H. Digitizing road network utilizing LANDSAT imagery

Digitizing road network utilizing LANDSAT imagery

Preface

Road information is useful for estimating area affected by human activities. People moves via roads quickly and enters into areas adjacent to the roads for various purposes, such as logging, subsistence agriculture, wood collection, mining, plantation, etc.

Road network is growing year by year, so that continuous updating of the information is necessary to grasp current status of the lands. Satellite imagery is a strong tool for catching the newest situation of national scale of road network. Especially, free mid resolution satellite imagery such as LANDSAT and Sentinel-2 is helpful to cover nationwide network because high resolution imagery costs some amount although it can detect more small and obscure ground features.

New roads constructed clearing forest are easy to find with mid-resolution satellite imagery because forest and new cleared area have completely different color each other. On the other hand, old cleared areas in forests already covered by grass are not clear because both this kind of area and forests looks green color, so that it is difficult to distinguish each other. Timely updating of the road network after construction of new roads is necessary to keep the quality of the information.

Roads in cities, grasslands, agricultural fields are difficult to find because roads and the surrounding area shows similar color in mid resolution satellite imagery. It is recommended to update road network information using road GIS information generated by other institution such as National Economic and Fiscal Commission, Department of Works & Implementation, etc. or high resolution satellite imagery every decade.

As of August 2017, national road network, including all kinds of roads such as roads in forest, city, agricultural field, etc., in year 2000, 2005, 2011 and 2015 already have been developed nationwidely. In this document, procedures to make this information is described. These procedures can be applied for digitizing work to update the road network information in the future.

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Employed information

Layer	Source	Remarks
Road GIS information	GeoBook	Derived from National Economic and Fiscal Commission (NEFC) 2005 Cost of Services surveys, satellite imagery and Road Asset Management System (RAMS) data.
River GIS information	GeoBook	Derived from 1:250,000 topographic maps
Census Unit information	GeoBook	Derived from PNG 2008 Census
Provincial boundaries	Developed by the Project	
LANDSAT AGP[15] 2000	Developed by the Project	
LANDSAT AGP 2005	Developed by the Project	
LANDSAT AGP 2011	Developed by the Project	
LANDSAT AGP 2015	Developed by the Project	
RapidEye 2011	Procured by Grant Aid Program[16]	

[15] Annual Greenest Pixel: mosaicked imagery including all the scenes in each year beginning from the first day of the year and continuing to the last day of the year obtained by specified satellite(s) with the greenest pixel on top, where the greenest pixel means the pixel with the greatest value of the Normalized Difference Vegetation Index (NDVI). See **Annex F** for procedure to obtain this imagery.

[16] "The Forest Preservation Programme in the Independent State of Papua New Guinea" funded by Japan International Cooperation System (2012 – 2013)

Procedure

1. Road network of year 2000 was developed as the basis of the information.

A. Digitize road referring LANDSAT AGP 2000 directly.

Use “Snapping” tool to connect line features.

