Methodological Analysis)

Contribution of spatial information for identifying HCV/HCS forest

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

Identifying HCV forest

Six HCVs

An HCV (High Conservation Value) is a biological, ecological, social or cultural value of outstanding significance or critical importance.

HCV 1: Species diversity

HCV 2: Landscape-level ecosystems and mosaics

HCV 3: Ecosystems and habitats

HCV 4 : Ecosystem services

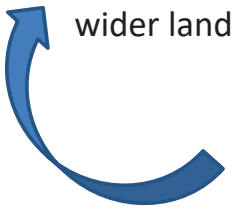
HCV 5 : Community needs

HCV 6 : Cultural values

HCV approach

1. Identification

1.Interpreting what the six HCV definitions mean in the local or national context
2.Deciding which HCVs are present in the area of interest or which HCVs in the wider landscape may be negatively impacted by project activities.



Stakeholder consultation
Analysis of existing information
Collection of additional information

Including
Spatial infromation

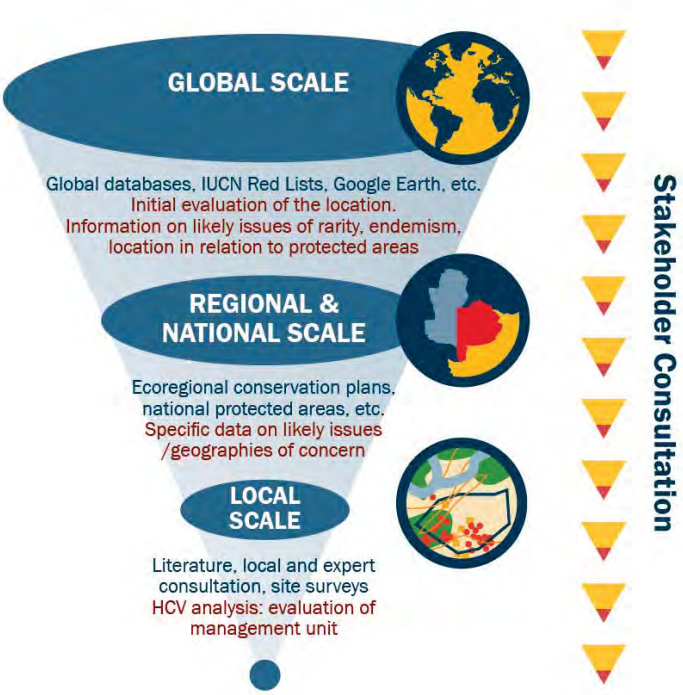
2. Management

Appropriate management decisions must be taken and implemented in order to maintain or enhance an HCV.

3. Monitoring

A monitoring regime should be established to ensure that management practices effectively maintain and/or enhance the HCVs over time.

Level of information



The figure is referred from "Common Guidance for the HIGH CONSERVATION VALUES"

The HCV assessment will ultimately be conducted at the site scale, requiring field survey data.

Global and national scale assessment is conducted as a scoping study prior to continuing with the full HCV assessment.

Access to national information is a key to identify specific country-level values saving money and resources for not carrying out a full HCV assessment for this area.

HCV 1: Species diversity

Concentrations of biological diversity including endemic species, and rare, threatened or endangered (RTE) species that are significant at global, regional or national levels.

The following would qualify as HCV 1:

- A high overall species richness, diversity or uniqueness.
- Populations of multiple endemic or RTE species.
- Important populations or a great abundance of individual endemic or RTE species.
- Year-round (e.g. key habitat for a specific species) or,
- Seasonally, including migratory corridors, sites for breeding, roosting or hibernation, or refuges from disturbance.
- Small populations of individual endemic or RTE species.
- Sites with significant RTE species richness, or populations of priority species.
- Particularly important genetic variants, subspecies or varieties.

Indicators:

- The presence of a recognized biodiversity priority area
- A designation by national authorities, or by reputable conservation organizations
- The presence of natural habitat in good condition

HCV 2: Landscape-level ecosystems and mosaics

Large landscape-level ecosystems and ecosystem mosaics, that are significant at global, regional or national levels, and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance.

The following would qualify as HCV 2:

- Large areas (e.g. could be greater than 50,000 ha, but this is not a rule) that are relatively far from human settlement, roads or other access.
- Smaller areas that provide key landscape functions such as connectivity and buffering. These smaller areas are only considered HCV 2 if they have a role in maintaining larger areas in the wider landscape.
- Large areas that are more natural and intact than most other such areas and which provide habitats of top predators or species with large range requirements.

Indicators:

- Existing landscape-level designations (e.g. Ramsar sites, etc.)
- Areas with low levels of overall disturbance and high connectivity
- Large, undisturbed landscape-level forests comes from the World Resources Institute
- Other forests matching criteria (with an area of at least 500 km^2 etc.)

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

HCV 3: Ecosystems and habitats

Rare, threatened, or endangered ecosystems, habitats or refugia.

The following ecosystems would qualify as HCV 3:

- Naturally rare because they depend on highly localised soil types, locations, hydrology or other climatic or physical features.
- Anthropogenically rare, because the extent of the ecosystem has been greatly reduced by human activities compared to their historic extent.
- Threatened or endangered (e.g. rapidly declining) due to current or proposed operations.
- Classified as threatened in national or international systems.

Indicators:

- In regions where many natural ecosystems or habitats have been eliminated, and others have been heavily impacted by development, remaining natural ecosystems of reasonable quality are likely to be HCV 3.
- Where ecosystem proxies indicate the presence of RTE ecosystems, even if these are inaccessible or have not been confirmed on the ground.

HCV 4 Ecosystem services

Basic ecosystem services in critical situations including protection of water catchments and control of erosion of vulnerable soils and slopes.

The following ecosystem (services) would qualify as HCV 4:

- Managing extreme flow events
- Maintaining downstream flow regimes
- Maintaining water quality characteristics
- Fire prevention and protection
- Protection of vulnerable soils, aquifers and fisheries
- Provision of clean water
- Protection against winds, and the regulation of humidity, rainfall etc.
- Pollination services
- Ecosystems which provide a protective barrier against destructive fires that could threaten communities, infrastructure or other HCVs.
- Groundwater recharge zones
- Grasslands providing buffering against flooding or desertification

Indicators:

- Remote and/or poor rural areas
- Where there is naturally low soil fertility
- Upstream of extensive or important wetlands, fish nurseries and spawning grounds, or sensitive coastal
- Upstream of municipal water sources
- Steep areas, or areas of high rainfall
- Arid or dryland areas particularly susceptible to erosion and desertification

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

HCV 5 : Community needs

Sites and resources fundamental for satisfying the basic necessities of local communities or indigenous peoples (for example for livelihoods, health, nutrition, water), identified through engagement with these communities or indigenous peoples.

The following would qualify as HCV 5:

- Hunting and trapping
- Fuel for household cooking, lighting and heating
- NTFPs such as nuts, berries, mushrooms medicinal plants, rattan
- Fish other freshwater species relied on by local communities
- Building materials
- Fodder for livestock and seasonal grazing
- Water sources necessary for drinking water and sanitation
- Items which are bartered in exchange for other essential goods, or sold for cash

Indicators:

- Access to health centres or hospitals is difficult,
- There is little or no water and electricity infrastructure
- People have a low capacity to accumulate wealth (living “day to day”)
- Farming and livestock raising are done on a small or subsistence scale
- Indigenous hunter-gatherers are present
- etc.

HCV 6: Cultural values

Sites, resources, habitats and landscapes of global or national cultural, archaeological or historical significance, and/or of critical cultural, ecological, economic or religious/sacred importance for the traditional cultures of local communities or indigenous peoples, identified through engagement with these local communities or indigenous peoples.

The following would qualify as HCV 6:

- Sites recognised as having high cultural value within national policy and legislation.
- Sites with official designation by national government and/or an international agency like UNESCO.
- Sites with recognised and important historical or cultural values, even if they remain unprotected by legislation.
- Religious or sacred sites, burial grounds or sites at which traditional ceremonies take place that have importance to local or indigenous people.
- Plant or animal resources with totemic values or used in traditional ceremonies.

Indicators:

- No description in the guidance

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

Availability of spatial information for HCV identification

	Global (examples)	National (in case of PNG)
Biodiversity priority area	Global IUCN Red List	Biodiversity priority area (CEPA)
Designation of authorities	World Heritage Sites	Protected area (CEPA)
Natural habitat	Ramsar sites	Biodiversity priority area (CEPA)
Low levels of disturbance	Hansen loss	Forest cover map (PNGFA)
High connectivity	Hansen tree-cover	Forest cover map (PNGFA)
Remaining natural ecosystems	Intact Forest Landscapes	Forest cover map (PNGFA)
Presence of RTE ecosystems	Global IUCN Red List	Biodiversity priority area (CEPA)
Remote and/or poor rural areas	Open Street Maps	Census unit (PNG statistical office)
Naturally low soil fertility	FAO/UNESCO Soil Map	PNGRIS (UPNG)
Important wetlands	CIFOR map	Forest cover map (PNGFA)
Municipal water sources	---	---
Steep areas, or areas of high rainfall	WorldClim	PNGRIS (UPNG)
Arid or dryland areas	WorldClim	PNGRIS (UPNG)
Access to health centres or hospitals	Open Street Maps	GeoBook (UPNG)
Water and electricity infrastructure	---	---
Low capacity to accumulate wealth	---	---
Living “day to day”	---	---
Small or subsistence scale farming	---	Forest cover map (PNGFA)
Indigenous hunter-gatherers	---	---

Identifying HCS forest

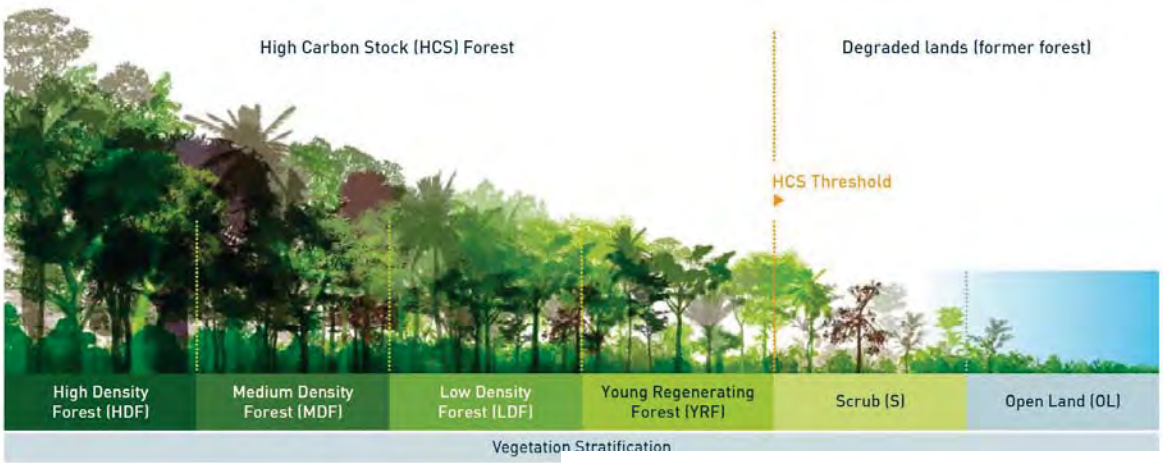
Capacity Development for Operationalization of PNG Forest Resource Information Management System for Addressing Climate Change

HCS Approach

+Secondary forests etc. are often not considered to be HCV and are consequently not protected.

+HCS Approach is the first practical, field-tested methodology for distinguishing forest areas that should be protected.

+HCSA uses field data on levels of biomass, vegetation structure and composition, together with a view from above (satellite or Light Detection and Ranging – LiDAR).



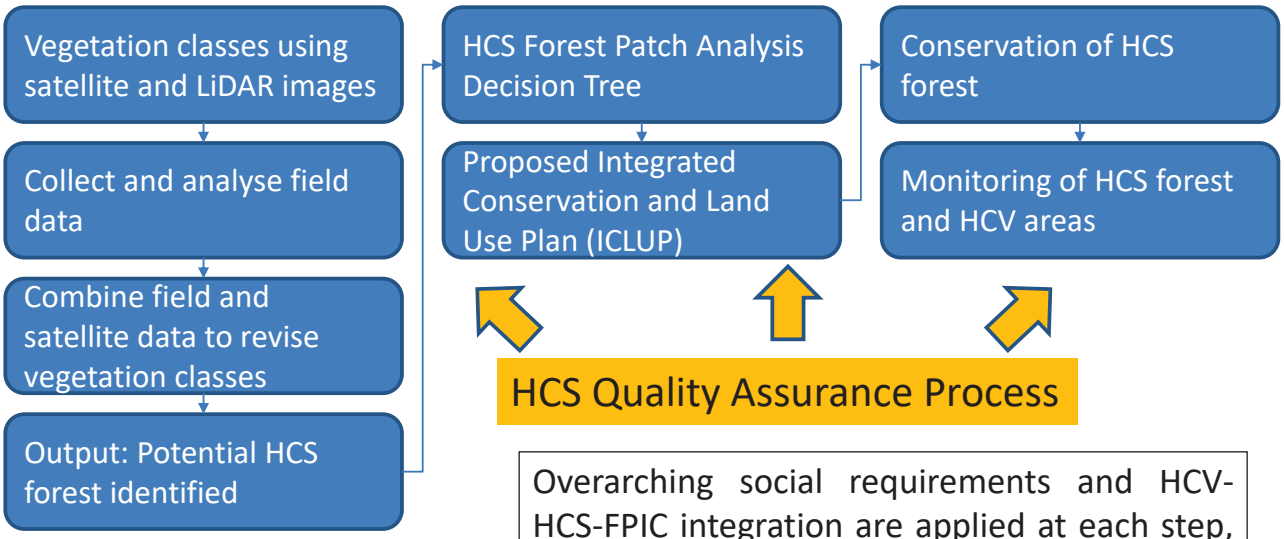
The figure is referred from "THE HCSA APPROACH TOOLKIT"

Outline of the HCS Approach

Phase 1: Vegetation classification to identify forest areas

Phase 2: HCS forest patch analysis

Phase 3: HCS-HCV Protection



Overarching social requirements and HCV-HCS-FPIC integration are applied at each step, and modify the implementation of subsequent steps and phases.

Phase 1: Identifying forest areas

MODULE 2
Social Requirements

Communication with local

The first step: respecting communities' rights to their lands and FPIC (Free, Prior and Informed Consent).

MODULE 3
Integration of HCV-HCS-FPIC

Information gathering, data analysis, community agreement, etc.

The HCS Approach relies on comprehensive HCV assessments and the FPIC of local communities to be put into practice.

MODULE 4
Vegetation Stratification

Classification and field calibration

Initial vegetation classification through satellite and LiDAR image analysis and field data to calibrate the vegetation classification.

Typical data required for Integration of HCV-HCS-FPIC

ENVIRONMENTAL DATA	SOCIAL DATA	GEOSPATIAL DATA
• Topography and slopes	• Location of villages	• Digitised Elevation Model (DEM)
• Vegetation cover	• Stakeholder mapping, including local NGOs and development projects	• Company development plans
• Soil (especially peat)		• Satellite images (e.g. Landsat/ Sentinel)
• Hydrology	• Demographics	• LiDAR data (if available)
• Existing biological studies (recent)	• Ethnographic tenure data	• Initial land cover maps
• IUCN Red List and maps	• Land cadastre	• Administrative boundaries
• CITES list	• Existing socioeconomic studies (recent)	• Other concessions' boundaries
• Key Biodiversity Area	• Language background	• Protected area boundaries
• National protected species list	• Cultural background	• Moratorium maps (if applicable)
• Protected areas	• Ethno-botany studies	• Forest and state area maps
• Analysis of relevant environmental plans, policies and regulations	• Socioeconomic status and development needs	• Land system maps
	• Relevant official social and development plans, policies and regulations	• Spatial planning maps
• History of forest disturbance		• Physiographic regions

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

Environmental data available in PNG-FRIMS

All data is national scale

- Topography and slopes
  SRTM, GeoSAR, etc.
- Vegetation cover
  Forest Base Map,
  Forest Cover Map
  (2000, 2005, 2011, 2015)
- Soil (especially peat)
  PNGRIS, Forest Base Map (for swamp)
- Hydrology
  Watershed (from DEM),
  Hansen datamask (waterbody),
  PNGRIS (precipitation)
- Existing biological studies (recent)
  None
- IUCN Red List and maps
  None
  Available in http://maps.iucnredlist.org/
- CITES list
  None
  Available in http://checklist.cites.org/
- Key Biodiversity Area
  None
  CEPA has the data
- National protected species list
  None
- Protected areas
  Available
  CEPA has the updated data
- Analysis of relevant environmental plans, policies and regulations
  None
- History of forest disturbance
  Hansen lossyear

Social data available in PNG-FRIMS

All data is national scale

- Location of villages
  - Census Units
- Stakeholder mapping, including local NGOs and development projects
  - None
  - CCDA has REDD+ activity data?
- Demographics
  - Census Units (Population in 2000, 2008)
- Ethnographic tenure data
  - None
- Land cadastre
  - None
- Existing socioeconomic studies (recent)
  - None
- Language background
  - None
- Cultural background
  - None
- Ethno-botany studies
  - None
- Socioeconomic status and development needs
  - None
- Relevant official social and development plans, policies and regulations
  - None

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

Geospatial data available in PNG-FRIMS

All data is national scale

- Digitised Elevation Model (DEM)
  - SRTM, GeoSAR, etc.
- Company development plans
  - None
- Satellite images (e.g. Landsat/Sentinel)
  - Landsat, RapidEye (2011), PALSAR (2007)
- LiDAR data (if available)
  - None
- Initial land cover maps
  - Forest Base Map, Forest Cover Map
- Administrative boundaries
  - Province, District, LLG
- Other concessions' boundaries
  - Logging, Mining
- Protected area boundaries
  - Available
  - CEPA has the updated data
- Moratorium maps (if applicable)
  - None
- Forest and state area maps
  - None
- Land system maps
  - Forest Base Map, Forest Cover Map
- Spatial planning maps
  - Proposed concession
  - Proposed protected area (CEPA)
- Physiographic regions
  - None

Annex 37

Training Material on Measurement and Reporting

FREL / FRL: International Carbon Offset Frameworks

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

OUTPUT 3: Forest information for addressing Deforestation through REDD+ is prepared

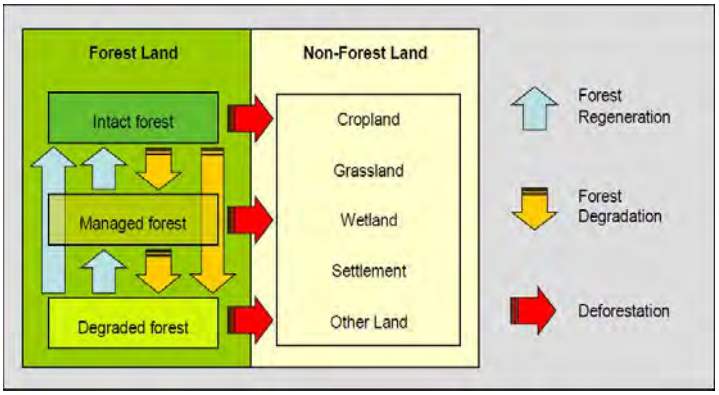
Carbon methodologies in the Forestry sector

June 5th 2015

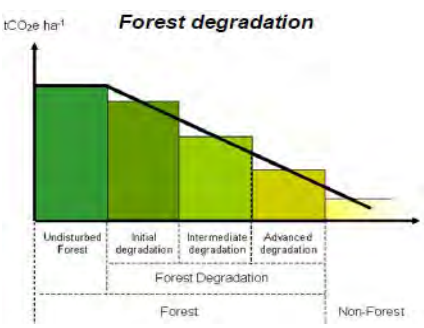
What do we want to measure:

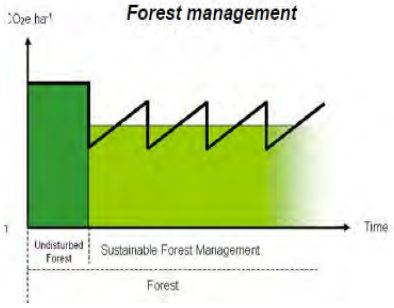
Land transitions and related forest carbon stocks

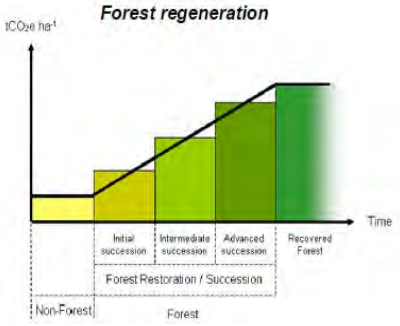
Land use and land cover changes



Forest carbon stock variations







Where to find appropriated methodologies

Main existing methodologies to calculate Forest emissions developed for implementing actions (programs or projects) are found in:

- The Verified Carbon Standards (**VCS**)
- The VCS Jurisdictional Nested REDD+ framework (**JNR**)
- The Kyoto Protocol Clean Development Mechanism (**CDM**)
- The WB FCPF Carbon Fund methodological framework (**FCPF-CF**)

Consider these information (procedures and monitoring data) in its design/enhancement will ensure the Forest Resources Information management system developed in PNG (PNG-FRIMS) to:

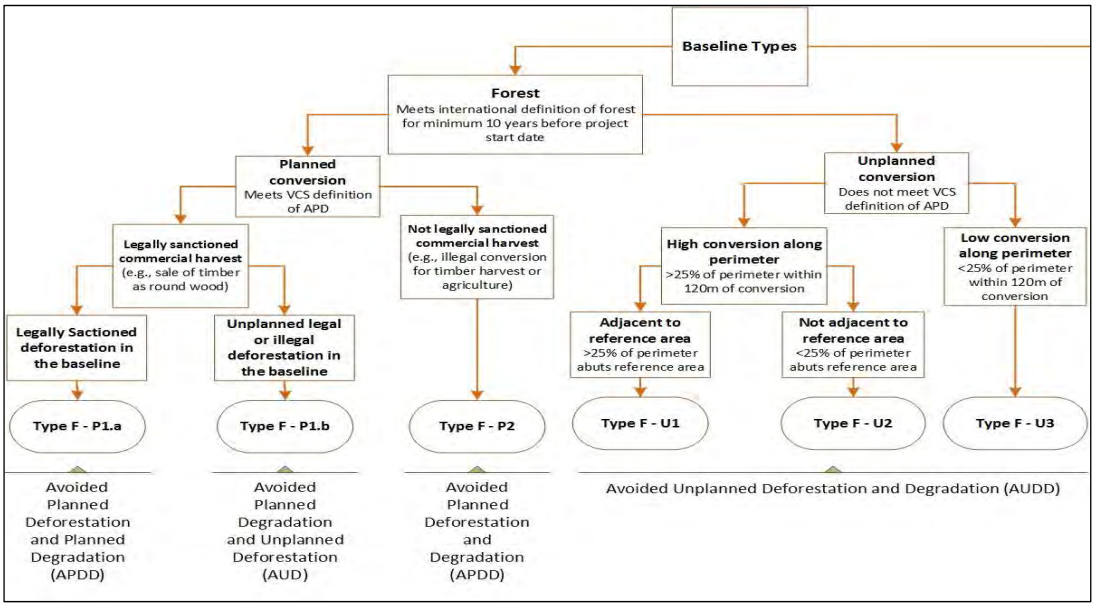
- **Support effectively present projects/programmes** addressing deforestation
- **Support effectively future (post-Kyoto) projects/programmes** addressing deforestation because these most advanced practices of C accounting will be pillar of lessons learnt for the establishment of standards/methodologies in emerging mechanisms
- **Be directly useful** for the establishment of a national Forest Reference Emission Level
- **Be useful for many other activities related REDD+:** DD driver study, national strategy, etc.

