

Papua New Guinea Forest Base Map 2012

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

1. Background

JICA PNGFA Project 2011-2014

Japan International Cooperation Agency (JICA) and PNG Forest Authority (PNGFA) implemented a capacity development project since 2011 to 2014 combined with the Japanese Grant Aid Program that provided the project with remote sensing data and GIS equipment. The project set up a PNG Forest Resource Information Management System (PNG-FRIMS) based on a GIS system with remote sensing technology (JICA and PNGFA, 2016).

Development History of the Forest Base Map 2012

Before the project 2011-2014, national level Forest Base Map was created as at 1975 and had not been updated since minor update in 1996. This outdated map based on legacy technology caused various practical problems to PNGFA. Responding to this situation, The PNG Forest Base Map 2012 was initially developed as a main layer of the PNG-FRIMS in 2014. Following the successful completion of the project 2011-2014, new project 2014-2019 commenced for realizing the full operationalization of the PNG-FRIMS. The improvement and finalization of the Base Map 2012 was taken over by this new JICA-PNGFA Project 2014-2019 and completed in February 2016.

2. Development, improvement and finalization of the Base Map 2012

In order to cope with challenging conditions including rugged terrain, vast forest area, very poor road connection and landowner issue (97% of the land in PNG is customary owned by clans), Forest Base Map 2012 was developed using optical satellite imagery (RapidEye), Rader satellite data (ALOS-PALSAR) and other existing data. Significant improvements such as up-to-date information, finer segmentation size, forest/non-forest delineation including water area etc. are seen in the newly developed Forest Base Map 2012.

ALOS-PALSAR: The Advanced Land Observing Satellite (ALOS) "DAICHI" equipped with Phased Array type L-band Synthetic Aperture Radar (PALSAR) launched by Japan Aerospace Exploration Agency (JAXA) in 2006.

(a) Data input and process

Satellite observation data used for developing the PNG Forest Base Map 2012 (Base Map 2012) include RapidEye (optical sensor, captured in 2010 and 2011) and ALOS-PALSAR (radar sensor, captured in 2007 and 2010). Airborne radar information shared from the PNG National Mapping Bureau (NMB) was also utilized as data for elevation from sea level.

Classification and its coding system of forest and other land-cover used in the Base Map 2012 was developed by integrating classification code necessary for PNGFA work and classes discernible from satellite imageries on the basis of the land cover classification and code registered in Forest Inventory Mapping System (FIMS) (Hammermaster & Saunders, 1995 and McAlpine, and Quigley, 1998,). 'Alpine grassland' and 'Subalpine grassland' were picked up from 'Grassland and Herbland' according to the elevation from sea level. 'Forest plantation' and 'Plantation other than forest plantation' are newly added to the Forest Base Map 2012. Details of the classification and coding system are illustrated in sub-section (b) below.

Segmentation and object-based classification of the land cover was done by using a software 'eCognition' for satellite imagery analysis as well as a software 'R' for statistical analysis of the segments. For this analysis, we utilized RapidEye satellite imageries (five bands), NDVI (Normalized Difference Vegetation Index) generated from analysis on RapidEye data, elevation data shared from NMB (five meter mesh), and slope and watersheds (or catchment boundaries) generated from analysis on NMB elevation data.

Automated classification of the segments were done for forest and other vegetation by 'eCognition' and 'R', after calculating 'feature parameters' of each segment by using statistical value including average and standard deviation of various parameters of all pixels in each segment. The classification was done by multi-stage classification following a forest classification flowchart tailored for this work, by using parameters including Brightness, Green, Near Infra-Red (NIR), NDVI, elevation from Digital Elevation Model (DEM), and slope.

Where we encountered with difficulty by cloud cover on optical RapidEye imageries, we interpolated forest/ non-forest distinction by utilizing PALSAR radar data.

Correction by human interpretation was made where we found automated classification is difficult for some classes (Larger Urban Centres, Bare Areas, Cropland/ Agriculture land, Woodland, Savanna, and Scrub) or obvious error classification made by automated process. The human interpretation was supported by photographs taken by digital camera on hand-held GPS (Global Positioning System) terminal from helicopter, verification by ground truthing, mobilization of existing knowledge, and literature study.

‘Forest Plantation’ was distinguished from ‘Plantation other than forest plantation’ by referring to plantation boundaries data owned by PNGFA. ‘Forest Plantation’ indicated on the Forest Base Map is not necessarily corresponding to the actual distribution of forest plantations since PNGFA does not have every boundary information of forest plantations which are often managed by private sectors.