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

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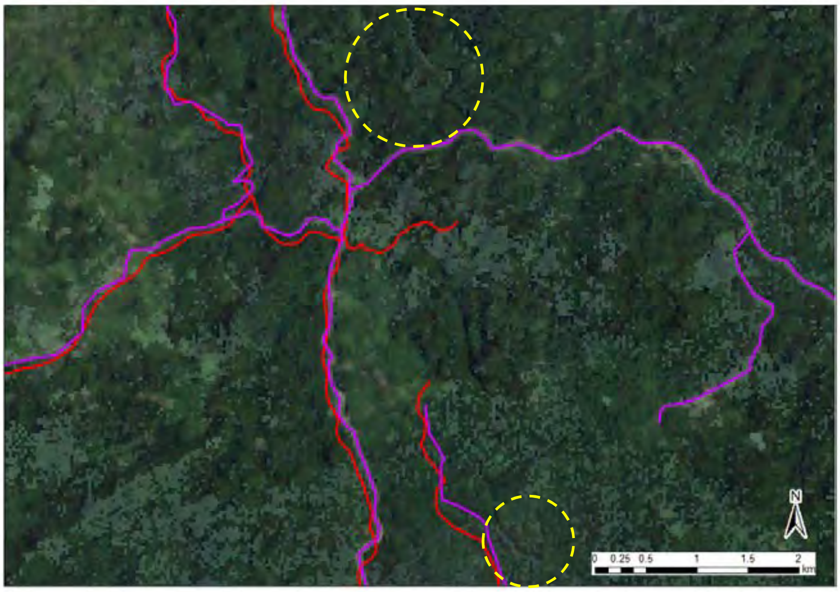
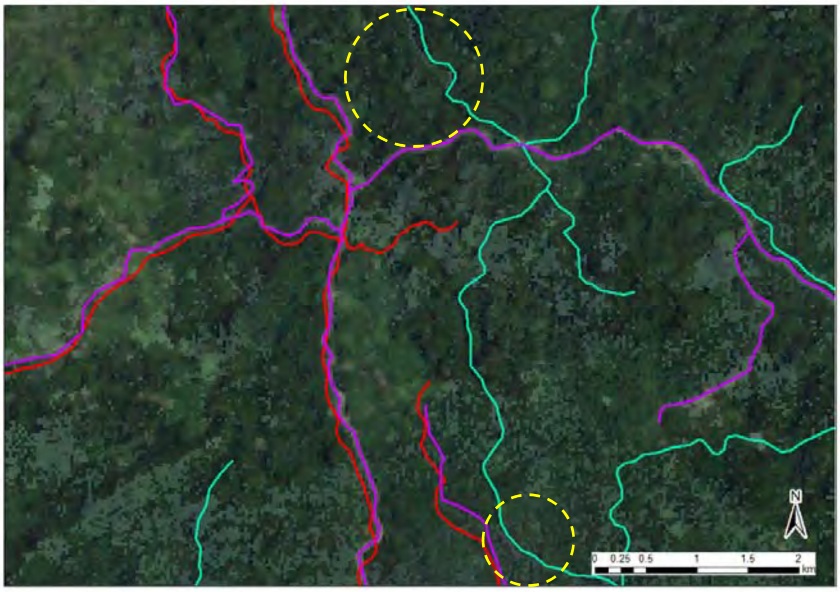
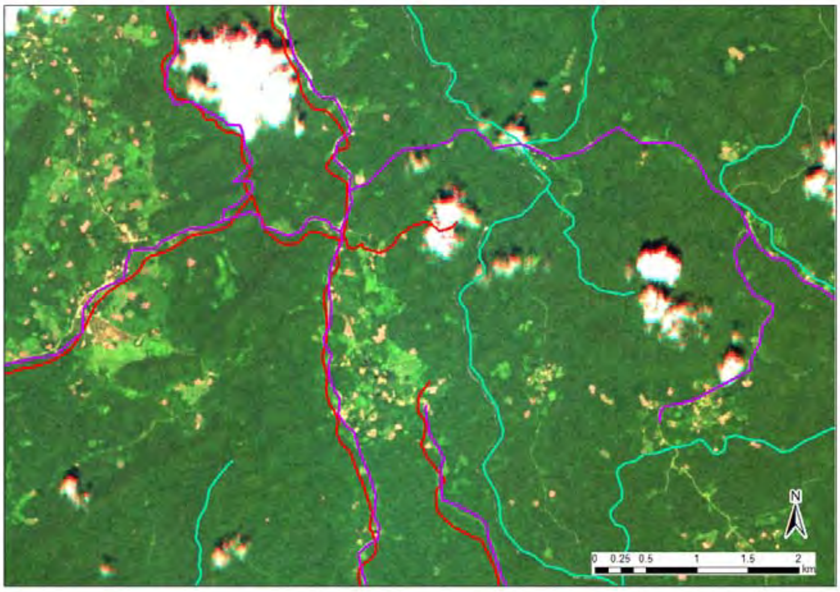
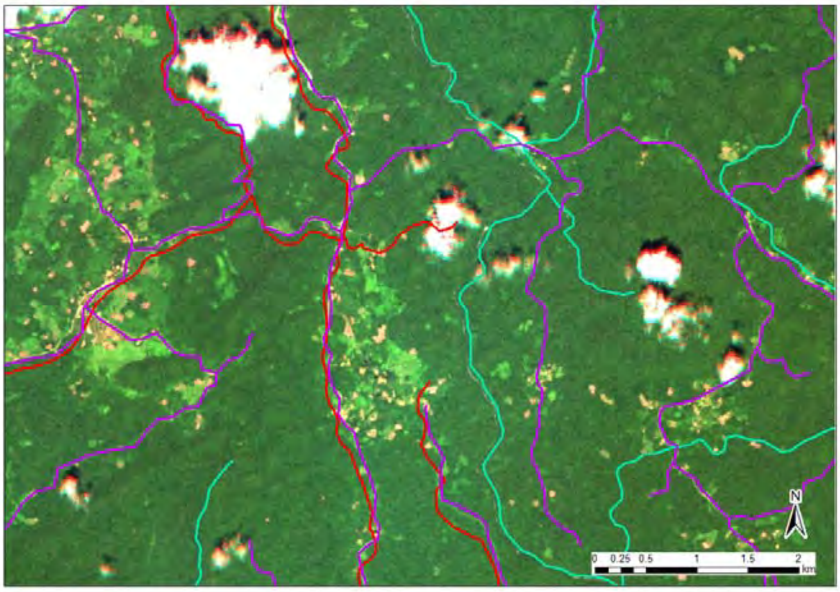
C. To avoid digitizing rivers as roads, refer the river GIS information.