The Verified Carbon Standards

Types of project activities:

- Avoided planned deforestation and degradation APDD
- Avoided unplanned deforestation and planned degradation AUD
- Avoided unplanned deforestation and degradation AUDD

Types of Baseline (land activities scenario without the intervention of the project):



Jurisdictional Nested REDD+ programmes

- **Def**: integrated accounting framework for crediting REDD+ projects, policies and programs across a state or province to scale up activities over the long term

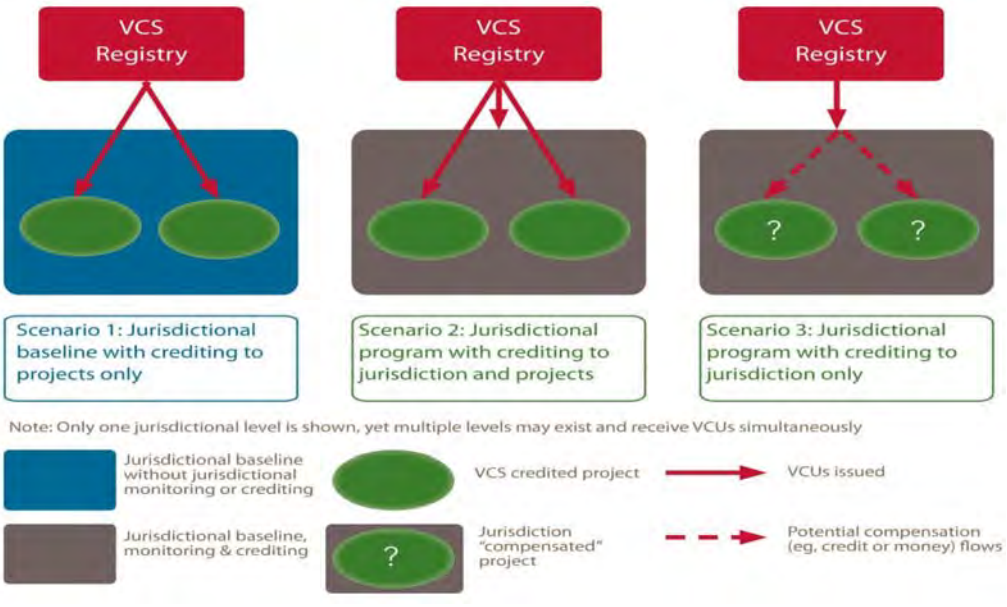
- **Content**: guidelines jurisdictions can use + platform (project suitability, credit allocation) + integration of Emission Reduction from outside + components (MRV and credits)

- **Objectives**:
- Increase environmental integrity, impacts and beneficiaries
- Reduce risks of leakage and risks for investors
- Create clear pathways for successful early action projects to be recognized within emerging nat/subnational REDD+ programs, and be integrated in government programs.
- Serve as model of programs and Result Based Payment systems for the future

- **Users**:
- Project developers: ensure fitting with emerging methodologies, policies (and get credits)
- Host countries seeking RBP models to credit ER generated from policies
- Bi/multi-lateral donors to effectively use REDD+ funds in ER rewards

Jurisdictional Nested REDD+ programmes

- **System of functioning:**



Scenario 1: Carbon project; Scenario 2: Carbon program; Scenario 3: REDD+ program

2005>Kyoto phase I>2012	2012>Kyoto phase II>2020	Post-Kyoto > 2020

FCPF Carbon Fund methodological framework

- **Introduction**

- FCPF = readiness fund + carbon fund; CF to reduce loss and impoverishment of forests
- RBPs to incentivize REDD+ policies and measures in 5 countries

- **Methodological framework**

Not a technical methodology (procedure of Carbon accounting), More standards to follow: 37 criteria grouped in 5 groups: ambition, carbon accounting, safeguards, sustainable program design / implementation, Emission Reduction transactions

- **However some technical requirements:**

- Degradation taken into account if accounts > 10% of the total emissions from DD
- Carbon Pools excluded if account < 10% of total emissions
- Need to show: project area, Activity Data (transitions between land categories) and Emission Factors
- Estimation and reduction of uncertainties
- Reference level
- Robust monitoring system and MMR: measurement, monitoring and reporting
- Take into account Leakage and Non permanence

Main existing methodologies in the Forestry sector

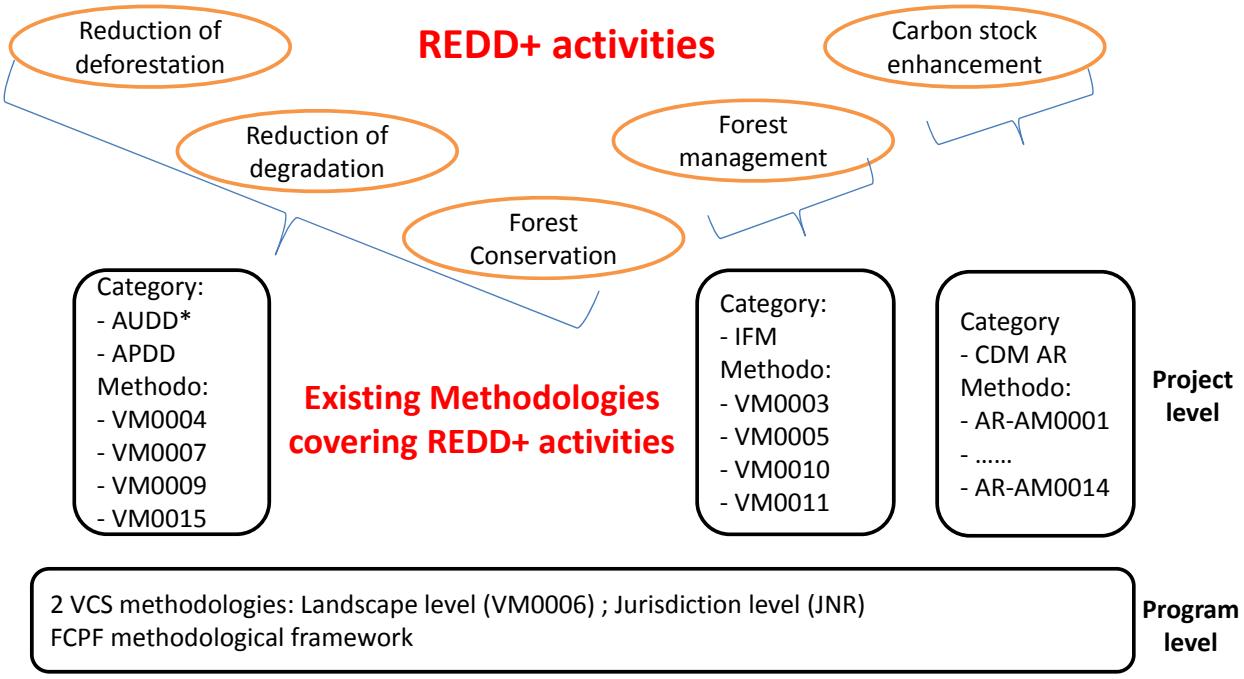
Reduced Emissions from Deforestation and Degradation			
VM0004	VM0007	VM0009	VM0015
Conservation that avoid planned land use conversion in Peat Swamp forests	REDD+ Methodology Framework	Avoided Ecosystem conversion	Avoided unplanned deforestation

Improved Forest Management			
VM0010	VM0003	VM0005	VM0011
Conversion from Logged to Protected Forest	Extension of Rotation Age	Conversion of Low-Productive to High-Productive Forest	Calculating GHG benefits from preventing Planned Degradation (RIL)

Afforestation / Reforestation	
AR-AM0001: Reforestation of degraded land	AR-AM0014: AR of degraded mangrove habitats
AR-AM0002: Restoration of degraded lands through AR	AR-ACM0003: AR of lands except wetlands
AR-AM0003: AR of degraded land through tree planting, ANR and control of grazing	AR-AMS0001: A/R on grasslands or croplands
AR-AM0004: AR of land currently under agricultural use	AR-AMS0003: AR on wetlands
AR-AM0005: AR for industrial/commercial uses	AR-AMS0007: AR on lands other than wetlands
AR-AM0010: AR on unmanaged grassland in protected areas	AM - Large scale, ACM - Consolidated Methodologies, AMS - Small scale

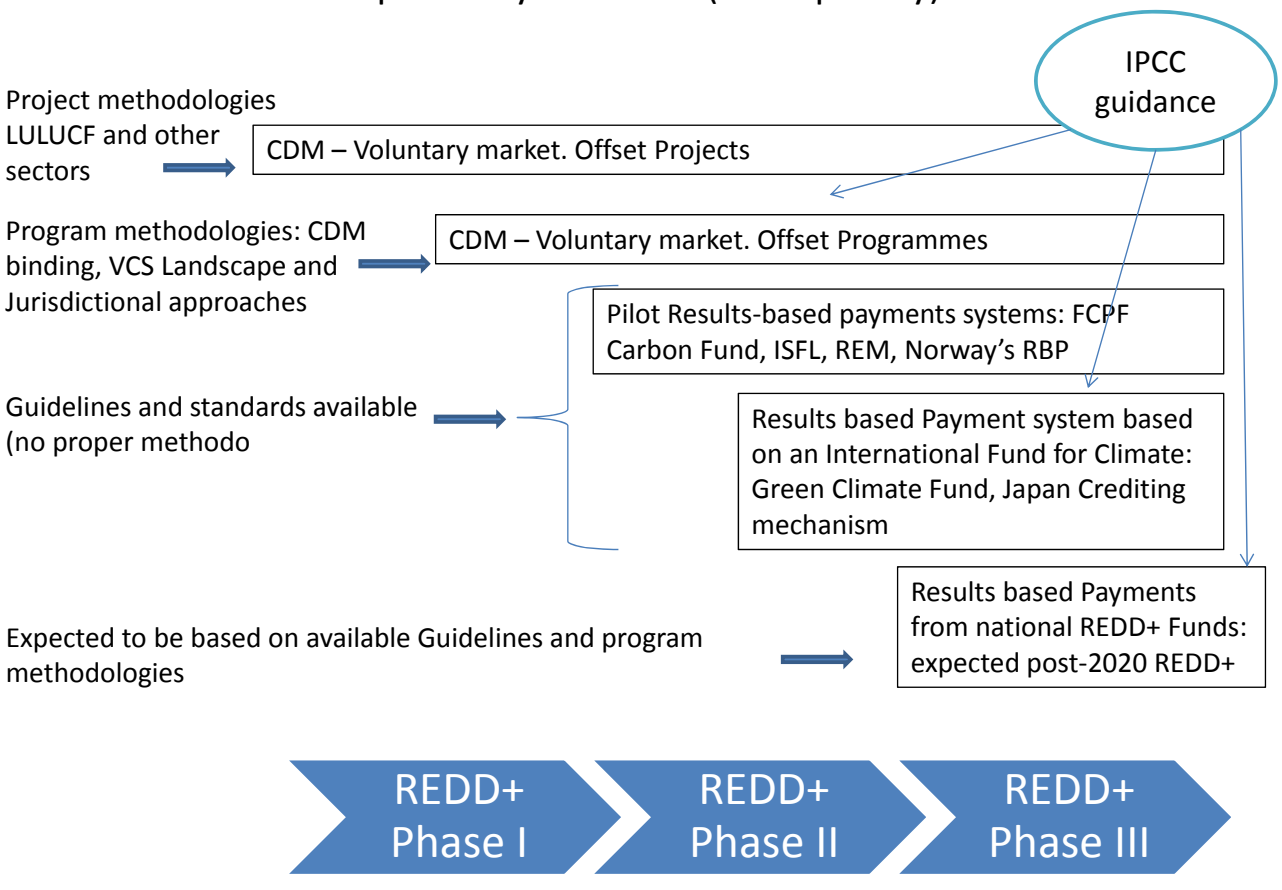
REDD+		
VM0006	JNR programme	FCPF Carbon Fund
Carbon accounting for Mosaic and Landscape-scale REDD projects	Jurisdictional Nested REDD+ programme	FCPF CF methodological framework

Coverage of REDD+ activities assessment methods by existing Forestry methodologies



* Activity categories: VCS Avoided planned deforestation and degradation (APDD), Avoided unplanned deforestation and planned degradation (AUD), Avoided unplanned deforestation and degradation (AUDD), Improved Forest management (IFM); Clean Development Mechanism Afforestation / Reforestation CMD AR

Evolution of Carbon methodologies in the Forestry sector and proximity to REDD+ (concept only)



Process for acquiring Forest data/information for accounting Carbon: Estimation vs. Monitoring

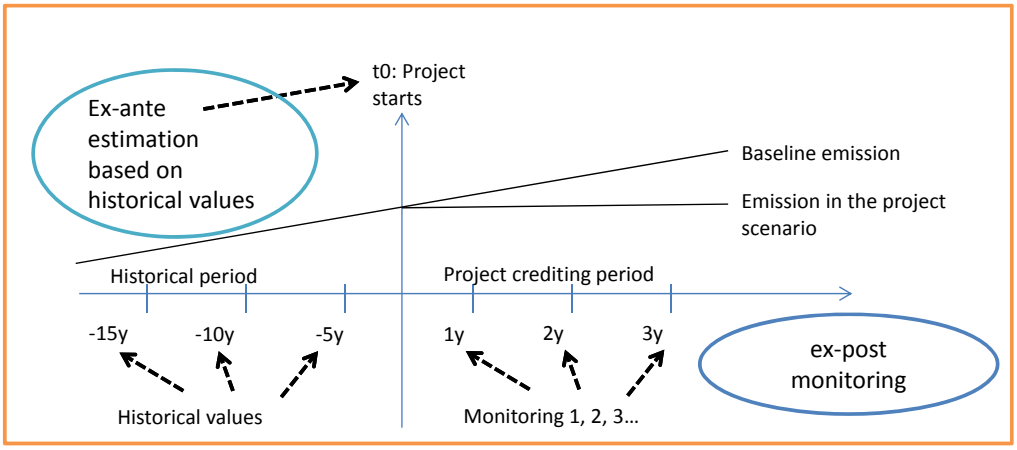
Information acquiring process: Estimation vs. Monitoring

Schematically emissions reductions are calculated from this equation :

Emission Reductions = Baseline emissions – Project Emissions – Leakage emissions

FRIMS is able to support :

- Ex-ante estimations of the baseline and project emissions
- Ex-post monitoring for:
  - Calculating actual project emissions, and
  - Confirming baseline estimations



Baseline and project activities expected in PNG

Five VCS methodologies most representative of REDD+ drivers and activities and their related baseline and project activities :

PNG context

Methodologies

Logged to Protected Forests (VM0010/VM0011)

April Salumei; Central Suau

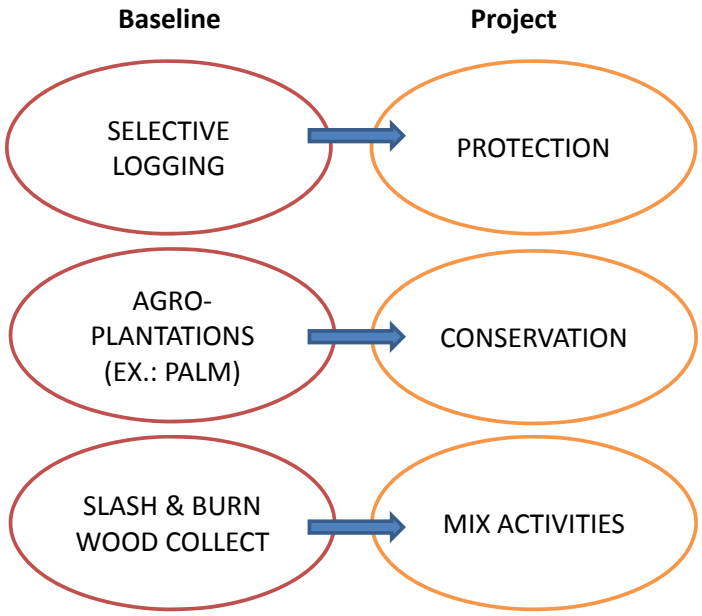
Avoid peat conversion for agriculture plantations (VM0004)

Likely with Agri leases increase

Avoided unplanned deforestation/degradation (VM0006/VM0015)

Large scale (landscape) and Mixed (Mosaic) approach

Future REDD+ RBP programmes



Methods of determination of degradation and deforestation

DD Drivers	Methods of determination of emissions from DD	
	Ex-ante estimation (from historical values)	Ex-post monitoring
Forest degradation		
Illegal logging	Landscape approaches (VM0006/15)	All methodologies consider Illegal logging in project emissions
Legal selective logging	Logged to Protected Forests (VM0010/11)	Reduced Impact Logging methodologies (VM0003/05)
Deforestation		
Slash-and-burn for subsistence agriculture	Landscape approach (VM0006/15)	All methodologies consider Agriculture in project emissions
Clear cutting for commercial plantations	Avoiding agro-plantation (VM0004)	Not considered as project emissions (otherwise the methodology is not suitable)
Fire	Not yet specific methodology dealing with avoiding forest Fires	All methodologies consider Fires in project emissions

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

OUTPUT 3: Forest information for addressing Deforestation through REDD+ is prepared

Procedures and required data to calculate emissions from forest degradation

June 5th 2015

A) Methods found in Project methodologies to calculate emissions from forest degradation

Calculate emissions from forest degradation

N.B: Methods of estimation of the **deforestation** is provided in the part detailing technical procedures to estimate carbon stocks in the Landscape approach

VCS methodologies VM0010, 11 and 04 provide some methods of:
- estimation of forest degradation from selective logging
- monitoring of degradation from illegal logging

Estimate the impact of Selective Logging on carbon stocks, 2 steps:

Step 1: Volume extracted

V logged (selective logging)
+
V collected (illegal logging)

Calculation steps →

Step 2: Carbon stocks loss

Volume extracted

↓

Above Ground Biomass affected

Estimate logged Volumes from legal selective logging

Method 1:
RECORDS
Record of Volume extracted or Financial benefits from logging

Method 2:
TIMBER HARVEST PLAN
In the project area or a representative area

"The description of harvesting in the form of a Harvest Plan forms the basis of the baseline scenario for greenhouse gas accounting"

Method 3:
FOREST INVENTORY REPORT
or local documentation

Three cases of Forest Inventory Report:
1. No data available
2. A detailed set of data is available: H, DBH and species
3. A simpler set of data is available: Density and BCEF