Some classes (Cropland/ Agriculture land, Forest Plantation, and Plantation other than forest plantation) are delineated by human interpretation relying on local knowledge of PNGFA officers and staffs attached to Area and Provincial Forestry Offices by utilizing RapidEye imageries and geo-referenced photographs taken by handheld GPS terminal. The PNGFA officers and staffs used ultrahigh resolution satellite imageries on Google Earth and Bing Map, existing information on cropland (Mapping Agriculture Systems of PNG, MASP and Papua New Guinea Resource Information System, PNGRIS), and data on Digital Elevation Models (DEMs).

(b) Typology of forests and other land use

P	Low altitude forest on plains and fans – below 1000 m	G	Grassland and herbland
H	Low altitude forest on uplands – below 1000 m	Ga	Alpine grassland – above 3200 m
L	Lower montane forest – above 1000 m	Gi	Subalpine grassland – above 2500 m
Mo	Montane forest – above 3000 m	M	Mangrove
D	Dry seasonal forest	O	Cropland/Agriculture land
B	Littoral forest	Qa	Plantation other than forest plantation
Fri	Seral forest	Qf	Forest plantation
Fsw	Swamp forest	E	Waterbody
W	Woodland	Z	Bare area
Sa	Savanna	U	Larger urban centre
Sc	Scrub		

(c) Appropriate scale of use

The ground resolution of the RapidEye imageries used for the development of the Forest Base Map 2012 data is five (5) meters (re-sampled from original six point five (6.5) meters) meanwhile it is ten (10) meters for PALSAR used for interpolating cloud cover area. The mapping scale is between 1/25,000 and 1/50,000 for the data development while minimum mapping polygon size is 1 hectare. Therefore, this map should be used at a scale between 1/25,000 and 1/50,000 with noting the constraint of location accuracy described in the sub-section (d) below.

(d) Limitations of location accuracy and geographical coverage

Location accuracy: The location accuracy of the Forest Base Map 2012 is equal to that of orthorectified dataset of LANDSAT (Land Satellite) developed by United States Geological Survey (USGS) because the specification was designed in accordance with LANDSAT, taking account of the conditions of reference data available for PNG and future updating of data. According to the limitation of the resolution of LANDSAT, location error of plus or minus thirty (30) meters may have been included. Due to this limitation, it should be noted that the ground based positioning by GPS has higher location accuracy than that of this map.

Coverage: This map is developed for utilizing on purpose of forest management by the PNGFA. Therefore, the map does not exhaustively cover some small islands and other areas where forest management operation by PNGFA are not currently conducted.

Delineation of Cropland/Agriculture land: Since conditions of crop land varies depending on applied practice and cropping cycle, local knowledge and supplementary information is prerequisite for their interpretation and classification at much localized level. According to that nature, the map does not exhaustively cover all cropland and agriculture land.

Classification among Woodland, Savanna, and Scrub: The accurate delineation, verification and monitoring of boundaries of Woodland, Savanna, and Scrub cannot be done as long as relying on interpretation and classification solely on satellite imageries. The savanna, particularly in PNG, only occurs in limited areas resulting from repetitive human-induced burning under specific climatic and ecological conditions. The Scrub in PNG is also specifically defined as a low-rise forest vegetation comprised of specific tree species. Taking these conditions into account, these three classes are identified on the Forest Base Map 2012 by referring to FIMS and localities.

Distinction between P (Low Altitude Forest on Plains and Fans, Plain-Forest) and H (Low Altitude Forest on Uplands, Hill-Forest): The distinction between 'P' and 'H' type forest are made according to incline (or slope) in the Forest Base Map 2012. We are aware that the distribution of 'P' and 'H' are significantly different between the Forest Base Map 2012 and FIMS in Western Province where plains are dominant and topography is relatively gentle. This difference occurred mainly because the FIMS development process took account of composition of tree species as well. After consultations within JICA Project Team (comprised of PNGFA officers and JICA experts), we decided to keep the methodology for the Forest Base Map 2012 as it is because the classification depending on slope is important and useful information for forest management operations. The slope is often a main determinant of efficiency and practicability of the logging operations as it determines maneuverability of heavy machineries in field.