D. Comparing LANDSAT imagery and RapidEye imagery, digitize unclear roads.





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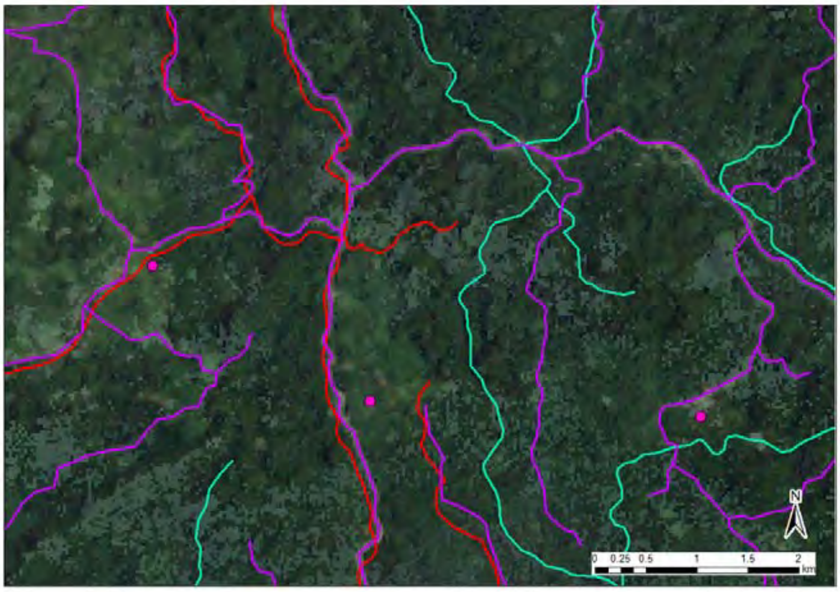
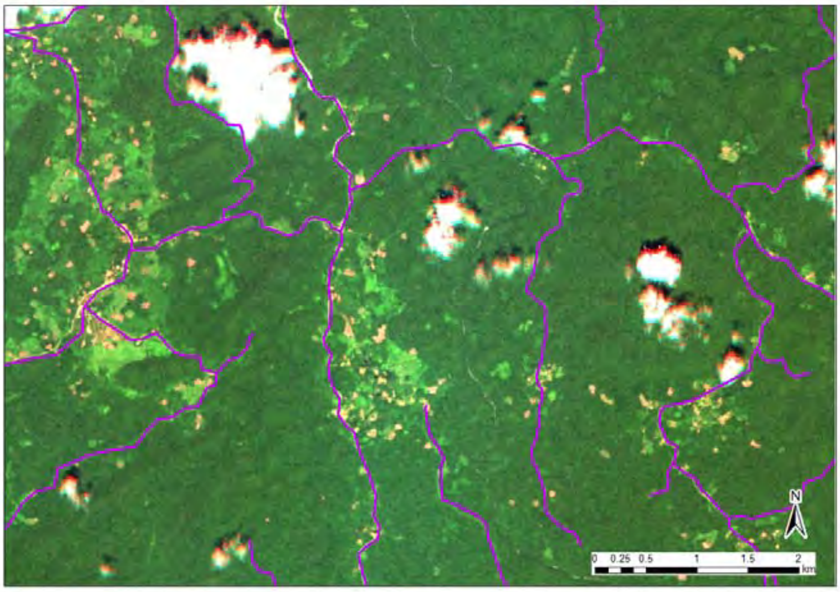
E. Census Unit information is also useful to estimate intensity of human activities. In the following image (top), the pink circles are Census Unit information. The color spotting around the points indicate existing of agricultural fields there.