→ BASELINE CALCULATION

→ Detailed in the next page

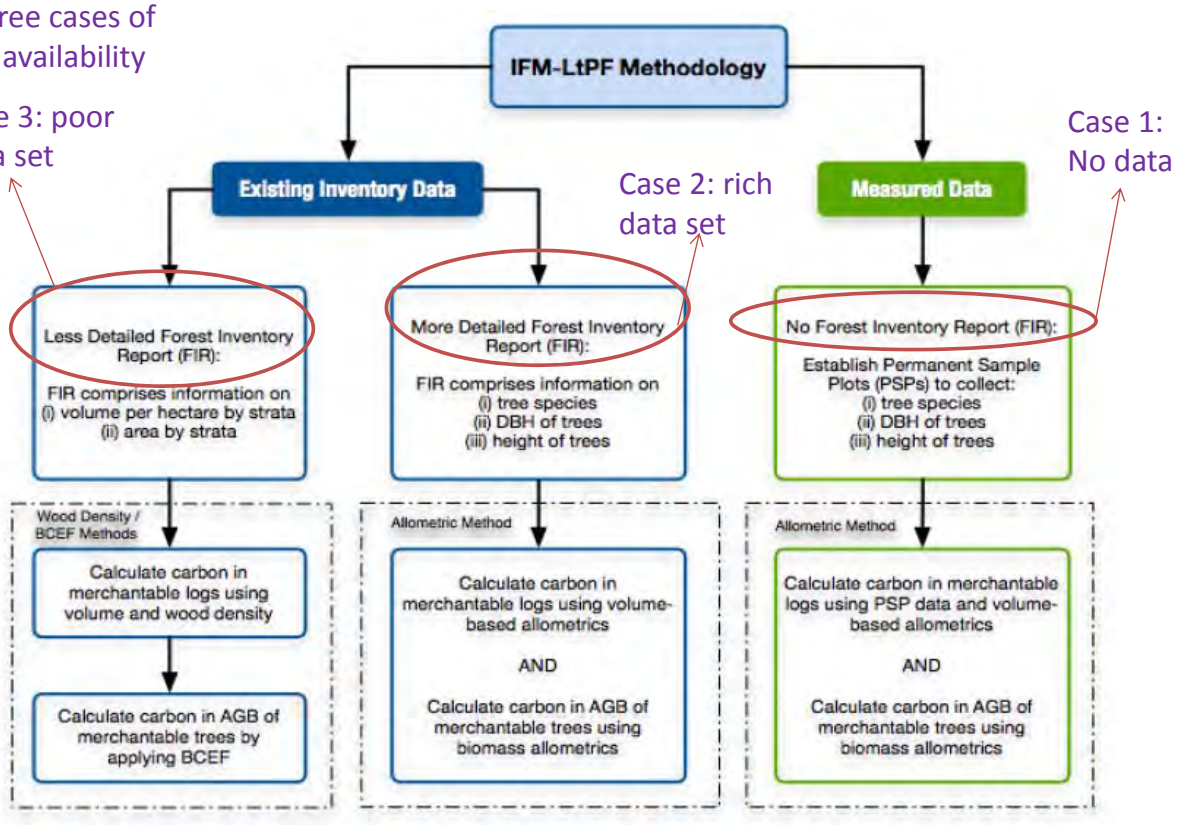
Estimate emissions from Selective logging

In three cases of data availability

Case 3: poor data set

Case 2: rich data set

Case 1: No data



Monitor emissions from Illegal logging

Method 1: FOREST INVENTORY: sampling, data management and analysis
=> DBH and H

Method 2: PARTICIPATORY RURAL APPRAISAL
=> Volumes extracted

Method 3: PRA + FIELD OBSERVATION
=> DBH or Volumes of extracted trees

Method 4: HIGH RESOLUTION DATA ANALYSIS
=> Volume harvested

- Identify harvested areas
- Calculate harvested areas per stratum from GIS ->
- Use standard procedure (stoke et al., 1998) and field verification
- Obtain Volume harvested before project starts

Method 5: LOGGING GAPS ANALYSIS
=> Carbon Emissions

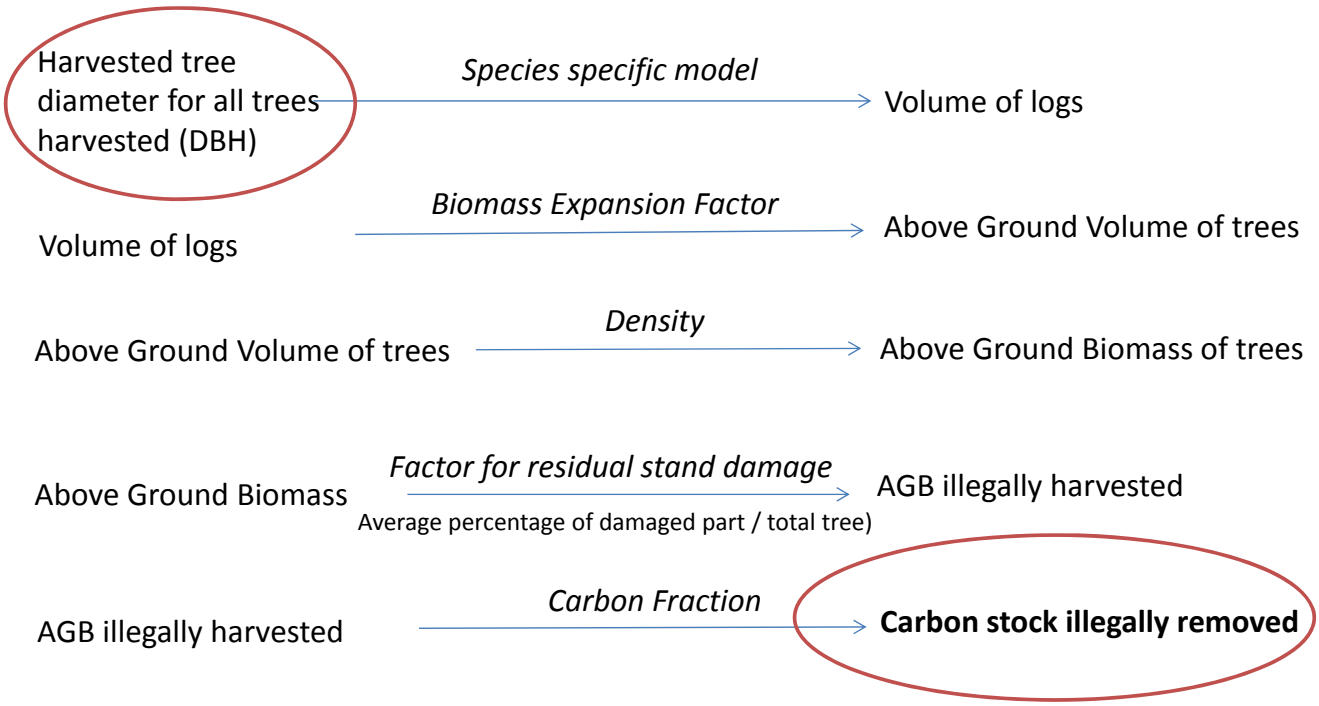
Remote sensing survey and field confirmation →

- Number and Area of logging gaps or peat drainage area
- Emission Factor per logging gap (EF calculation detailed in Landscape approach)
- Emissions = area of gaps x number of gaps x EF

PROJECT EMISSIONS CALCULATION

Nota Bene: in 2012, for developers of the methodology VM0010, Remote Sensing using optical sensor are not capable of direct measurements of biomass changes. They rely on future development of RADAR, LiDAR, SAR.

Calculate Carbon stocks variations due to Forest degradation from Volume or DBH



B) List of parameters often estimated or monitored for degradation processes assessment

Data/information often used in Project design (at beginning)

Data / parameters	Complementary information to bring
Evidence on Forest state as minimum of 9 years ago	
Name of the project area: compartment number, allotment number, local name	⇐ Legal documents about land tenure
- Map(s) of the area preferably in digital format	⇐ Map (digital)
- Forest cover map - Map must be stratified in minimum 2 classes	⇐ Remote Sensing + GPS every 4y
- Forest/Non-forest classification	⇐ Accuracy 89% at least
Geographic coordinates of each polygon vertex along with the	⇐ Documentation on coordinates accuracy
- Total land area - Area for each stratum	⇐ Any GIS results

Data often used in ex-ante estimation of baseline, project and leakage emissions from DD

Data / parameters	Necessary support
- Area per stratum and parcel that was harvested 1 year ago, between 2 and 10 years ago, between 11 and 20 years ago - Area cleared, harvested or logged under the baseline scenario	→ Map of harvesting, logged over and degradation areas
- Area burnt per stratum at a t time - Area where natural disturbance (fire, storm, volcanoe, etc.) occurred	→ Map of fire areas and other disturbances
- Volume harvested/extracted in a stratum, if possible per wood product and species - Volume of timber projected to be extracted (gross V) *N.B: Gross volumes not net volumes used commercially*	→ Tree volume map / harvesting activities records
- Mean merchantable volume per stratum - Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type	→ Timber volume map

Monitoring ex-post component and monitoring activities (include deforestation monitoring)

Monitoring component	Activity for monitoring	Frequency	Ressources
A: boundary	Detect integrity of project boundary	1 y	ALOS (50m), LANDSAT (30m)
B: stratification	Land cover classification (detect any changes in classes / stratum)	1 y	ALOS (50m), LANDSAT (30m), field
C: land cover changes (deforest.)	Detect and appraise area of deforestation	1 y	Detect: LANDSAT (30m), Appraise area: high reso (5m)
D: logging (degradation)	Detect and appraise number and area of degradation spots (ex.: logging gaps) by date, location, biomass lost or affected)	Continue	High resolution (5m)
E: fire (deforestation)	Detect and appraise area of burning: - forest burning - peat burning	Continue	MODIS imagery (mini 100m)
F: forest carbon stocks changes	- Species - H and DBH (emission Factor) - Volume and Biomass EF	10 y (each BL)	Field
G: leakage	New logging or conversion permit in the project region	1 y	Detect: LANDSAT (30m), Appraise area: high reso (5m)

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

OUTPUT 3: Forest information for addressing Deforestation through REDD+ is prepared

PROJECT FOREST CARBON ACCOUNTING METHODOLOGY

Case of the "Mosaic and landscape REDD program" (VCS methodology)

June 5th 2015

PLAN

- INTRODUCTION: LIMIT, MAIN TASKS
- DEFINITIONS
- BOUNDARY SELECTION
- STRATIFICATION
- ANALYSIS OF DRIVERS
- DETERMINATION OF FOREST CARBON STOCK CHANGES
  - EMISSION FACTOR
  - ACTIVITY DATA

INTRODUCTION

Limits of the methodology

The example of the methodology VCS VM0006 "Carbon accounting for Mosaic and Landscape-scale REDD projects" is chosen because:

- **Large scale approach** so that programmes (inc. JNR) can use this methodology
- **Mosaic approach** showing different activities in different contexts (REDD+ programme-like)
- **Detailed and compiled** Carbon accounting methods (lessons for any activities of Carbon aaccounting)

Limit of activities considered:

- **Avoided Unplanned deforestation and degradation** in a mosaic configuration
- **Improved forest management**
- **Plantations**

Overview of the calculation

Emissions reduction/removals from the project = E(Baseline) – E(project) – E(leakage)

N.B: ER = E(baseline) when E(project) and E(leakage) are nil

E(baseline) = historical deforestation + historical degradation – Regeneration/Reforestation

= land cover change (AD) x carbon stock density per class (EF)

Definitions 1/3

Forest: the project has to show that the area is forest area since 10 years at least

Baseline: Calculated every 10 years

Project scenario: Mosaic deforestation and degradation occurs in the project area (that depends on methodology)

Areas: Project: where activities carried out; Leakage: sum of leakage belts; Reference: where DD rates obtained to predict future DD rates for the baseline. Minimum = 250 000 ha

Land Use and Land Cover classes (LULC)	Classes Determined by **Forest/Non-forest state** Determining factors : local climate, soil condition, canopy cover 6 classes at least (IPCC, 2003): forest, cropland, grassland, settlement, wetland, other
Forest strata	Strata determined by **Carbon stock density** Determining factors: native forest type, past and future land management, landscape position, biophysical state, disturbance and regeneration (Carbon density homogeneous)

1 LULC class = several forest strata

Minimum Mapping Unit used for RS and classification procedures MMU ≤ 1ha

Definitions 2/3

Transition (1 class/stratum to another categories):

- Deforestation
- Degradation
- Regeneration / natural succession
- Increased forest / cover reforestation

Agent of Deforestation / Degradation (DD):

Person or group contributing to DD

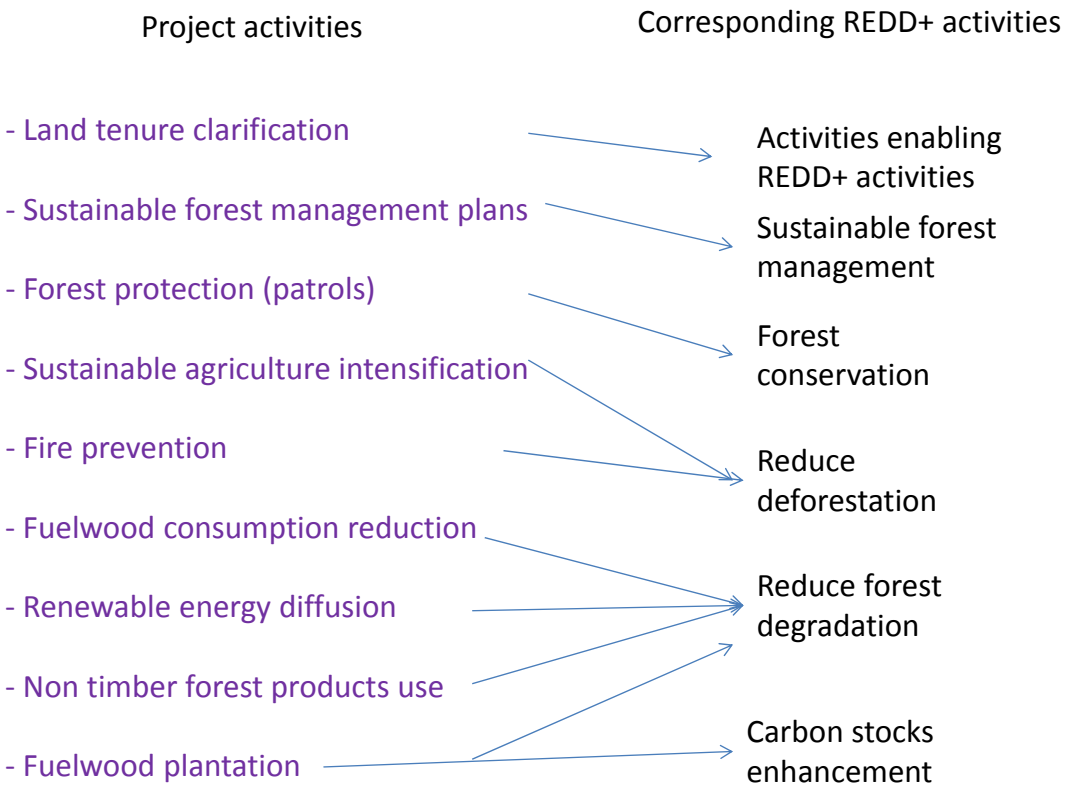
Deforestation drivers:

- Subsistence farming:
"A system of farming where all or almost all of the produce is used to meet the consumption needs of the farm family without any significant surplus for commercial sale"
- Settlement
- Infrastructure (roads)

Degradation drivers:

- Timber logging for sale or use
- Wood collection for fuelwood sale or use
- Cattle grazing in forest
- Understory vegetation extraction for sale or use
- Human induced forest fire

Definitions 3/3



Boundary selection

Project area parcel

Determination: digital files, vector-based in Keyhole Makeup language (KML file format)

Information:

- Name
- Centroid coordinate: latitude and longitude using WGS1984 datum
- Area
- Tenure
- Administrative unit

Reference region

- Area > 250 000 ha
- Boundaries coincide with natural, administrative, satellite footprint and watershed
- Protected areas (where activities no possible): park, military zone, commercial zones
- Forest area > 15% of total area

Stratification 1/4: Define data sources

Data (spatial info used for assessing DD) must be documented in the Project Document

Data Source	Main Use	Information needed about the data collected
High to medium resolution (≤ 30 m) RS data are required for at least three time points: - at least one image from 0-3 years - at least one image from 4-9 years - at least one image from 10-15 years No images older than 15y used	Historical analysis of deforestation and forest degradation	- Acquisition date and source ; data Type - Resolution (spatial and spectral) - Coordinate system and pre-processing Comparison of the sensors (If different sources of RS data) to ensure consistency
Readily available LULC maps which are already processed are complementary	Independent verification of the analysis	- Minimum Mapping Unit (ha) - Description of method used to produce data - Describe LULC classes and transition categories - How Classes match with IPCC classes/categories
Recent (< 5y) high resolution (< 5 m) RS data is required for at least part of the reference region	Ground-truthing and check of accuracy	- Acquisition date and source ; data Type - Resolution (spatial, spectral)
Direct field observations or visually interpreted locations from RS images are required for: - calibration of the classification / stratification - validation of the calibration and classification accuracy.	Ground-truthing and check of accuracy	- Acquisition date and source ; data Type - Coordinate system - Location of coordinates

Stratification 2/4: Examine land transitions

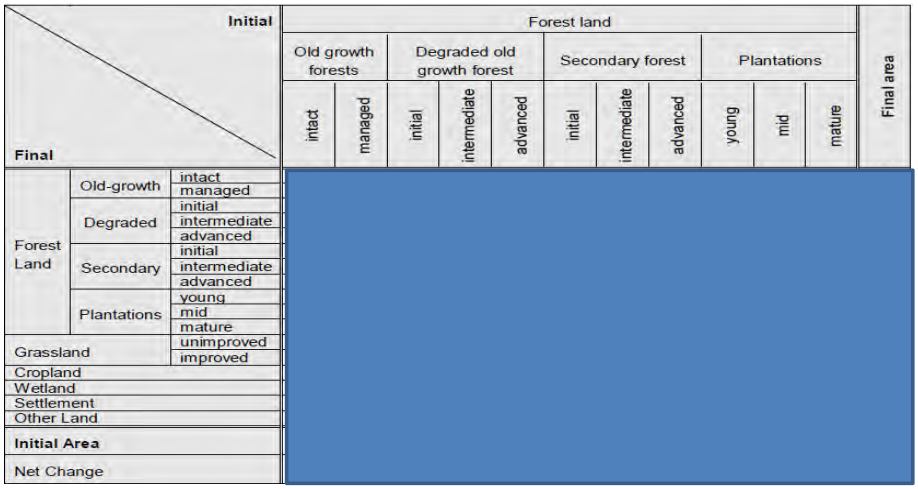
Define classes and strata

- Land Use Land Cover classes,
- Forest strata and
- Minimum Mapping Unit

For the Reference, Project and Leakage areas (Classification required accuracy **> 70%**)

Examine land transitions

Create a matrix of Class/Stratum transition (ex. VM0015)



Stratification 3/4: Analysis of transitions

Step 1: Pre-processing of RS data

Geometric correction → Cloud cover loss handling → Rectification

RMSE (average location error between 2 images) ≤ 1 pixel

Maxi allow for a single image = 20% of clouds

Cloud areas filled with RS images no older than 3 years

Step 2: Classification/stratification

Attribution of class/stratum to pixel or segment → Include anciliary data (Optional). MMU = 1ha → Increase accuracy of stratification when forest degradation is appraised

Methods: maxi likelihood, decision trees, support vector machine, etc.

Ex.: climate, soil, elevation, slope, tenure

Forest stratification model:
- Input data in the model: optical RS, RADAR, LIDAR, topography, classes
- rule-, regression-, machine-learning based

Step 3: stratification accuracy and Discouting Factor

DF will be used to discount Emission Reductions from avoiding DD → Independent determination of classes → Compare predicted classes versus independently determined classes

DF(classification) and DF(stratification) for project, leakage, reference areas

Use field observation, in situ map, ground truthing

Do it in 50 locations of the reference region

Stratification 4/4: Summarize historical transitions

- List transitions for each pair of images (ex. same image in 2010 and 2014)

- Report all in a transition matrix:
  - ☐ Number of images per transition type
  - ☐ Corresponding area

- Report overall area of transition categories: land cover changes (%of images, area)

1ha from old growth to managed forest

1ha from forest to grassland

Final \ Initial			Forest land											Final area
			Old growth forests		Degraded old growth forest			Secondary forest			Plantations			
			intact	managed	initial	intermediate	advanced	initial	intermediate	advanced	young	mid	mature	
Forest Land	Old-growth	intact	100											100
		managed	1	5										6
	Degraded	initial	1		2									3
		intermediate			2	1								3
		advanced				2	3							5
	Secondary	initial						2						2
		intermediate						1	3					4
		advanced							1	1				2
	Plantations	young					1	1	1		1		1	5
		mid									1	2		3
		mature											1	1
Grassland		unimproved	1	1	1	2		1	1	1				8
		improved				1	1							2
Cropland				1		1		2	3	3				10
Wetland														0
Settlement														0
Other Land														0
Initial Area			**103**	**7**	**5**	**7**	**5**	**7**	**9**	**5**	**2**	**2**	**2**	**154**
Net Change			-3	-1	-2	-4	0	-5	-5	-3	3	1	-1	0

Analysis of drivers

Step 1: Identify agent of DD
farmers, hunters, loggers

Step 2: Identify agent motivations
poverty, changes in policies, etc

Step 3: Assess relative importance
of drivers to the historical DD = Carbon loss per driver x Relative contribution of the driver to DD*

Step 4: Analyze mobility of drivers: mode of transportation, moving speed in the project area, etc.

Step 5: Identify pre-disposing factors
(driving variables of DD for each driver):
access to forest, slope, market distance, settlement, etc.