3. Contents of the 2012 map

VEG	VEGNAME	Area (ha)
P	Low Altitude Forest on Plains & Fans	8,707,393
H	Low Altitude Forest on Uplands	12,264,035
L	Lower Montane Forest	8,042,001
Mo	Montane Forest	355,513
D	Dry Seasonal Forest	935,368
B	Littoral Forest	70,358
Fri	Seral Forest	158,719
Fsw	Swamp Forest	2,035,431
M	Mangrove Forest	521,933
W	Woodland	3,062,749
Sa	Savanna	639,969
Sc	Scrub	392,078
G	Grassland and Herbland	3,231,935
Ga	Grassland (Alpine)	110,602
Gi	Grassland (Subalpine)	86,979
Z	Bare areas	23,874
U	Larger Urban Centres	23,896
E	Lake & Larger Rivers	600,105
O	Cropland/Agriculture land	4,413,543
Qf	Forest Plantation	66,670
Qa	Plantation other than Qf	411,614
	SUM	46,154,764

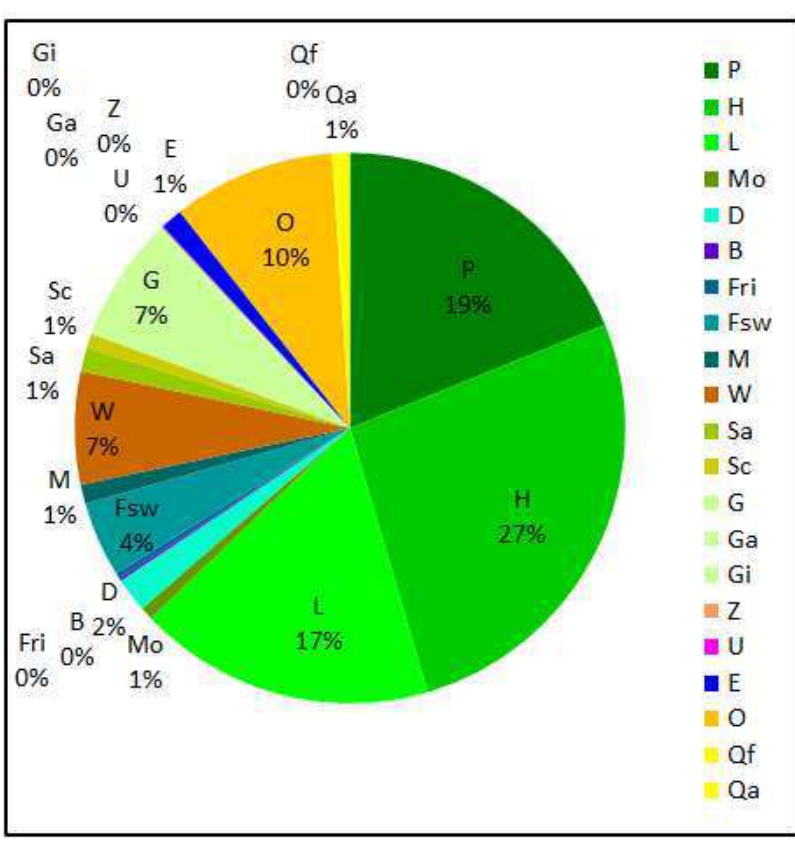


Table 1. Forest area by forest type

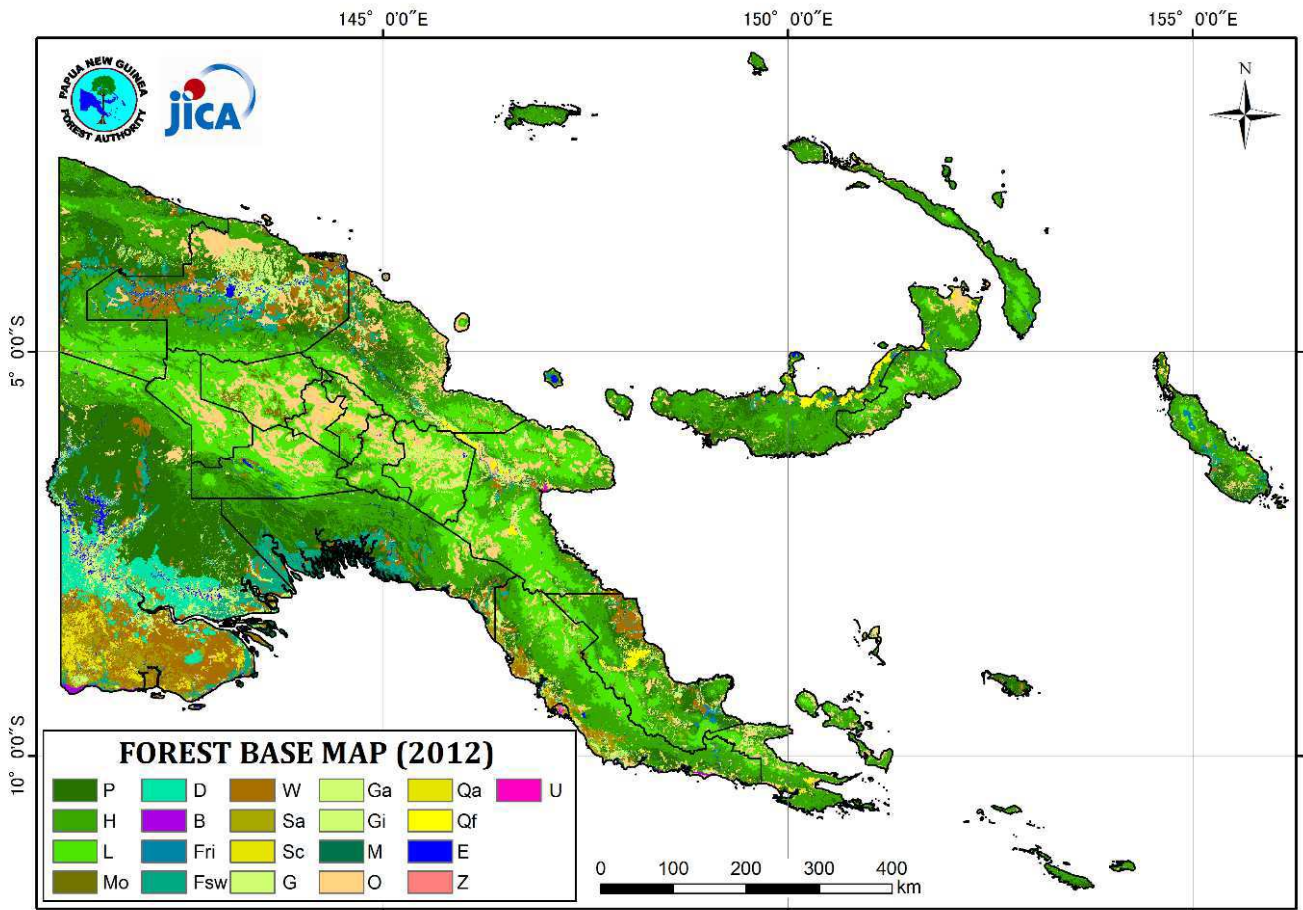


Figure 1. Forest Base Map 2012

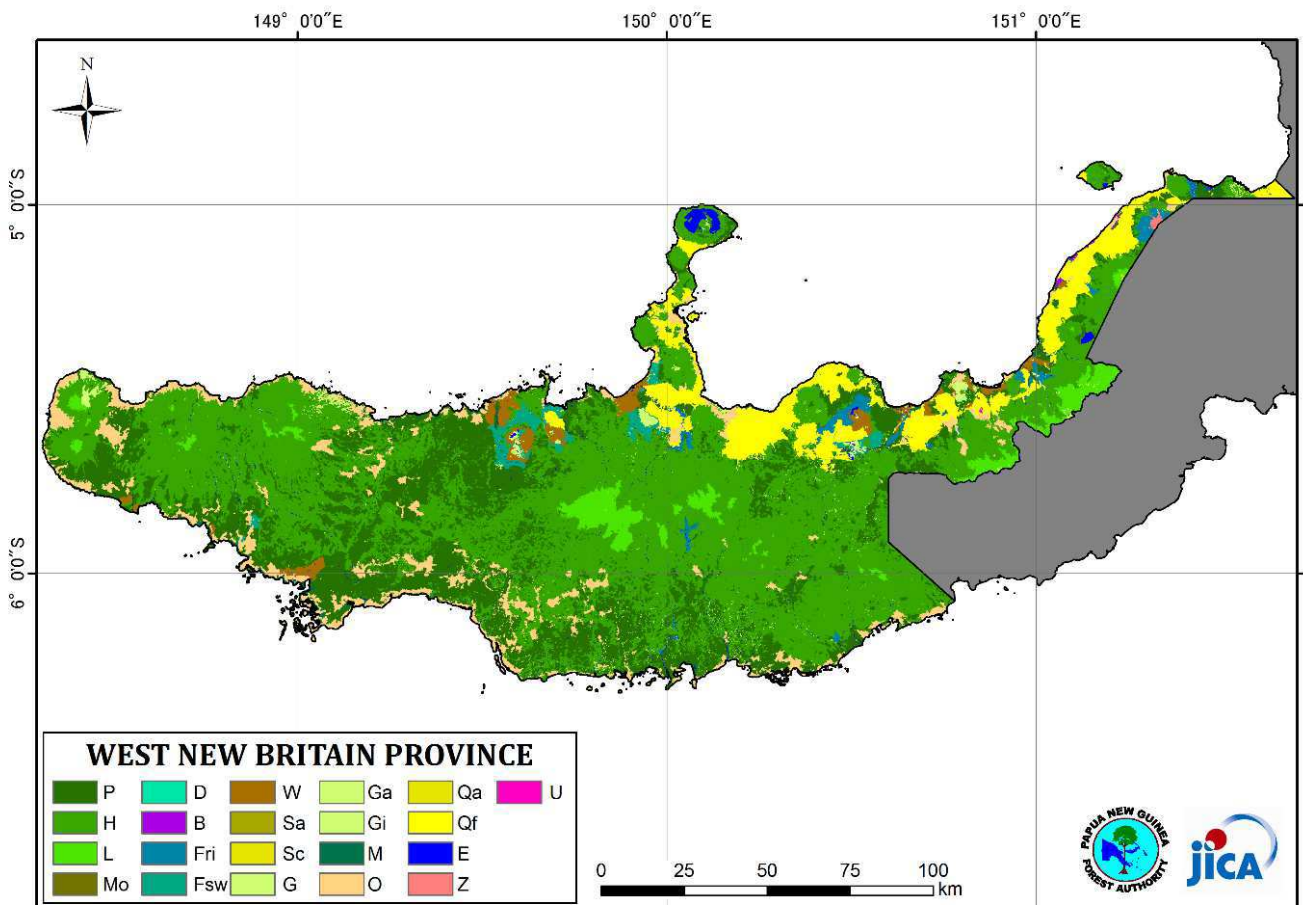


Figure 2. Forest Base Map 2012 (West New Britain province)

4. Data Access and contacts

(a) Paper map 'PNG Forest Base Map 2012' by computer prints

Coverage	Size	Scale	Price (See Note)
National	A0, A1, A2, A3, A4	1: 1,600,000 to 6,400,000	K150, 100, 50, 40, 20
Province	A0, A1, A2, A3, A4	1: 150,000 to 2,200,000	K150, 100, 50, 40, 20

Note: Price in this table subject to change without further notice.

(b) Digital format

Format (See Note (1))	Coverage	Fit to print on or scale at	Suitable medium	Price (See note (2))