2. Road network of year 2005, 2011 and 2015 were digitized in order from the oldest year adding line features on the road network feature on the older year.

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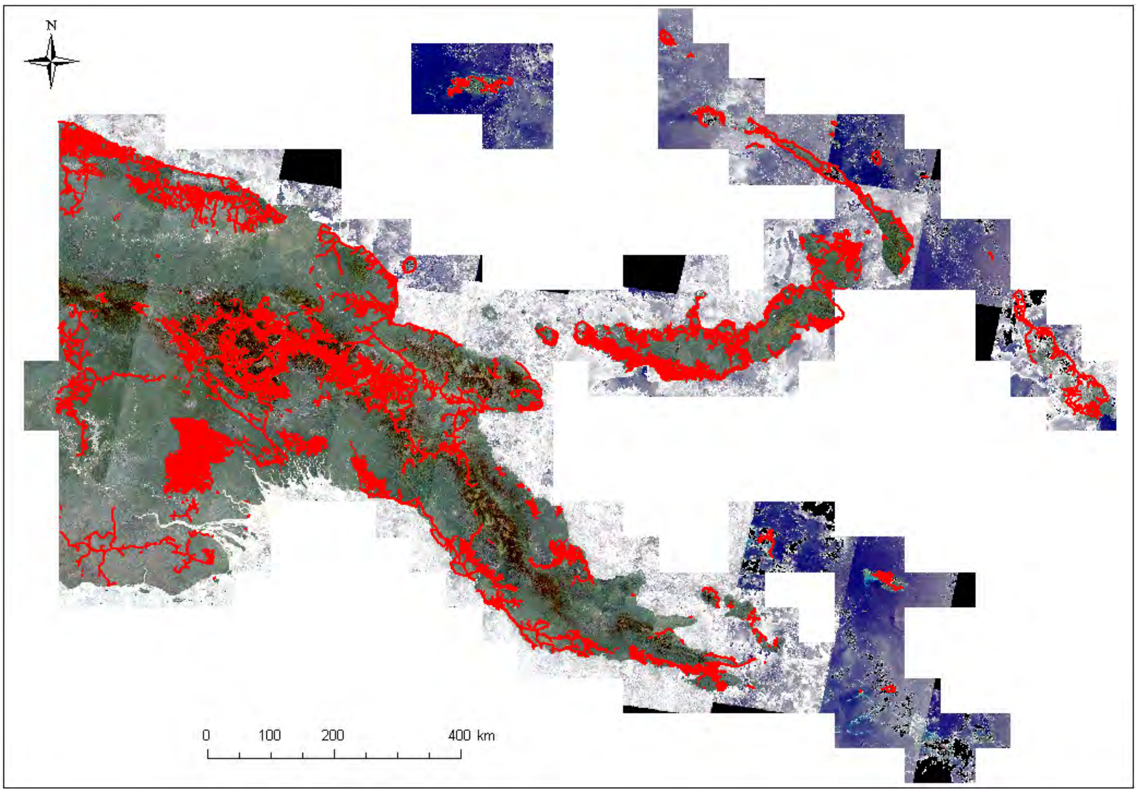