* Proportion of Carbon loss leading to deforestation (Def) vs. forest degradation (Deg) for different drivers

Driver	Def	Deg
1. Conversion of forest land to cropland	100%	0%
2. Conversion of forest land to settlements	100%	0%
3. Conversion of forest land to infrastructure	100%	0%
4a. Logging for commercial sale by clear cutting	100%	0%
4b. Logging for commercial sale by selection cutting (i.e. by employing either individual tree selection method and/or group selection)	0%	100%
5a. Logging for domestic use as clear cutting	100%	0%
5b. Logging for domestic use by selection cutting (i.e. by employing either individual tree selection method and/or group selection)	0%	100%
6. Wood collection for commercial on-sale of fuelwood and charcoal	5%	95%
7. Fuelwood collection for domestic and local industrial energy needs	5%	95%
8. Cattle grazing (i.e., in-forest grazing)	5 %	95%
9. Understory vegetation extraction (i.e., thatch grass collection for roof and livestock bedding materials, shrubs and small trees for straw fences)	50%	50%
10a. Small forest fires to the extent that they are not part of natural ecosystem dynamics	0%	100%
10b. Large crown fires to the extent that they are not part of natural ecosystem dynamics.	100%	0%

Emission Factors. Calculation steps

Emission Factors: carbon stock density based on sampling plots determined for all transitions (forest to cropland; primary to secondary forests, etc.), expressed in tCO2e/ha per transition

Step 1) Identify classes/strata: Classes/strata quantified are those likely to changes

Step 2) Literature review: Review existing biomass stock density and biomass increment data (IPCC)

Step 3) Determine sample size: Number, location and layout of sampling plots (IPCC)

Step 4) Measure Carbon stock density: in t/ha

Step 5) Calculate EF *per land transition category and summarize*

Emission Factors. Step 4: Measure Carbon stock density

Carbon stock density (tC/ha) total biomass Carbon =

AGLB (above ground living biomass in tree + in non-tree)
+ AGDB (above ground dead biomass lying + standing)
+ BGB (below ground biomass)
+ SOM (soil organic matter)

Method to appraise each compartment :

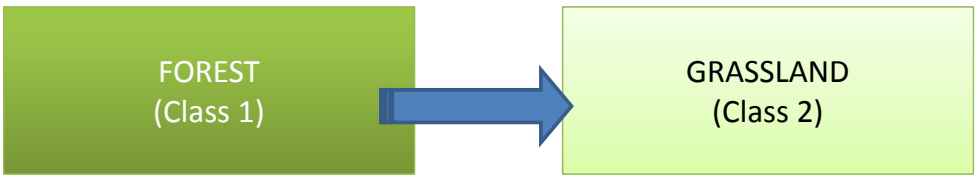
Carbon pools	Measurement method
AGLB (tree)	H, DBH, allometric equation
AGLB (non tree)	Destructive method or Default value
AGDB (lying)	Line intersect method
AGDB (standing)	Same as ABLB (tree)
BGB	Root-to-shoot ratio
SOM	Soil sampling: depth, bulk density, dry OM, SOC

Guidance on carbon pool consideration depending on the land transition selected :

Type of land-use / land-cover transition	Living biomass (trees)		Dead organic matter			Soil
	Above-ground	Below-ground	Wood products	Dead wood	Litter	Organic matter
Forest to cropland	+++	++	+	+	+	+
Forest to pasture	+++	++	+	+	+	
Forest to shifting cultivation	+++	++		+		
Forest to degraded *forest*	+++	++	+			

+++ = include always; ++ = inclusion recommended; + = inclusion possible

Emission Factors. Step 5: Calculate EF per land transition categories



Emission Factor (tCO2e) $= \frac{44}{12}\ x\ [Biomass\ (Class\ 2) - Biomass\ (Class\ 1)]$

in tC

N.B:

- $Biomass\ (Class\ 2) = 0$ => EF = $\frac{44}{12}\ x\ Biomass\ (Class\ 1)$
- EF < 0 => carbon emission
- EF > 0 => carbon stock increase or sequestration

tCO2e/ha

Summary matrix

EF tCO2e /ha	C1	C2	C3
C1			
C2			
C3			

Activity data

Activity Data: Deforestation and Degradation rates determined for all transitions (forest to cropland; primary to secondary forests, etc.), expressed in ha/year per transition

Determination of Activity Data = ex ante estimation of land transition rate based on historical changes

Step 1) calculate total deforestation rate and degradation rate in Ref region

Step 2) calculate regeneration rate and forest cover increase rate per class/stratum

Step 3) calibrate/validate a spatial model to predict the suitability for Def and Degradation

Step 4) calculate all specific transition rates per class/stratum and summarize

There must be a full symmetry in carbon accounting: degradation included in Baseline if regeneration included

Deforestation →	Reforestation
Degradation →	Regeneration

Activity data. Step 1: Total Deforestation and Degradation rates

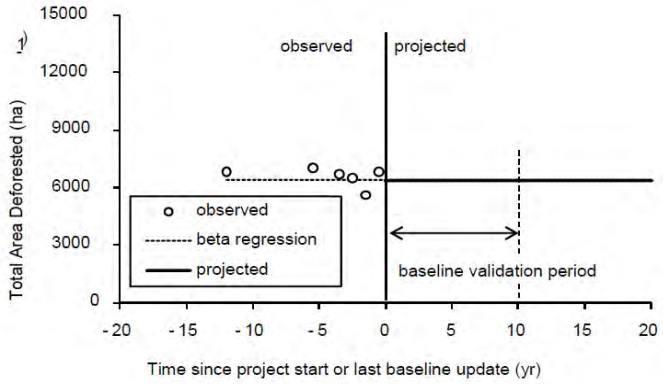
Determine total deforestation (and degradation separately) in Ref region and Ref period aggregating all pairs of consecutive images (% of ha loss)

Past trends (historical DD rates) → Extrapolation by Beta Regression → Baseline (future DD rates)

N.B: If only 2 historical data:
Future DD rate =
mean (rate 1 + rate 2) / 2

Case 1: Historical DD rate is constant

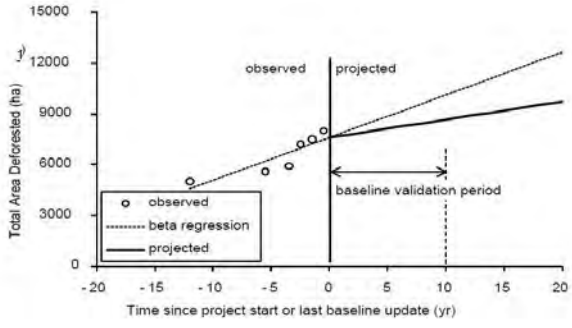
Future DD rate = mean of observed DD points (regression line coefficient = 0)



Activity data. Step 1: Deforestation and Degradation rates

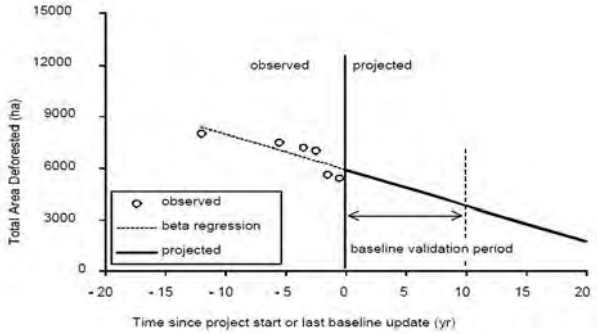
Case 2: Historical DD rate increase

Future DD rate = line with the lowest historical coefficient (regression coefficient > 0)



Case 3: Historical DD rate decrease

Future DD rate = historical DD i.e. beta regression original line
(regression coefficient < 0)



Summary!

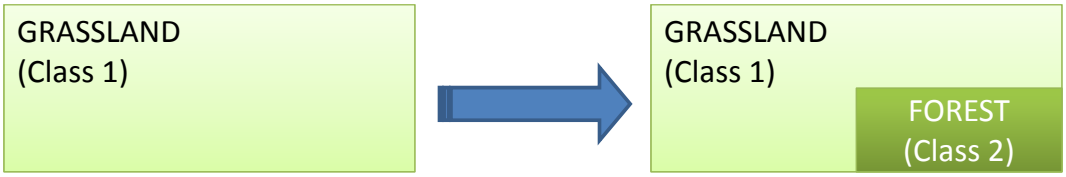
Total Def	Total Deg
rate %D	rate %d

Activity data. Step 2: Regeneration and Forest cover increase rates

Determine class/stratum Reforestation (and regeneration separately) from data for each consecutive pair of images in the Ref region and during the Ref period (% of ha gain)

There must be a full symmetry in carbon accounting: degradation included in Baseline if regeneration included

$$\text{RR rate} = \frac{area\ of\ transition\ (Class1 \rightarrow Class\ 2)}{Area\ initial\ Class\ 1}\ x\ (t2\ -t1)$$



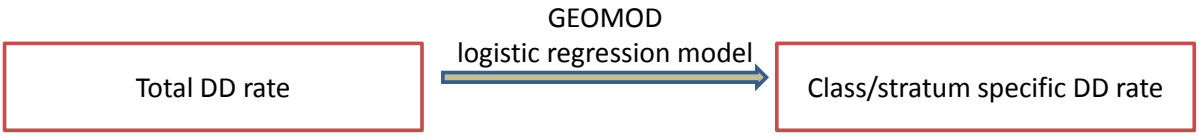
Summary Matrices

Ref rate	C1	C2	C3
C1			
C2			
C3			

Reg rate	C1	C2	C3
C1			
C2			
C3			

Activity data. Step 3: Spatial model for DD suitability

Total Deforestation rate is found but we do not know where Deforestation occurs



Procedure:

- Report Land use changes and the presence of pre-disposing factors (spatial driver variables) in one class
- Likelihood of land use changes are quantified according to the presence of drivers
- Predict future land use changes according to the presence of drivers

Spatial driver variables:

- Constant (slope, elevation) vs. dynamic (forest density, distance to road)
- Continuous (distance to market) vs. categorical (soil class)

Principles:

- Neighborhood
- Land suitability
- Forest scarcity

Activity data. Step 3: Calibration of a Def. and a Deg. model

Total Deforestation rate is found but we don't know where Deforestation occurs

Select > 10 000 pixels (or cells) → Give attributes to each pixel

1 pixel correspond to a pair of 2 subsequent maps (image 1 and 2)

- Final stage (deforested, degraded, unchanged)
- Location
- Land transition category
- Value of each driver
- Distance to forest edge

Random separation in 2 lots

- 2/3 of pixels for data set calibration (to feed the DD models)
- 1/3 of pixels for data set validation (to independently assess the quality of models)

Model is able to predict the suitability for deforestation for every location in the project area, in an interval of [0;1] i.e. from 0 to 100%.

Activity data. Step 4: Calculate specific transition rates, Summary

Transition rates are calculated for each class/stratum

- The model provides a map of the location of deforestation (pixel under the attribute "Deforested"
- This map is not used as it because it does not represent reality
- All pixels of status "Deforested" in one class (different locations) are aggregated
- We obtain the average of Deforestation for this class

GLOBAL SUMMARY :

DEG rate	C1	C2	C3
C1			
C2			
C3			

DEF rate	C1	C2	C3
C1			
C2			
C3			

Ref rate	C1	C2	C3
C1			
C2			
C3			

Reg rate	C1	C2	C3
C1			
C2			
C3			

EF tCO2 e/ha	C1	C2	C3
C1			
C2			
C3			

E(baseline) = historical deforestation + historical degradation – (Regeneration+Reforestation)

E(deforestation) = EF(deforestation) x Deforestation rate

tCO2e/year = tCO2e/year x ha/year

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

OUTPUT 3: Forest information for addressing Deforestation through REDD+ is prepared

Stakes of the FRIMS enhancement

Concepts only

June 5th 2015

Demand from the Climate Change sector to PNG Forest Authority FRIMS services

Private enterprises

Local and international interested in C business

Multi/Bi-lateral agencies

Test/implement Results Based Payments: GCF, FCPF, Norway,…

PNG REDD+ national framework

National/provincial programs (inc. projects) and FREL

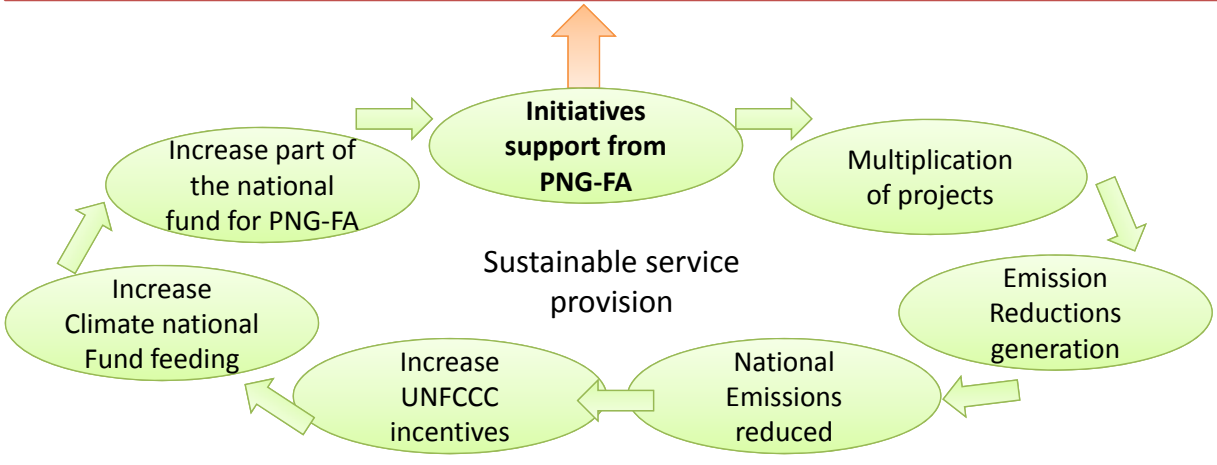
PNG Adaptation institutions

Set up Adaptation projects: landslide management, agroforestry, etc.

PNG other institutions

Development of Climate smart sectors (smart agri, renewable En, low-emission urban planing, etc.)

Demand in Forest information for addressing Climate Change expected to increase



PNG Forest Authority FRIMS **services** in Climate Change sector

PNG Forest Authority

PNG FA Mapping and Inventory

- Detailed and customized maps
- GIS analysis support
- Carbon map
- Volume map
- Environmental conditions
- Tenure
- Facilitation of relations with land owners

PNG FA REDD+/CC dpt

- Orientate requests from project developers within FA
- Advice on project activities suitable with the context
- Advice on valorization frameworks available and applicable
- Methodological support on Carbon accounting procedures

Project design and decision-making | Project management | Project assessment | Carbon calculation

FRIMS support REDD+ projects **Carbon calculations**

- Forest base map
- Info on timber concessions
- Forest cover changes
- Data from NFI
- Regrowth model

- Cleared areas (deforestation)
- Harvested and Fire areas (degradation)
- Regrowth

- Biomass map
- Carbon map
- Growing stock map

Enhanced FRIMS

Activity Data | **Emission Factors**

Used for several Carbon calculations

Calculate Baseline and Project emissions	Establish a baseline of Forest Emissions	Calculate LULUCF GHGe
+ REDD+ framework, RBP	+ adjustment factor (political decision)	+ GHGe from other sectors
Projects' Emission Reductions / incentives	Nat/SN Reference Level	National communication biennial update report
SubN/Local	Nat/SN	National

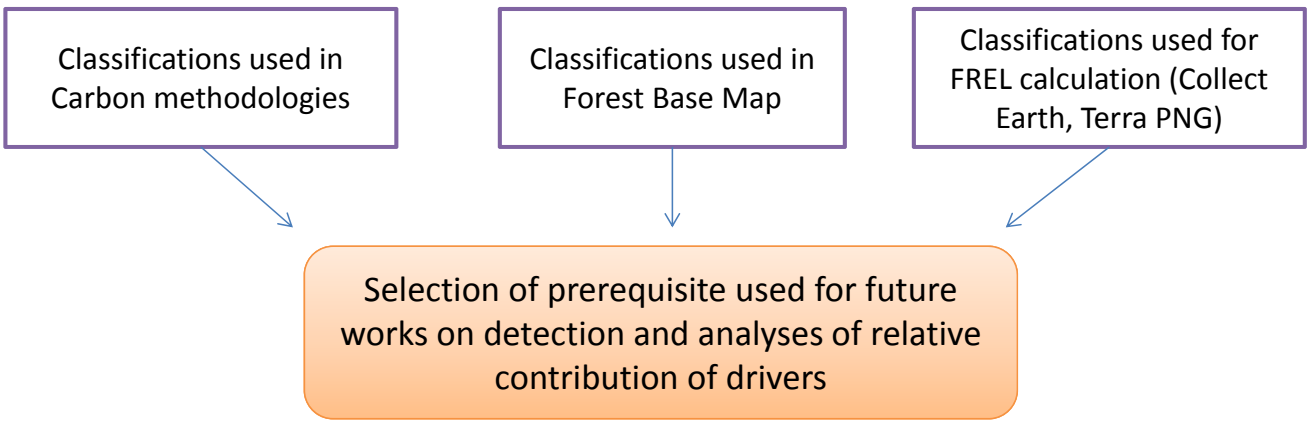
Annex 38

Training Material on Measurement and Reporting

FREL / FRL: Possibility of REDD+ in PNGFA Activities

1) Agreements on prerequisites for analysis of drivers of deforestation and forest degradation

June 10th 2016



Track 1:

Definitional issues:

- LULC classes
- Forest strata
- FMU
- Land transition
- DD drivers

Track 2:

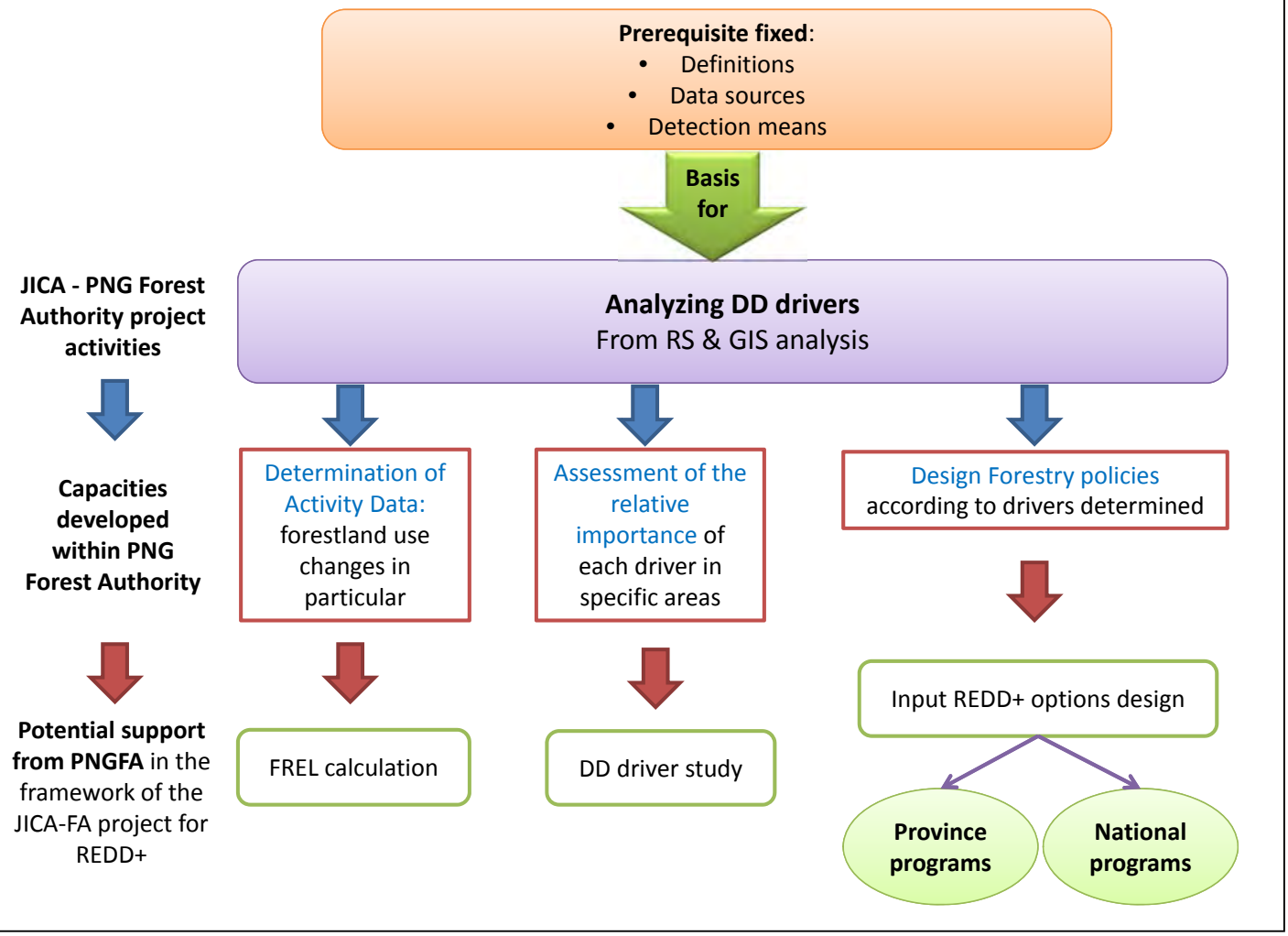
Data availability and sources:

- Disturbance in logging concessions
- Regeneration
- Plantations
- SABLs
- Settlements

Track 3:

Identification/Detection means:

- Hansen loss: mine, road, plantation, logging road, disaster, agriculture, fire
- Case of illegal logging
- Case of agriculture