PDF	National	A3	CD-ROM	K 50
	Province	A3		K 50
Raster on TIFF	Province	To be used from 1/50,000 to 25,000		K 20 (See note (3))

Note (1): Provision of other digital format map may be arranged and admitted for government and academic institutions for public and research purposes principally for mutual information exchange basis subject to agreement of Minutes of Understanding or other appropriate form of written consent.

Note (2): Price in this table subject to change without further notice.

Note (3): Raster on TIFF format may be shared subject to a written consent of usage and copyright credit obligation and citation with acknowledgement to PNGFA and JICA in case of further use in a publication, academic work and any other type of use of the data. A decision on this manner of distribution is made by the PNGFA and JICA according to the nature of the data and its usefulness for the social development of PNG as an information social infrastructure.

(c) Contact information

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(d) Liability

In no event will the authors, its related partnerships or corporations be liable to anyone else for any decision made or action taken in reliance on the information in this map or for any consequential, special or similar damages, even if advised of the possibility of such damages.

5. Reference

Bourke, R.M., Allen, B.J., Hobsbawn, P. and Conway, J., 1998, 'Papua New Guinea: Text Summaries. Agricultural Systems of Papua New Guinea Working Paper No.1'. Department of Human Geography, Research School of Pacific and Asian Studies, The Australian National University, Canberra, Australia

Hammermaster, E.T. and Saunders, J.C., 1995, 'Forest Resources and Vegetation Mapping of Papua New Guinea. PNGRIS Publication No. 4'. AusAID, Canberra, Australia

McAlpine, J. and Quigley, J., 1998, 'Forest Resources of Papua New Guinea Summary Statistics from the Forest Inventory Mapping (FIM) System'. Prepared by Coffey MPW Pty Ltd for the Australian Agency for International Development and the Papua New Guinea National Forest Service

JICA and PNGFA, 2016, '2014-2019 JICA-PNGFA Project Outline - JICA-PNGFA Forestry Project 2014-2019 Fact Sheet No.1'. Papua New Guinea Forest Authority, Port Moresby, Papua New Guinea

6. Citation

JICA and PNGFA, 2017, 'Papua New Guinea Forest Base Map 2012 - JICA-PNGFA Forestry Project 2014-2019 Fact Sheet No.2'. Papua New Guinea Forest Authority, Port Moresby, Papua New Guinea

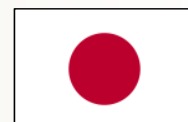
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Project Facebook Page: <https://www.facebook.com/jica.png.forest.monitoring>



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