Map of Road in Papua New Guinea (2015)

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I. Manual of topology check

Manual of topology check

Managing data topology

If you have features that are coincident and share the same location of coordinates, boundaries, or nodes, chances are that geodatabase topology can help you better manage your geographic data.

Geodatabase topologies help you ensure data integrity. Using a topology provides a mechanism to perform integrity checks on your data and helps you to validate and maintain better feature representations in your geodatabase.

Topological relationships

Topology is the arrangement for how point, line, and polygon features share geometry.

Topology is employed to do the following:

- Constrain how features share geometry. For example, adjacent polygons such as forest base map have shared edges.
- Define and enforce data integrity rules: no gaps should exist between polygons, there should be no overlapping features, and so on.
- Support topological relationship queries and navigation, such as to identify feature adjacency and connectivity.
- Support sophisticated editing tools that enforce the topological constraints of the data model.

The process of building a topology from existing data can be summarized in the following steps:

Step1. Design your topology.

Step2. Create a set of feature classes within a common feature dataset in a geodatabase.

Step3. If you have existing feature data, load these into your feature classes.

Step4. Create the topology using ArcCatalog or geoprocessing tools.

Step5. Build and validate your topology.

Step6. Add the topology to ArcMap and set its display properties.

Step7. Use the editing environment to identify and fix errors.

Topology works

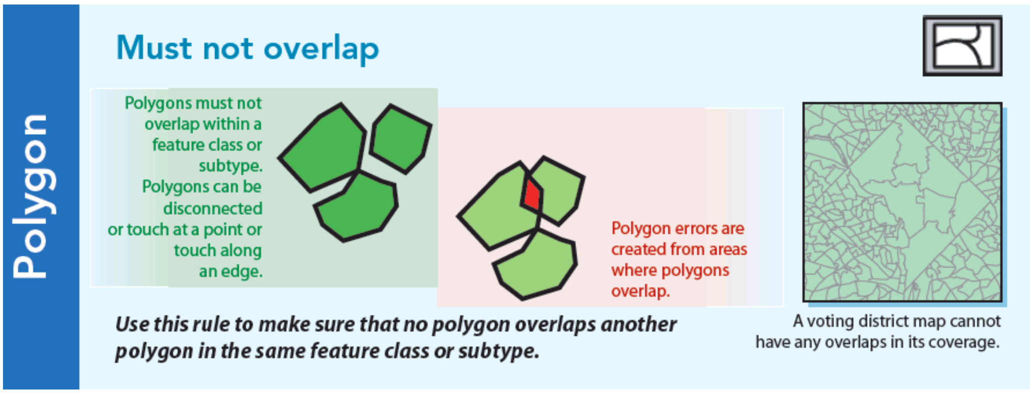
Step1. Design your topology.