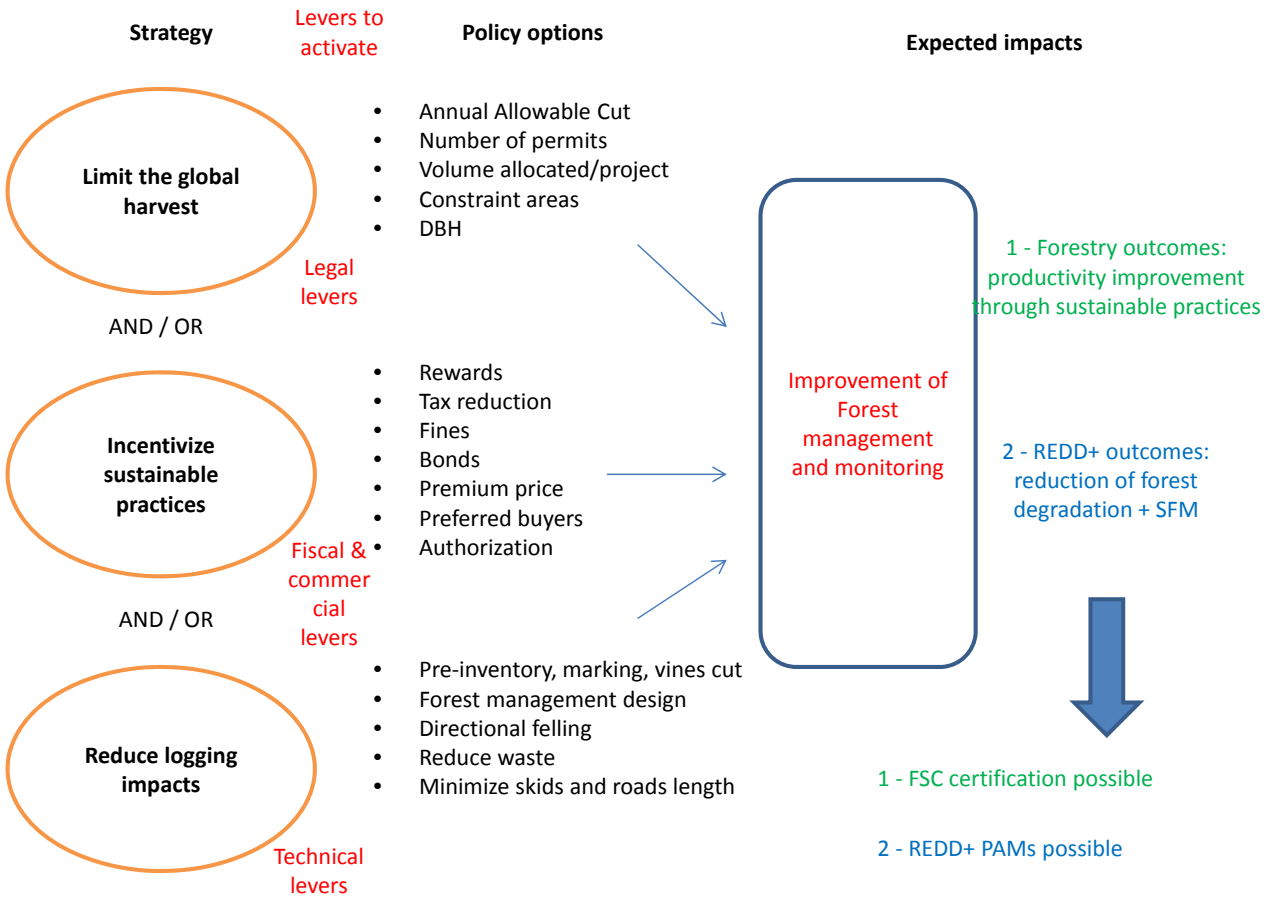


2) PNG Sustainable forest management programme

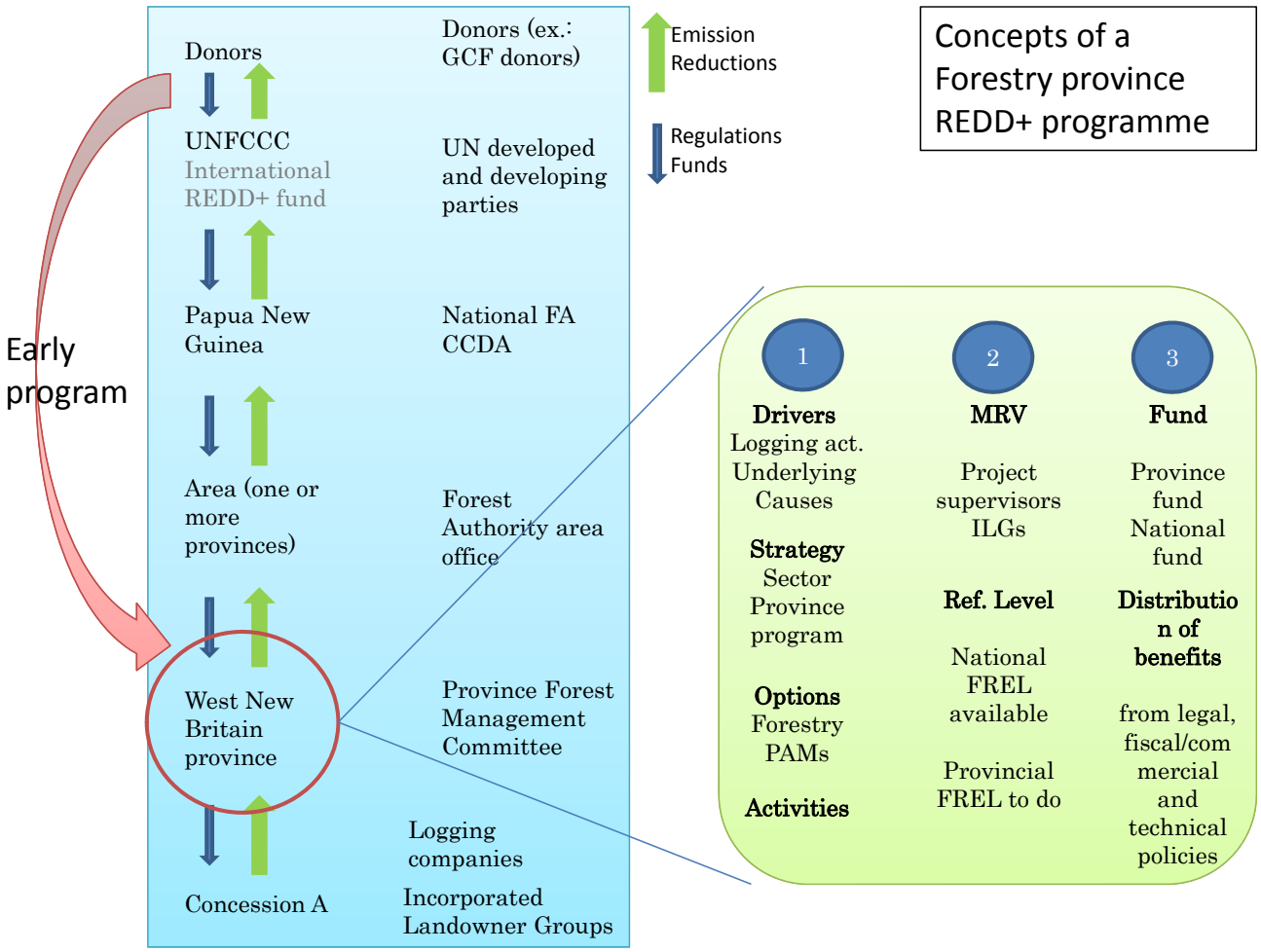
Consider initiatives that can be led from PNGFA
supported by JICA/PNGFA project
in the framework of REDD+

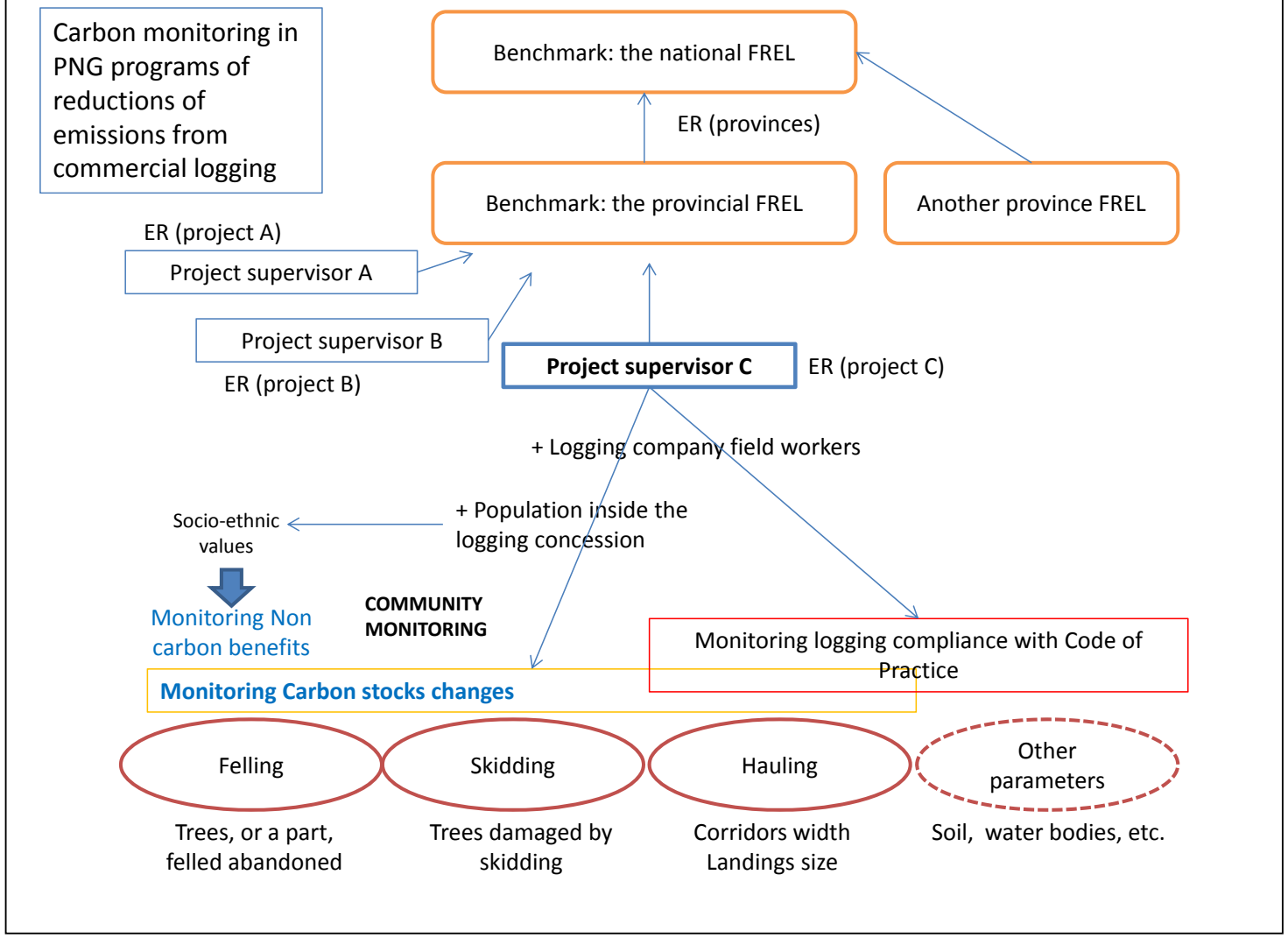
June 10th 2016

Levers to activate in the Forestry sector for changing logging practices in Papua New Guinea



Concepts of a Forestry province REDD+ programme





Forestry options for REDD+ implementation

3) PNG Forest plantations programme

Consider initiatives that can be led from PNGFA supported by JICA/PNGFA project in the framework of REDD+

June 10th 2016

Current plantations -Need Update-

- 11 projects managed by Forest Authority: 25 000 ha

- 1 managing area: 25 000 ha.

Total = 50 000ha.

- Species:

Eucalyptus 50%
Acacia: 20%
Araucaria: 20%
Pinus: 10%
Teak: 5%

Country target

- Vision 2050:

Calls for forest plantations development

- National target:

800 000 ha by 2050
250 000 ha by 2025

- Provincial target:

1000 ha per year
40 000 ha/province by 2050

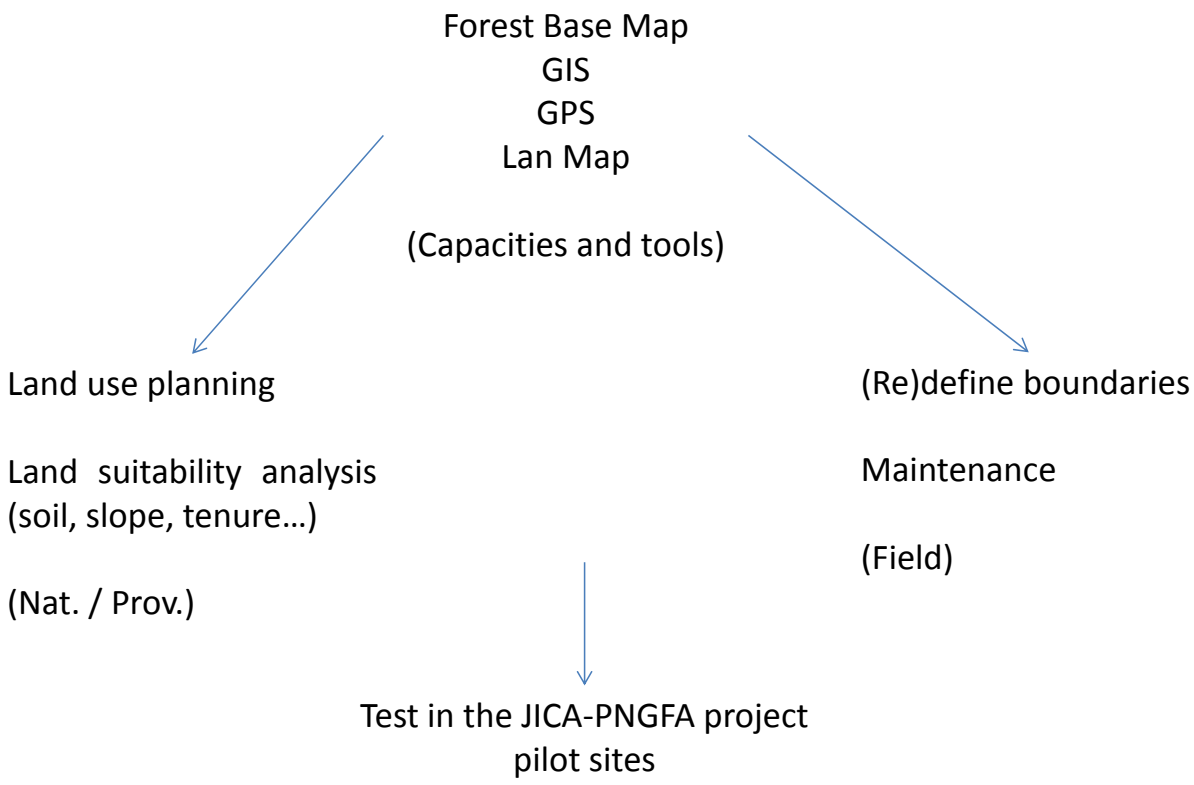
Objectives

+ Create conditions to facilitate operations in **existing plantations** by clarifying land tenure, redefining boundaries regularly and general maintenance

+ Facilitate the installation of **new development areas** by providing tools and resources for planning (zoning suitable areas) and installing plantations (GPS)

Attract private Timber companies

Support from the JICA-PNGFA project



REDD+ potential of the forest plantations programme

- Potential Emission Reduction:
  - ⇒ Displace forest harvesting degradation from primary forests to existing or new plantation sites (held on grasslands)
  - ⇒ Carbon stocks enhancement.
- Target: local communities, logging enterprises
- Scale: Province
- Approach: mixed Forestry / agro-forestry
- Supervision: plantation field servicers, coordinator (1 in Highlands 1 in Coastal regions), province and area forest officers
- Fund: PNG State, private investors, multi and bi lateral donors
- Test REDD+ components currently on-construction: MRV, FREL, SIS, etc.

Expected outcomes

- Reactivate existing plantations to attract investors (more than in natural forests)

- High benefits for climate, community and biodiversity

- Climate change mitigation from:
  - SFM: reducing logging concessions in natural forests
  - Carbon stocks enhancement: A/R in non-forest lands
  - Reducing deforestation from agriculture by providing income sources
  - Reducing forest degradation from pressure by logging projects

- Test REDD+ pilot initiatives and Result based payments

- Attract timber and carbon investors

Annex 39

Conceptual Points for Discussing and Planning Next Activities to Finalize the Project Output 3

PNG Forest Authority (PNGFA) – JICA project

"Capacity development project for operationalization of PNG Forest Resource Information Management System (PNG-FRIMS) for addressing Climate Change"

Working Draft/Internal Only

Conceptual points for discussing and planning next activities to finalize the Project Output 3

(possible supports to Land sectors)

Kokusai Kogyo, Co. Ltd. Stephane Salim. May 2017

Working Draft/Internal Only

Introduction- Output 3 activities in the PDM

Output 3: **Forest information for addressing Climate Change issues and contributing to REDD+ is prepared**.

Activities 3.1-4
Examine the contribution of PNG-FRIMS to following activities:

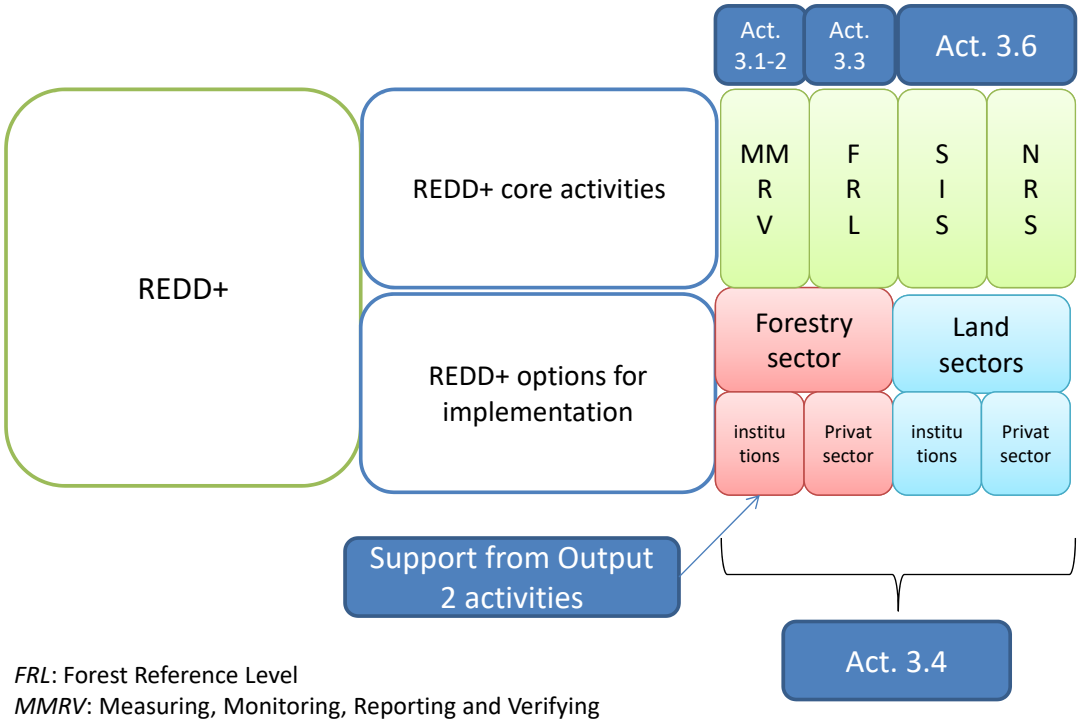
- 3.1-2: Estimate Emissions and Removals (+ manual)
- 3.3: Calculate or update Forest Reference Levels
- 3.4: REDD+ programmactic activities by facilitating the planning and implementation of initiatives relevant for REDD+, and the measurement of effects from interventions.

Other activities

- 3.5: Data sharing protocol
- 3.6: Inputs to CCDA
- 3.7: Training for calculating ER and FRL
- 3.8: Dissemination of project info

Working Draft/Internal Only

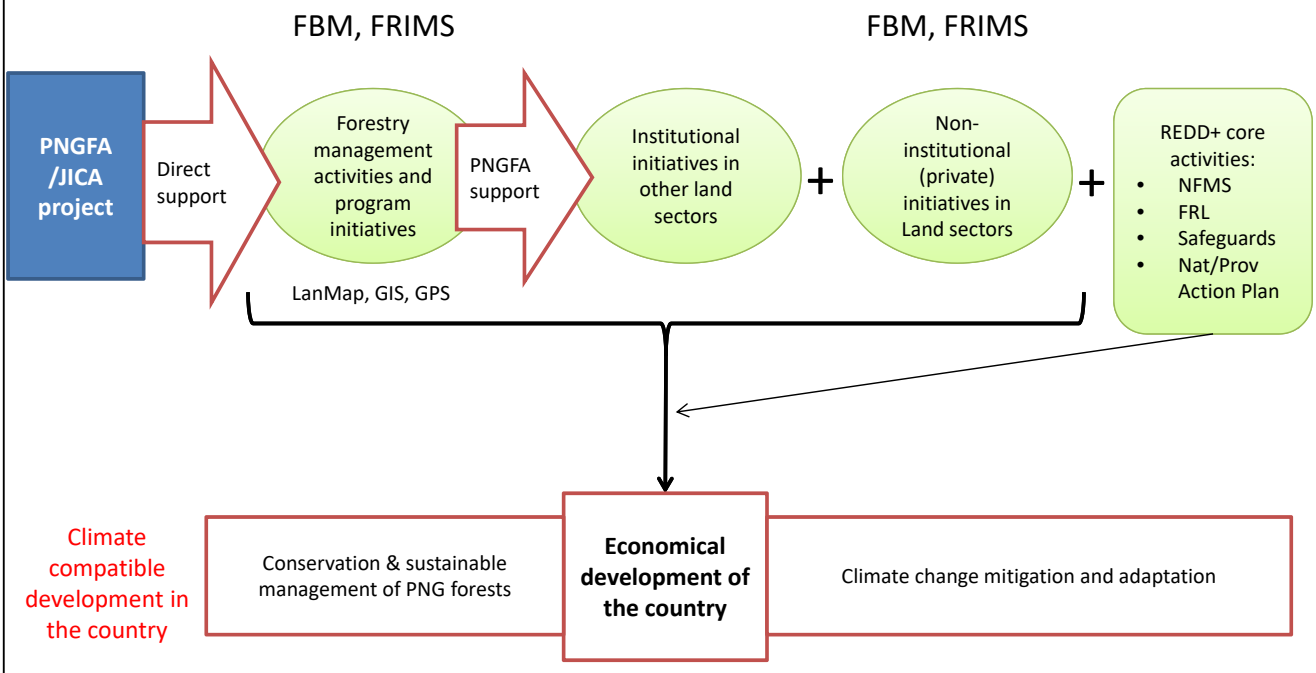
1- Support to REDD+ components



FRL: Forest Reference Level
MMRV: Measuring, Monitoring, Reporting and Verifying
SIS: Safeguards Information System
NRS: National REDD+ Strategy

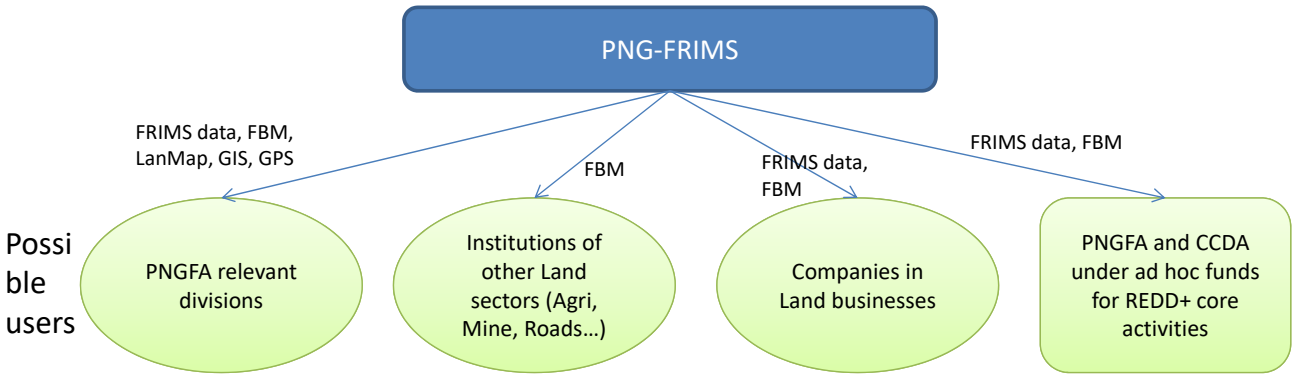
Working Draft/Internal Only

2- Support to initiatives relevant with REDD+ objectives



Working Draft/Internal Only

3- Support to activities relevant with REDD+ objectives



PLANNING of:
- Logging concessions (NFP, PFP, FMP)
- Forest plantations
- Forest regeneration

MANAGEMENT of:
- Harvesting operations assessment
- Forest plantation development
- Forest regeneration

PLANNING of:
- Land uses (Land Authority)
- Conservation areas (CEPA)
- Agriculture areas (DAL)
- Mining areas (MRA)
- Areas for cropping Energy species (Energy Authority)
- Roads and bridges (DoW)

ENVIRONMENTAL MANAGEMENT in:
- Timber productions in natural forests
- Timber productions in plantations
- Agri-commodities productions
- Natural resources extractions
- Road and bridge constructions

INPUTS into:
- Emissions and Removals estimates
- Em/Rem benchmarks estimates
- Safeguards respect assessment
- National / Provincial climate compatible programme design and planning

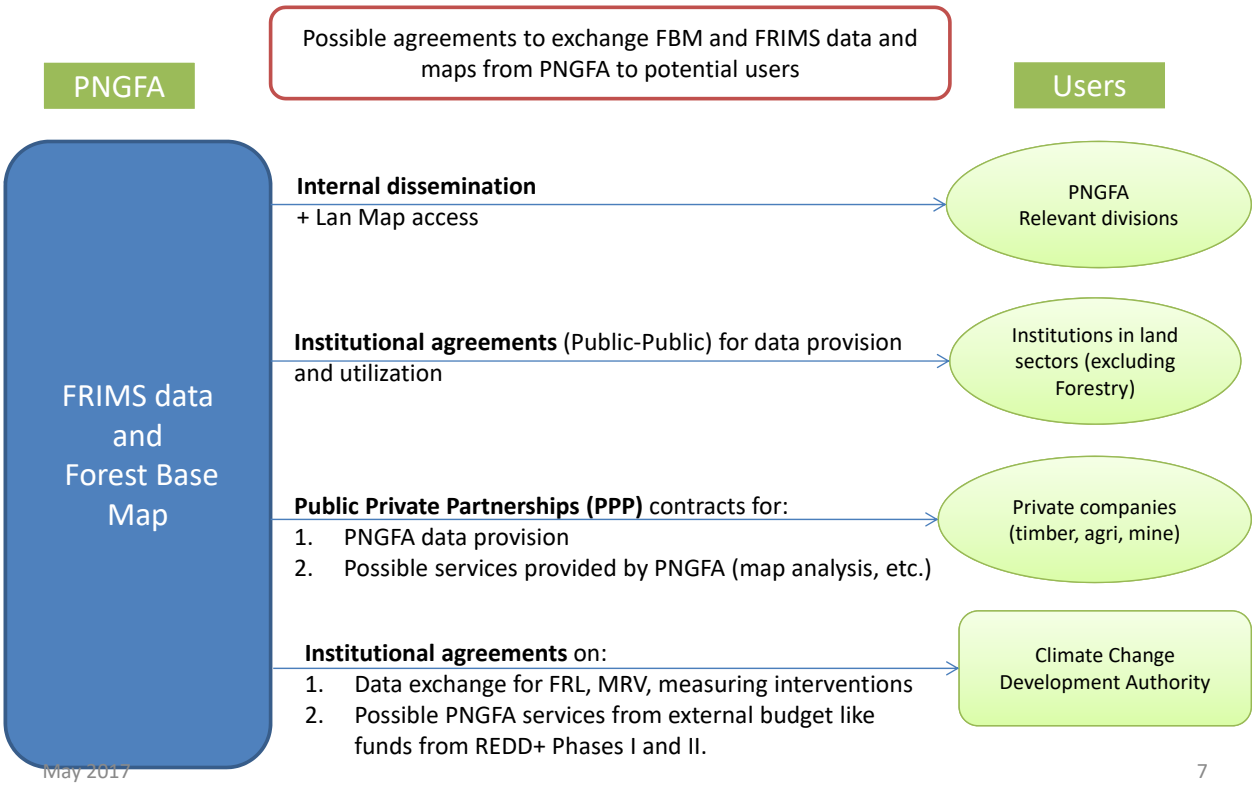
Working Draft/Internal Only

4- Support to objectives relevant with REDD+

PNG-FRIMS possible utilizations	REDD+ objectives achieved	PDM activity
Institutional activities in the Forestry sector (PNGFA): - Plan forestlands use in NFP/PFP - Plan and manage plantations and regeneration - Control logging operations and plan regeneration	General SFM approach Carbon enhancement Reduction of forest degradation	**3.4**
Institutional activities in land sectors other than Forestry: - Plan conservation areas - Plan agriculture, mining and road areas	Conservation Reduction of deforestation	**3.4**
Non-institutional activities (private business activities): - Sustainably manage harvesting operations (RIL) - Sustainably manage operations in other land sectors	Reduction of degradation Reduction of deforestation	**3.4**
REDD+ core activities: - Calculate or update reference Levels of emissions and removals (N/P-FRL) - Measure Emissions, Removals and Emission Reductions	Enabling conditions	**3.3** **3.1 / 3.2**

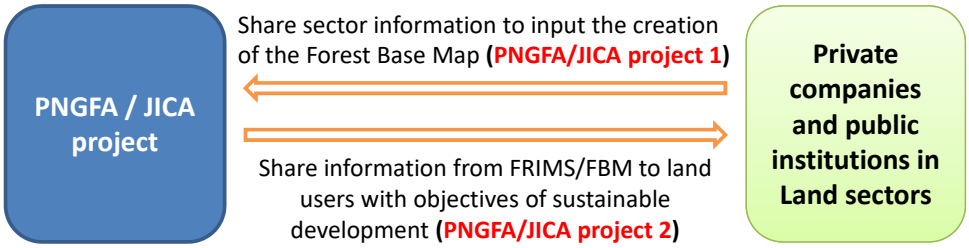
Working Draft/Internal Only

5- Possible arrangements for sharing PNG-FRIMS information



Working Draft/Internal Only

6- Possible rule system for data exchange

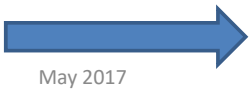


Systematization of data exchange (example)

Characteristics of potential users	Exchange or not	Price level
Participation (input) into the creation of the FBM	Yes / No	Free / Moderated / Not moderated
Objectives of data utilization: what sectors, commercial or non commercial, etc.		
Alignment of the proposed Land project with socio-environmental safeguards		
Type of data sought (ex.: raw Raster, map)		
Etc.		

Conclusion- Possible deliverables

1. PNG-FRIMS support to PNGFA in the estimation of emissions, removals and emission reductions from REDD+ relevant initiatives, at national/province level [PDM act. 3.1-2 and 3.6]
2. PNG-FRIMS support to PNGFA in the establishment or update of the national and possible provincial FRLs [act. 3.3 and 3.6]
3. PNG-FRIMS support to PNGFA internal initiatives relevant for REDD+ [act. 3.4 and 3.6] (*done partially in doc "SFM"*)
4. PNG-FRIMS data exchange and support to REDD+ relevant institutional initiatives in land sectors other than Forestry [act. 3.4 and 3.6]
5. PNG-FRIMS data exchange and support to REDD+ relevant non-institutional initiatives (from the private sector in all land sectors) [PDM act. 3.4 and 3.6]
6. Proposition of a general Data sharing procedures scheme [PDM act. 3.5-6]
7. Preparation of trainings and dissemination of information [PDM act. 3.6-8]



A work plan for next activities in Output 3 is expected to be designed from these concepts and discussions to reach such deliverables

Annex 40

Problem Analysis in PNGFA for Formulation of

Next JICA Project

JICA 3rd Project Formulation (Draft)

Problem Analysis for Logical Frame based on GCF Concept/Retreat & JICA Outputs

First Draft Material (Early Idea Note)

JICA Experts (Kadowaki, Koyama, Haraguchi)

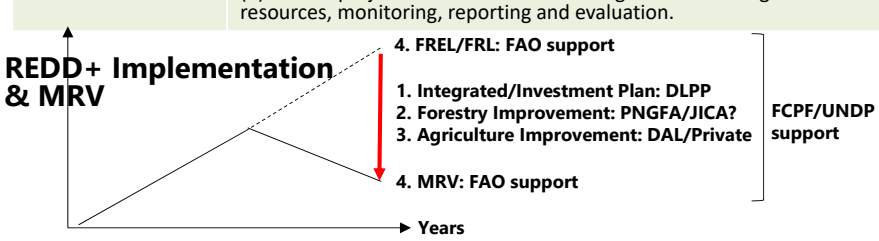
25 January 2018

(revised on 31 January)

Table of Contents

Background:
Countries Agenda: Green Climate Fund

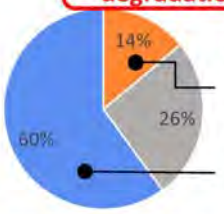
Item	Contents	Remarks
Preparation	**2017-18:** Feb: Submit to UNDP, Mar: Evaluation, Apr: Submit to GCF	**Working Material: Internal Only**
Implementation	**5 years: July 2018 start - June 2023 end** (Note: Plan of Proposal)	
Proposed Budget	**36M USD** (Note: Total Budget of implementation by the country)	
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 (3) Increasing Sustainable Production through Forest Plantations	**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
CO2 Emissions	**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



Readiness to Implementation (Role of PNGFA is important)

Background:
Forest Degradation & 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

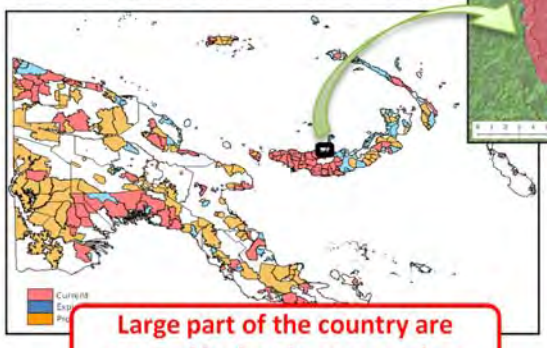
Undisturbed Logged Disturbed

The proportion of un-disturbed and disturbed forest

Increasing tendency in both timber yield and export volume

Trend of log export volume in PNG

Management Issues Where? When? How much?



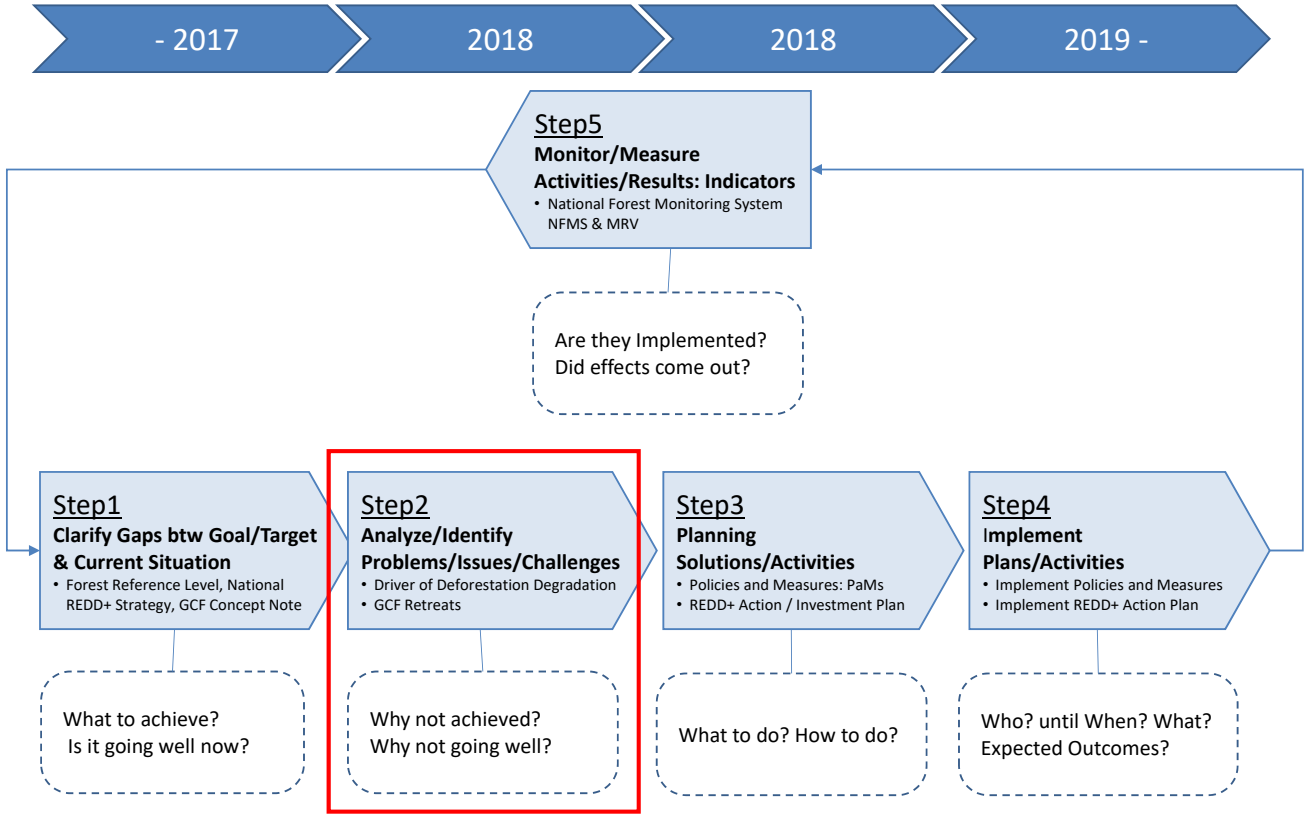
Large part of the country are covered by logging concessions

Concession Area implemented and proposed

Presence of logging in an inappropriate way

Example of after In-appropriate logging area

Project Formulation (Problem Solution): 5 Steps



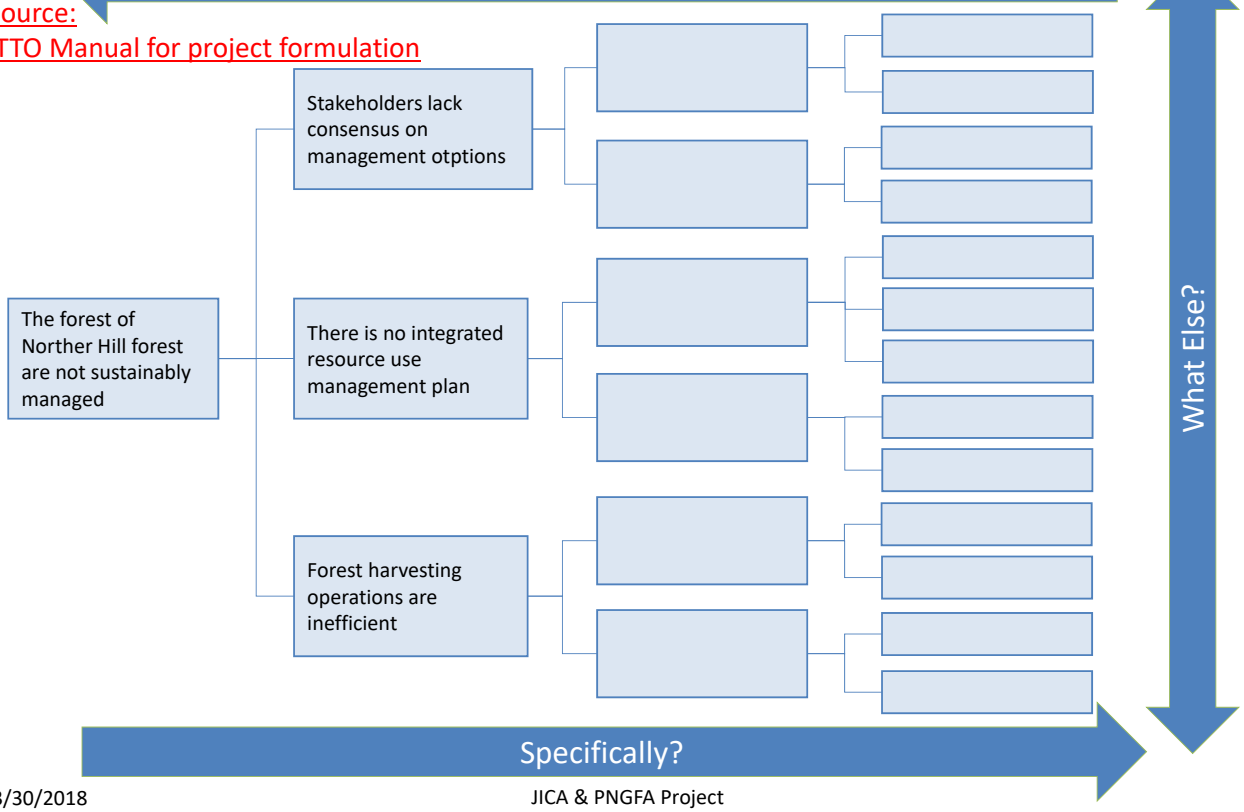
Problem Analysis: Objective & Notes

- For new JICA projects formation, JICA asks requesting country to start with conducting problem analysis to find problems, activities, and necessity, target and purpose of a new project.
- So this problem analysis is prepared to support discussion among PNGFA towards a requesting a new JICA project. It is based on NSR, GCF concept note, result of retreats, discussion with an officer of JICA HQ and JICA experts' observation.
- It might be biased and incomprehensive since it is prepared by only Japanese experts in very short term.
- With paying attention to this point, We, Japanese experts expect PNGFA to accelerate its discussion for a new project with expanding and improving this material.