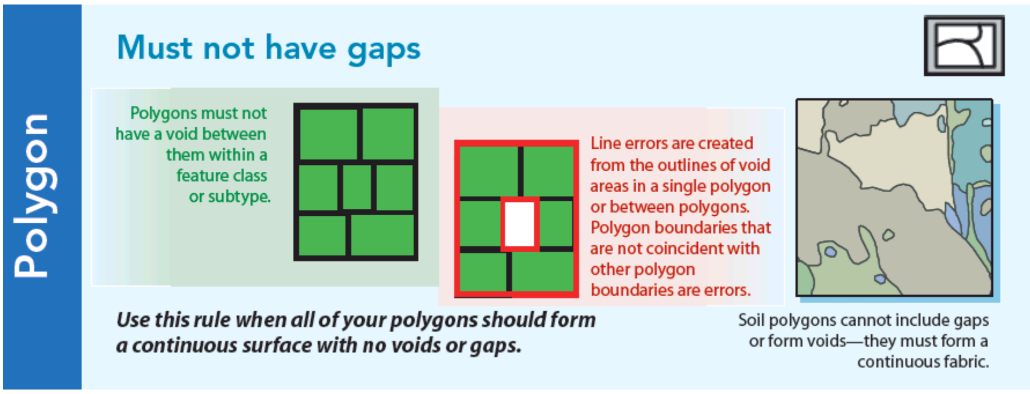
You can work through several design steps prior to developing a topology design before you use ArcGIS to create a topology in the geodatabase.

Following is a simple example.

Feature classes: Forest Base Map

Topology rules: Forest Base Map polygons must not overlap. Forest Base Map polygons must not have gaps.





Step2. Create a set of feature classes within a common feature dataset in a geodatabase.

Step3. If you have existing feature data, load these into your feature classes.

Step4. Create the topology using ArcCatalog or geoprocessing tools.

ArcGIS has a number of pathways for defining and creating a new topology. The primary method involves the use of tools in the Catalog window or ArcCatalog.

Here is the process used to create a topology using ArcCatalog.

1. Right-click the feature dataset to which you want to add a topology, point to **New**, then click **Topology**. > Click **Next**.
2. Name the new topology and specify the cluster tolerance. The default value will be set to the x,y tolerance of the feature dataset. A good default value is 0.001 meters. > Click **Next**.
3. Next, choose the feature classes that will participate in the topology. You will be shown a list of all the feature classes in your feature dataset. > Click **Next**.
4. Set the coordinate accuracy ranks for each feature class in the topology. > Click **Next**.
5. Add the series of topology rules that help you structure the spatial relationships between features and to control and validate how features share geometry. > Click **Next**.
6. Review the summary and click **Finish**. You have now added the new topology to your feature dataset. You will be asked if you would like to validate your topology in your feature dataset now. If you have data in your feature classes, you can choose Yes.

Step5. Build and validate your topology.

Once you have created a topology and loaded data, at any time, you can run a validation against the feature class contents of the topology. Validate performs the following processing tasks:

- Cracking and clustering of feature vertices to find features that share geometry (have common coordinates)
- Inserting common coordinate vertices into features that share geometry
- Running a set of integrity checks to identify any violations of the rules that have been defined for the topology

Once a new topology has been validated, subsequent edits are noted with dirty areas that identify subsets of your feature dataset that require revalidation. This saves time and improves performance, because only the areas that need to be revalidated can be processed.

Ways to validate a topology

You can validate a topology in the Catalog window or ArcCatalog by right-clicking the topology in the tree view and clicking Validate.

Once you have validated or edited the layers in the geodatabase topology, you can generate a summary of the number of topology errors remaining in the data. Open the properties for the topology layer, click the Errors tab, and click Generate Summary. If you want to save the summary, you can export the results to a text file.

Step6. Add the topology to ArcMap and set its display properties.

You can access the display properties for a topology layer just like any other layer—by right-clicking the layer name and clicking Properties. Then, click the Symbology tab to change the drawing properties for your topology.

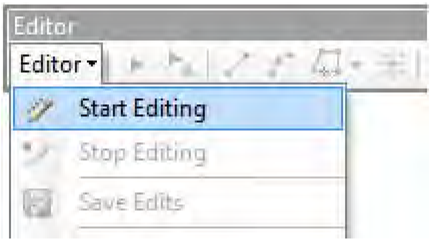
Step7. Use the editing environment to identify and fix errors.