Problem Analysis (Logic/Disassembly Tree)
(Example)

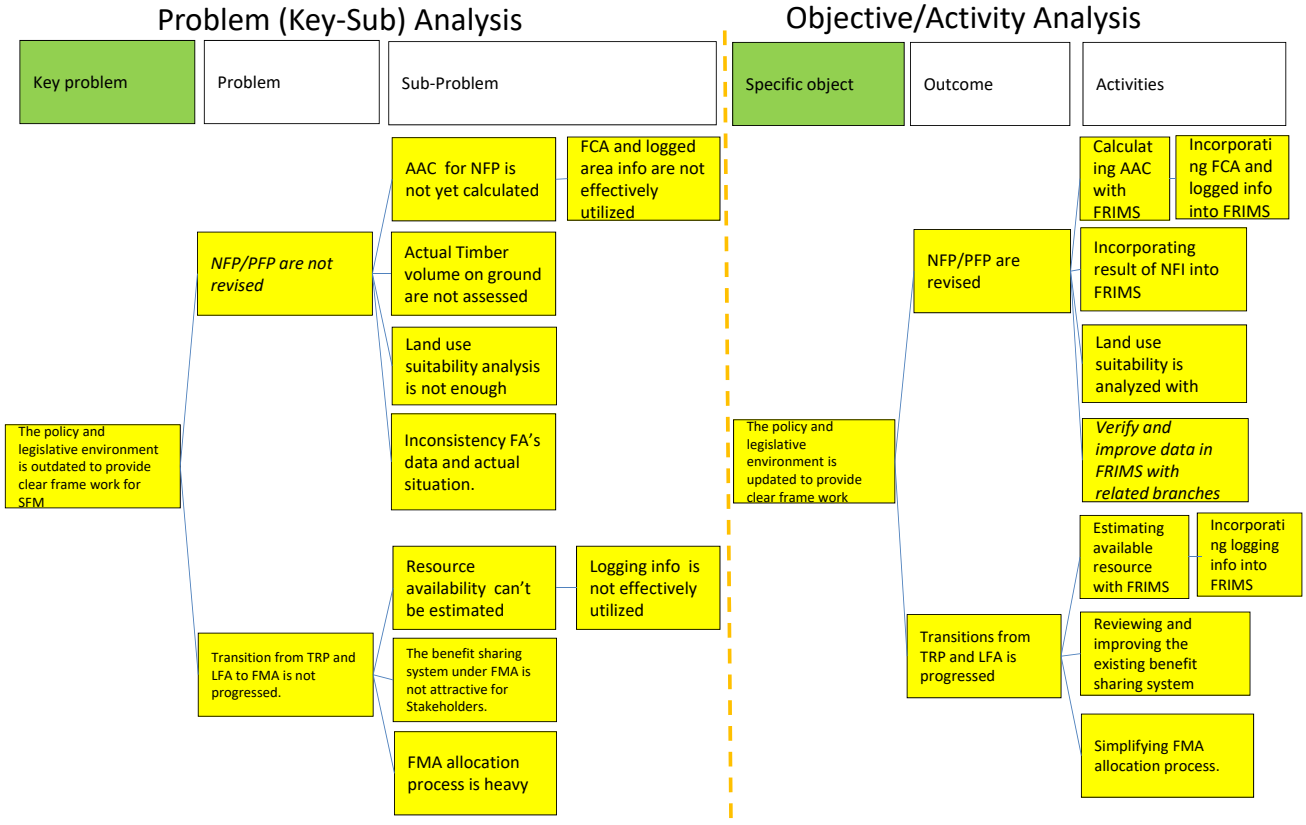
In Summary?

Source:
ITTO Manual for project formulation



Problem Analysis: SFM (1)
[Related to Activity 2.1 of GCF]

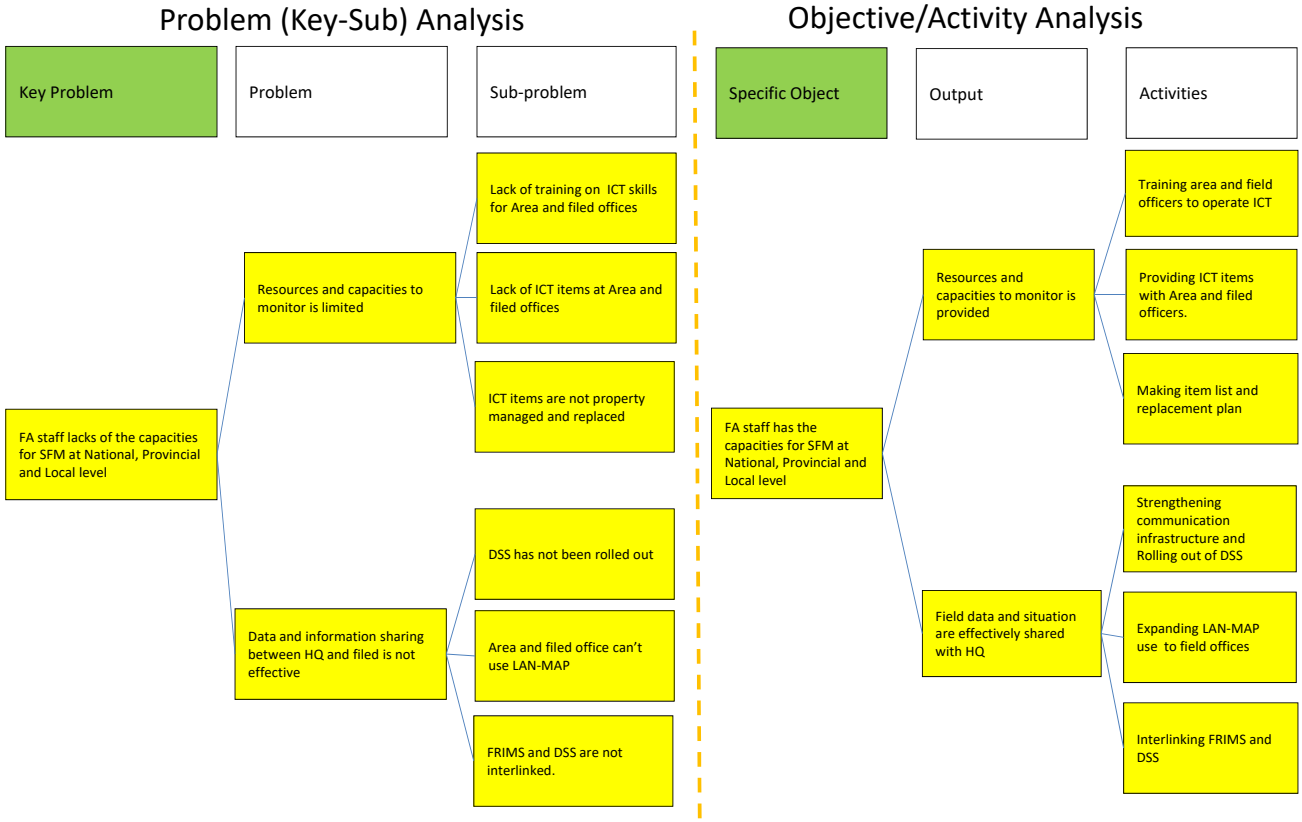
Date: 25th Jan. 2018



Problem Analysis: SFM (2)

[Related to Activity 2.1 of GCF]

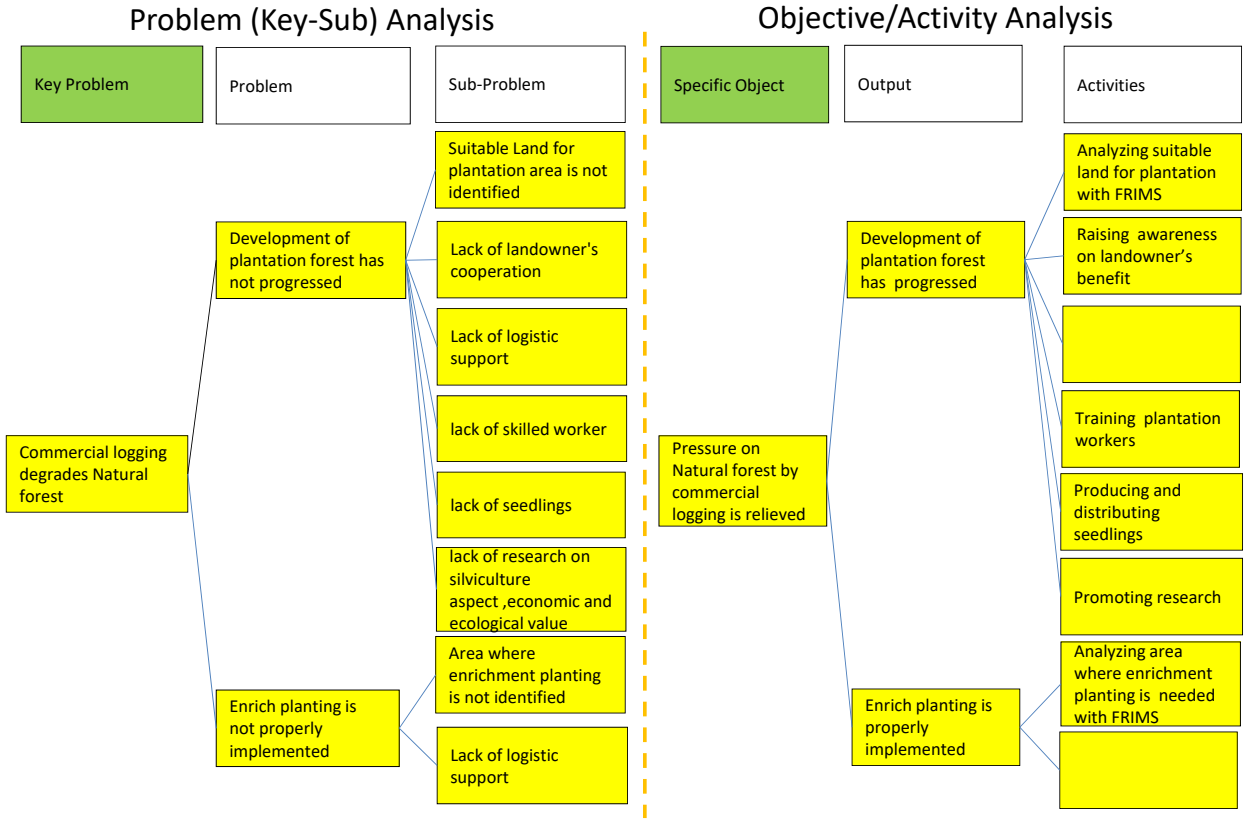
Date: 25th Jan. 2018



Problem Analysis: Plantation

[Related to Activity 2.3 of GCF project]

Date: 25th Jan. 2018



Problem Analysis: Timber Production

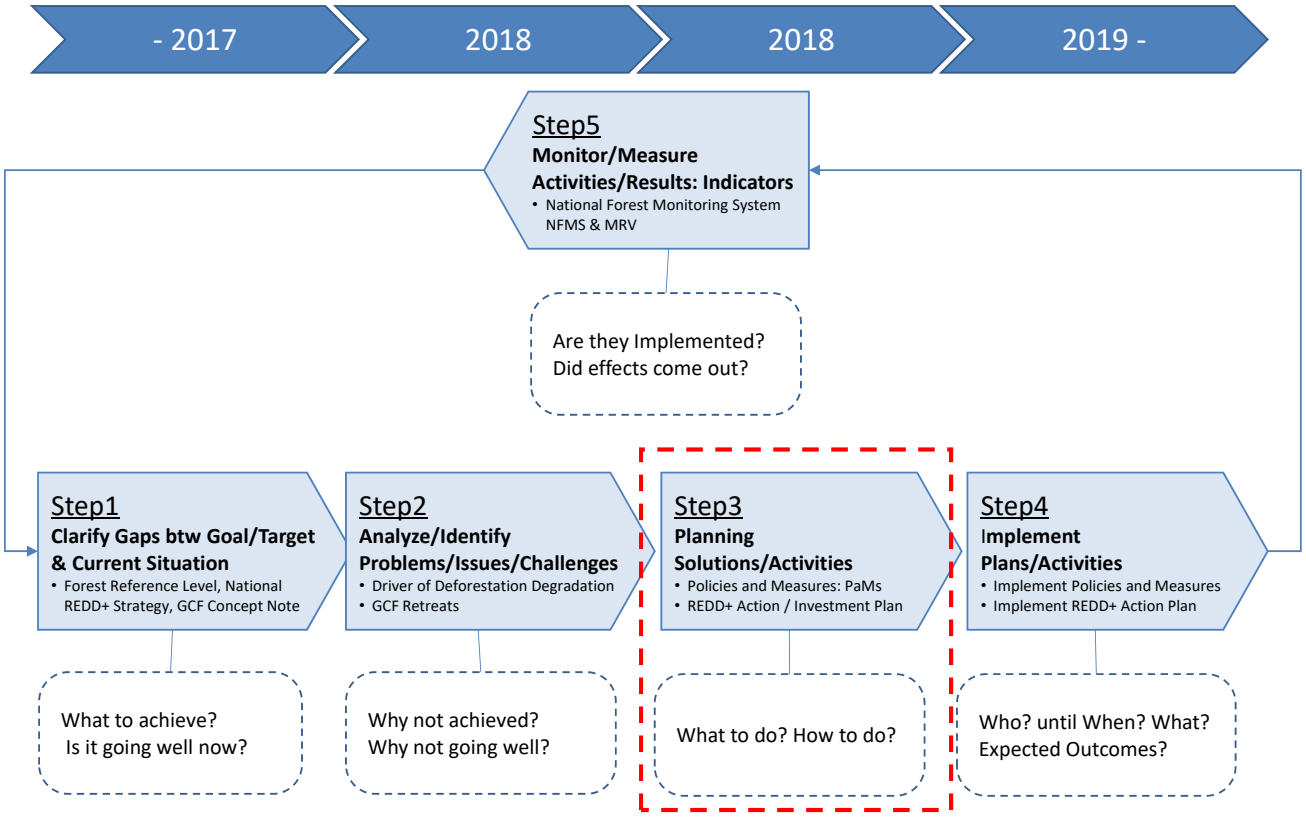
Date: 25th Jan. 2018

[Related to Activity 2.2 of GCF project]

Please work this topic as exercise

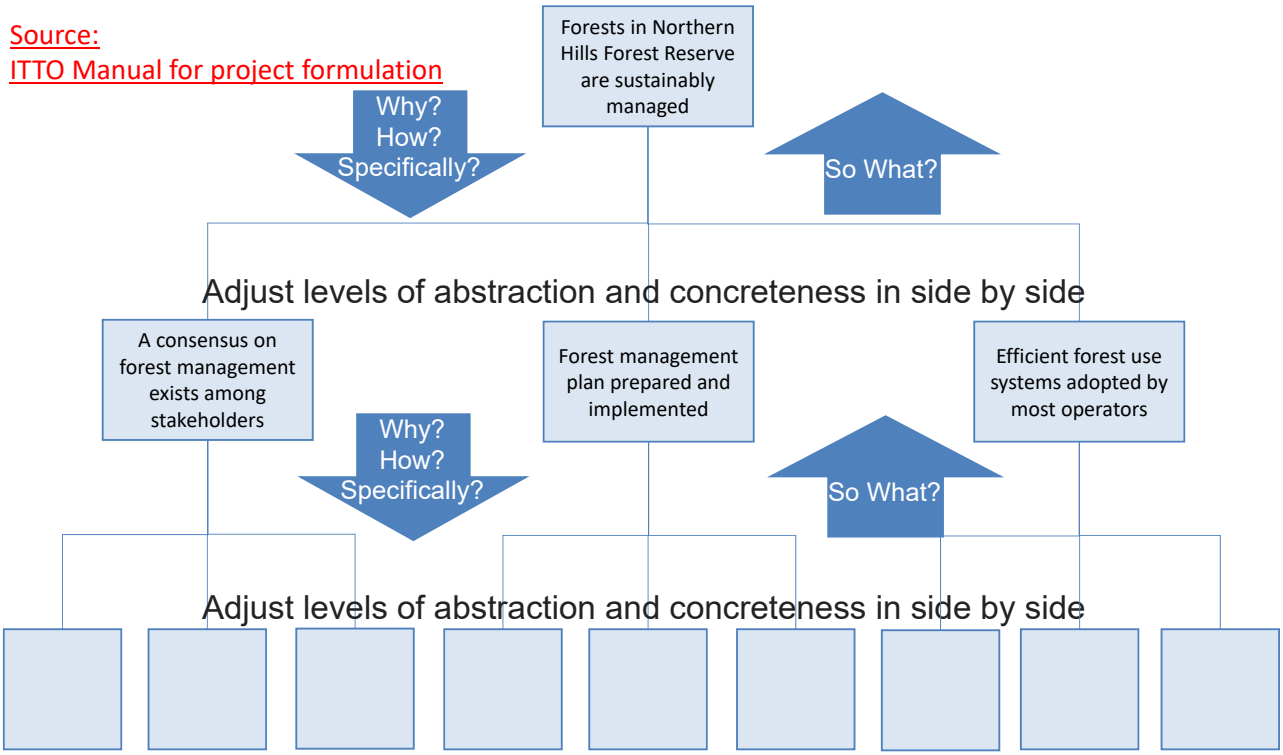
Problem (Key-Sub) Analysis			Objective/Activity Analysis		
Key Problem	Problem	Sub-Problem	Specific Object	Output	Activities

Project Formulation (Problem Solution): 5 Steps



Solution/Planning (Pyramid Structure) (Example)

Source:
ITTO Manual for project formulation



JICA Project 3rd: Direction (Outputs/Issues)

Necessary to define Direction & Basic Policies based on Achievements & Challenges/Issues as well as Request

JICA 3rd Project: Direction & Basic Policies
1.
2.
3.

Challenges/Issues of JICA 2nd Project	Requests for JICA 3rd Project

JICA 2nd Project: Achievements (Outputs)

JICA Project 2nd: Achievements & Challenges 1-1

Components	Achievements/Progress	Challenges/Issues (Requests)	Plan to achieve until 2019	Remining Issues after 2020
Output 1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS) System Function	**PMG-FRIMS: Updated & Integrated FIMS & FIPS**	Updated/Enhanced information is not fully used in PNG-FRIMS yet • Large amount of information (huge number of polygons) to handle	Updated/Enhanced Information is ready to be used in PNG-FRIMS • Organize the level/scale of information to manage effectively	Full-operationalization of PNG-FRIMS (including FIMS & FIPS)
	PNG-FRIMS: Developed Forest Information Browsing System (LAN Map)	- Utilization of LAN Map by the other divisions are not fully working out - Enhancement of thematic contents to be ready for planning/monitoring	- LAN Map is utilized working out by the other divisions - Thematic contents are enhanced to be ready for planning/monitoring	Full-operationalization (rollout) of LAN Map among FA with enhanced contents
	PNG-FRIMS: Developed Annual Allowable Cut (AAC) Calculation function (on trial based)	- Proposed simplified method has the area to be improved - The data used for calculation (e.g. logged over areas) to be improved	- Consider best step-wise approach with method and data improvement	Full-operationalization of FRIMS AAC calculation with improved dataset
	PNG-FRIMS: Developed Interactive Geo Statistical Analysis for Logging Planning	- The size and complexity of new data are heavy to processed dynamically	- Demo version of Interactive Geo Statistical Analysis function in FRIMS	Full-operationalization of Interactive Geo Statistical Analysis for planning

JICA Project 2nd: Achievements & Challenges 1-2

Components	Achievements/Progress	Challenges/Issues (Requests)	Plan to achieve until 2019	Remining Issues after 2020
Output 1: Enhanced PNG Forest Resource Information Management System (PNG-FRIMS) Data Products	**Forest BaseMap 2012 (Revised)** • Accuracy/Quality Assessment (CE) • Develop FMU with enhanced attr.	Sharing maps with other stakeholders • Result isn't documented/published • Utilize data for planning/monitoring	Maps are shared and utilized (pilot) • Publication: Big Book (Report/Atlas) • Demonstrate in pilot province/prj.	Update BaseMap (every 10 years)
	Forest Degradation Driver Map • Definition/Method is determined • Maps are developed nation-wide	Sharing maps with other stakeholders • Result isn't documented/published • Utilize data for planning/monitoring	Maps are shared and utilized (pilot) • Publication: Big Book (Report/Atlas) • Demonstrate in pilot province/prj.	Time series Emissions & Removals
	Forest Timber Volume Map (Draft) • Improve value with FIPS & PSP • Data integrated with F-BaseMap	Scientific value / Utilize for planning • Result isn't documented/published • Data is not used in FIMS application	Maps are utilized for planning (pilot) • Publication: Big Book (Report/Atlas) • Data is ready in FIMS@FRIMS app.	Update values based on NFI result
	Forest Cover Map 2015 (Updated) • PNGFA capacity to develop maps • Maps are developed nation-wide	Improve the efficiency for updating • Take time to develop maps by FA • Consider new tech/tools in works	Maps are finalized & utilized (pilot) • Role to work with local consultant • Collaborate with FAO(Terra/SEPAL)	Update maps 2020 (every 5 years)
	Past Forest Cover Maps 2000/2005 • PNGFA capacity to develop maps • WNB/WSK maps are developed	Limited human resources in FA • Take time to develop maps by FA • Expansion to the other provinces	Utilize local resource & Collaboration • Sub-contract with local consultant • Collaborate with FCPF2 (KKC+Local)	Expansion to other than NRS pilots
	Future Forest Change Modeling • Demonstrate in WNB with FA data • Potential application for planning	Capacity Building & Expansion • Training FA/Collaborate with others • Expansion to the other provinces	Capacity Building & Collaboration • Training FA/Collaborate with others • Collaborate with FCPF2 (KKC+Local)	Utilization in Planning & Monitoring
	Watershed (Catchment) Data • 3 level (on 5mDEM) is developed	Quality check with global dataset • Data is not country official data	Data is utilized in FA and others • Dissemination as PNG country data	Sharing outputs & issues with others
	Updated Constraints Data • Altitude/Slope/Inundation/etc	Data is not used in FIMS application • The amount/complex of new data	Data is ready in FIMS@FRIMS app. • Practical solution to utilize data	Sub-divisions for GHGi managed land
	Digitized Logging Road Data • Every 5 years data is developed	Data is not utilized in PaMs, etc • Data is not well-known/shared	Utilize data for planning/monitoring • Publication: Big Book (Report)	Update data 2020 (every 5 years)
	Logging Concession Boundary • Comprehensive check/improved	Still not full comprehensive among FA • Status update among divisions	Demo utilizing FMU for boundaries • Comprehensive data among FA	Full utilizing FMU as standard work
	Logged over Area/Boundary • Pilot area/pro data is digitized	Amount/Situation of existing data • Identify benefits by cost of work	Complete digitizing in pilot provinces • Sub-contract with local consultant	Complete data in other provinces
	Forest Clearance Authority (FCA) • Plan to digitize maps (with local)	Amount/Situation of existing data • Identify necessary time & inputs	Complete digitizing boundaries • Sub-contract with local consultant	Updating data as defined duty work
	Forest Plantation Boundary/Area • Plan to GPS survey (with local)	Not all data managed in I&M division • Identify necessary time & inputs	Updating data in FA & plan for future • Develop manual for local consultant	Updating data other than FA

JICA Project 2nd: Achievements & Challenges 2

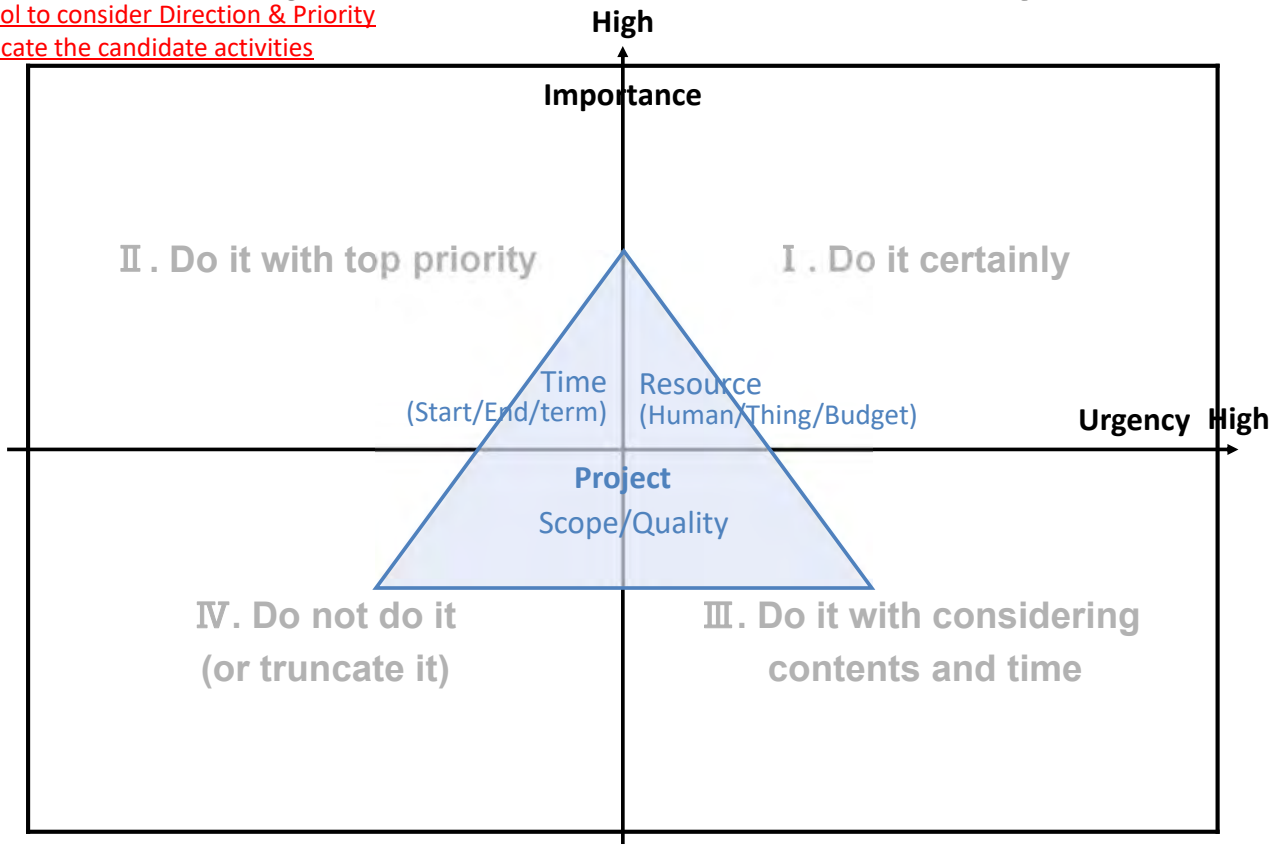
Components	Achievements/Progress	Challenges/Issues (Requests)	Plan to achieve until 2019	Remining Issues after 2020
Output 2: Improved National/Provincial Forest Plans, Management Plan/Monitoring System	**National/Provincial Forest Plan**	-Utilizing FRIMS for NFP/PFPs is not performed sufficiently, especially political aspect. -Forecast for finalizing NPF (NEC approval) is unclear.	Some contents made by FRIMS are reflected in NFP/PFPs.	-Complete utilizing FRIMS for NFP/PFPs
	Annual Allowable Cut (Modeling)	-Data concentration(NFI) of reliable timber volume is unfinished -Current yield curve is hypothesized as linear -Regrowth volume is added from first year after logging (Whereas logged over area is closed for 35 years)	Structure of regrowth volume calculation after logging is assembled in AAC model. Calculation of AAC volume based on current FRIMS data is conducted.	-AAC calculation based on reliable timber volume -Implementation of adequate yield curve after logging for AAC Calculation -Implementation of adequate regrowth model for AAC calculation
	Management Plan/Monitoring System	-ICT items such as GPS/GIS is still lacking to conduct LCoP/PMCP -DSS and LAN Map are not disseminated whole PNGFA	Management and Monitoring using FRIMS is introduced mainly Pilot Area.	-Completion of procurement for ICT items such as GPS/GIS to conduct LCoP/PMCP -Full-operationalization of LAN Map among FA with enhanced contents
	Guidelines for SFM utilizing FRIMS	-Guidelines to utilize FRIMS and indicate work procedures are not prepared	Some guidelines concerning about using FRIMS are prepared (or drafted).	-Development of political guidelines (or plans) scoping REDD+ for SFM utilizing FRIMS -Development of guidelines that indicate the workflow how PNGFA staff concern each other
	GPS/GIS/UAV Monitoring Training	-Overall procurement and management plan for ICT items is absence	HQ/Field officers obtain capacity of using GPS/GIS. HQ officers obtain capacity of basic usage of UAV. Potential for further utilization of RS technique in PNGFA mainly UAV is unveiled.	-Full-operationalization of self-directive management of ICT items

JICA Project 2nd: Achievements & Challenges 3

Components	Achievements/Progress	Challenges/Issues (Requests)	Plan to achieve until 2019	Remining Issues after 2020
Output 3: Prepared/Identified Forest Information for addressing/contributing-to REDD+	**Organize Potential for REDD+ PaMs** • Conditions of Sustainable Forest Management, TOR of Plantation Development are proposed	Utilizing the proposed direction and the activities (for JICA 3rd project and GCF proposal and investment plan, PFP expansion supported by FCPF2)	Contributing JICA 3rd formulation and GCF proposal and investment plan based on the outputs from JICA 1st & 2nd projects)	Implementation of the proposed direction and activities (GCF & JICA)
	AAC-based/Mapping-based FRL • AAC based FRL is considered • Mapping-based FRL is considered (Both will be worked in 2018)	Good understanding of differences of methods and results	Organize the characteristics of each method and best combination use of the methods to improve quality	Full-revision of PNG FRL based on the recommendation from the analysis
	Providing FRIMS data to NFMS • Provide Forest BaseMap, Logging Concession, Constrains data, etc for Collect Earth Assessment	FRIMS and Collect Earth database are not fully integrated (physically) • Collect Earth is operated in FAO network (not in PNGFA LAN)	Define data communication protocol by collaborating with FAO • FAO also consider to locate Collect Earth DB in PNGFA LAN	Full-operationalization of PNG-FRIMS as an important part of NFMS
	Support Function for DSS (TLS) • Function to publish Bookmarks (URL) of LAN Map with location and scale for the area of interest	- DSS is not fully working/delivered (at FA HQ as of beginning of 2018) - Network between FA HQ and local offices are not working yet	- FA follow up DSS implementation (with support of FCPF2?) - JICA will advice technically to enhance DSS to work with LAN Map	Full-operationalization of PNG-FRIMS and DSS as monitoring of NFMS

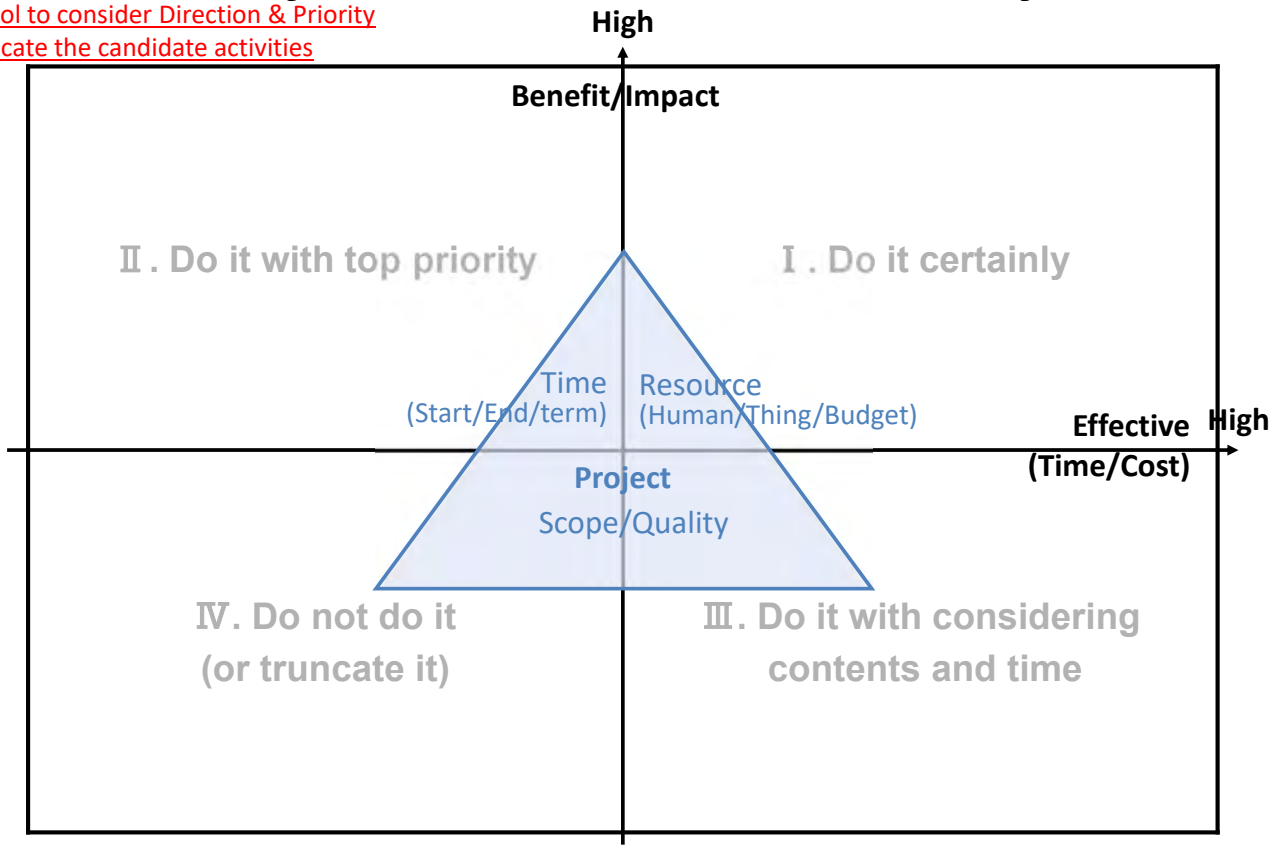
JICA Project 3rd: Direction & Priority

Tool to consider Direction & Priority
Locate the candidate activities



JICA Project 3rd: Direction & Priority

Tool to consider Direction & Priority
Locate the candidate activities



This table is made based on current progress under the output 3 of the JICA project

JICA 3rd Potential: Sustainable Forest Management

- Vision 2050: call for sustainable forest management
  - 90% reduction in emissions from 1990 by 2050 (also in Intended Nationally Determined Contribution)
  - **% of emissions from Agriculture, Forestry and Other Land Use derived from degradation by logging

  National Strategy for Responsible and Sustainable Development call for a more sustainable and responsible green development pathway

Components	Problems/Issues	Activities/Solutions (Draft)
• Land use planning (including Land suitability analysis)	Lack of basic info. Data is not effectively utilized	• Inputting existing data into FRIMS • Analyzing data and info with FRIMS for planning use
• Logging Code of Practice (Reduced Impact Logging)	1: Pre-Harvest Planning	• 5-year (volume estimates) and annual (inventories) and setup (coupe) plans
	2 (or 4): Felling	• Limit logs abandoned, damaged (thanks to directional felling) and wasted (stump) • Possible Planning directional felling
	3: Skidding	• Possible Planning Log line winching use • Minimize length of skid trails (use log winch in sloppy fields)
	4 (or 2): Hauling	• Planning of limited corridors and landing surfaces • Road area < 10% of setup, Road width < 40m, Landing nb < 3, Landing area < 0.25 ha per setup
	5: Post Harvest Treatment Regeneration	• Analyzing area to be regenerated. • Decompress surface of roads etc.
• Rehabilitation of degraded areas In Not production area. [It is not clearly discussed in NRS and the retreat.]	Area to be rehabilitated is not known	• Analyzing and identifying area to be rehabilitated
Note: Rehabilitation in Production forest mentioned in Plantation program		
• Development of forest plantation programs	[see paper on Forest Plantation Development]	[see paper on Forest Plantation Development]
• Estimation of carbon benefits • Carbon monitoring		

This table is made based on current progress under the output 3 of the JICA project

JICA 3rd Potential: Forest Plantation Development

- Vision 2050: calls for forest plantations development
  - National target: 250 000 ha by 2025, 800 000 ha by 2050
  - Provincial target:1000 ha per year, 40 000 ha/province by 2050

  To reach its national target in terms of planted area, PNG must quintuple existing plantations (50 000 ha) in less than 10 years.

Components	Problems/Issues	Activities/Solutions (Draft)
Development Strategy	Boundaries and areas of existing/operational plantations are not updated/accurate	• Updating forest plantations boundaries and area: during GPS training include forest plantation officers (Forest Development Directorate) during PNG-FRIMS update
	Suitable land and area for new developing plantations are not analyzed/identified	• Planning new forest plantations: land suitability analysis prioritizing Logged-over and savanna areas: during the design of national & provincial forest management plan insert consideration of forest plantations
Enabling Environment	Training: Management Plan Lack of resources for "management" and update plantation information	• Managing and maintenance of (existing and new) forest plantations: during trainings for utilizing Forest Base map and Lan Map include forest plantations officers
	Training: Monitoring System Lack of resources for "monitoring" and update plantation information	• Designing measures to ensure monitoring and control fires: during trainings on GIS and RS utilization insert a component related fires and include officers managing forest plantations
	Raising Awareness Land tenure: acquisition (competing land use options) and disputes between landowners	• Raising awareness on plantation leases and their benefits to landowners: thanks to knowledge increase of field officers concerning plantations benefits for Forestry but also for Climate Change (REDD+, PES)
	Review & Research Lack of research on economic and environment value of planting species	• Gathering and recording information on economic and ecological value of different timber species including mixture and new Agroforestry concepts: during updating PNG-FRIMS include data on plantations and species of interest
Initiate/Implementation	Funding	• Considering private sector business plan

This table cannot be made based on the output 3 of the JICA project (out of scope)

JICA 3rd Potential? Timber Production & Processing

- Target
  - Quantitively Goal 1
  - Quantitively Goal 2

  Note:

Components	Problems/Issues	Activities/Solutions (Draft)

Way-Forward (Rough Road Map)

1st half Feb. → 2nd half of Feb. → 1st half Mar. → 2nd half of Mar.

- By end of Jan: Compile the results of discussion
- 1st half of Feb: Problem Analysis among PNGFA
- 2nd half of Feb: Implementation plan with JICA/FCPF
- 1st half of Mar: Prepare Investment Plan/Proposal
- 2nd half of Mar: Submit the draft final Plan/Proposal

Note: This will be modified based on GCF preparation progress and schedule

Annex

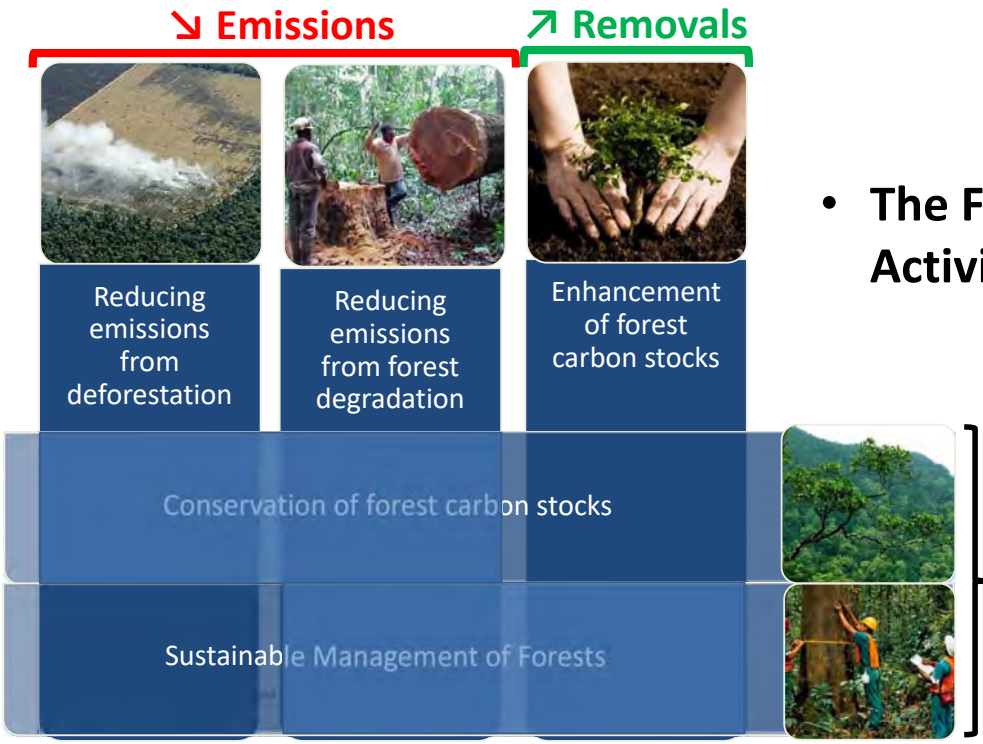
Annex:
Discussion among JICA Experts 1

- Comments for Slide 10
  - ✓This key problem "commercial logging degrades forest" is more for PaMs such as promoting SFM/RIL.
  - ✓For Forest plantation, it would be seen more as follow:
  - ✓+ Key problem: No sustainable source of wood; logging is concentrated in and affects natural forest stands.
  - ✓+ Specific objective: Provide a sustainable source of wood by switching logging from natural forests to forest plantations.
- General Comments
  - ✓wondering if it is suitable and if JICA will accept a project designed too close than the GCF proposal. Indeed the GCF proposal will normally receive budget for implementation so there are risks of duplication and redundancy in GCF and JICA project activities if the formulation design is too close. Of course integrating and taking into account GCF proposal is important though.

Annex:
Discussion among JICA Experts 2

- Slide 10: "key problem of commercial logging degrades natural forests". Yes why not proposing to change the title. It would be more accurate and allow separating the objectives of improving PMC procedures with those of developing Forestation programs.
- It is understood the analyzed problem is common for the whole country. But the response by JICA will be different than the response from FCPF. So it can be advantageous to think what specific problems (of the big problem) can be addressed by JICA specifically. In particular, JICA will deal with issues in relation with forest information and their management.
- To summarize, but of course open for discussions, please find what Forestry support activities will be included and excluded in the JICA 3rd project:
  - Included:
    - ✓ Management of logging on the following aspects: spatial planning, AAC, monitoring & control systems
    - ✓ Management of plantations
    - ✓ Management of regeneration
    - ✓ Province implementation of REDD+,
  - Excluded:
    - ✓ Management of logging on the following aspects: feasibility study and design of fiscal policies and promotion of timber certification
    - ✓ Promotion of downstream processing and development of sawmills
    - ✓ Promotion of small scale logging activities

Annex:
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

Annex:
REDD+ Activities/Scope and Land Change Matrix

Year			Current	Forest											Cropland		Grassland	Wetlands	Settlements	Others
			Sub-type	Natural										Plantation	Subsistence	Commercial				
			Condition	Primary					Degraded					Plantation	Cropland		Grassland	Wetlands	Settlements	Others
Previous	Sub-type	Condition	Stratification	Tropical rain forest	Tropical montain system	Tropical dry forest	Tropical shrubland	Mangrove	Tropical rain forest	Tropical montain system	Tropical dry forest	Tropical shrubland	Mangrove	Plantation	Cropland		Grassland	Wetlands	Settlements	Others
Forest	Natural	Primary	Tropical rain forest	Stable Forest (Forest Conservation)					Forest Degradation					Plantation (converted)			Primary Deforestation			
			Tropical montain system																	
			Tropical dry forest																	
			Tropical shrubland																	
			Mangrove																	
		Degraded	Tropical rain forest	Forest Restoration					Stable Forest (Sustainable Management of Forests)								Deforestation			
			Tropical montain system																	
			Tropical dry forest														Secondary Deforestation			
			tropical shrubland																	
			Mangrove																	
	Plantation	Plantation	Plantation	Plantation (recovered)																
Cropland	Subsistence	Cropland	Cropland	Afforestation/Reforestation (Enhancement of Carbon Stocks)													Stable Non-Forest			
	Commercial																			
Grassland	Grassland	Grassland	Grassland																	
Wetlands	Wetlands	Wetlands	Wetlands																	
Settlements	Settlements	Settlements	Settlements																	
Others	Otherland	Otherland	Otherland																	

Annex:
REDD+ Activities/Scope and Land Change Matrix