ArcMap contains a number of advanced tools and functions for managing and editing a topology.

Here is the general topology editing process:

1. Start ArcMap and add map layers for the feature classes in your topology that you want to edit. Also, add the topology you want to edit.

2. Start editing.



3. Add the Topology toolbar to ArcMap by clicking **Customize**, pointing to **Toolbars**, and clicking **Topology**.

4. Perform your edits and save them.

5. Validate the topology.

6. Review the errors in the Error Inspector window and repair any topology errors.

   Once you have discovered the topology errors, you can select the error on the map with the **Fix Topology Error** tool, or select the error from within the **Error Inspector**.

   6-1. Click **Error Inspector** and search for errors or click **Fix Topology Error** tool on the **Topology** toolbar.

6-2. You can use the Error Inspector window to find errors and exceptions.

To find errors for all rules	Click the **Show** drop-down arrow, and click **Errors from all rules**.
To find errors for a particular topology rule	Click the **Show** drop-down arrow, and click the rule.
To find errors in the visible extent	Check **Visible extent only**.
To find exceptions	Check **Exceptions**, and uncheck **Errors**.

6-3. Click **Search Now**.

6-4. Click the error in the **Error Inspector** list or use the **Fix Topology Error** tool to click it on the map.

6-5. Right-click the error in the list or on the map and click one of the available fixes. The fixes listed depend on the type of error.

For example, to fix a Must Not Overlap error by merging an overlapping polygon into another polygon, right-click the error, click Merge, then choose the feature into which to merge the error feature.

6-6. Validate the topology again to ensure the edit was correct and save your edits.

<u>**Frequently-used and useful tools for data management**</u>

Following tools were used for modifying Forest Base Map.

Integrate

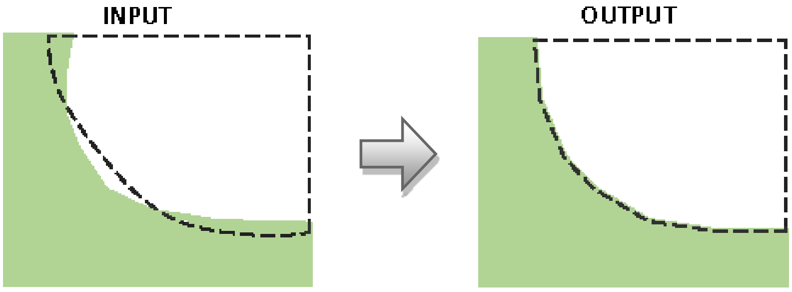
Data Management Tools > Feature Class > Integrate

Integrate is used to maintain the integrity of shared feature boundaries by making features coincident if they fall within the specified x,y tolerance. Features that fall within the specified x,y tolerance are considered identical or coincident.

For example, suppose you specify an x,y tolerance of five units (such as feet or meters) and your data has a parcel boundary that should be shared with the adjacent parcel boundary but is four units away. After running this tool, the boundaries of the two parcels would be made coincident because they were within the x,y tolerance of five units.

Integrate performs the following processing tasks:

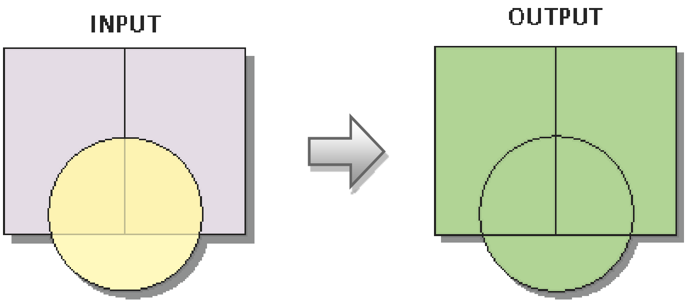
- Finds features that are within the given x,y tolerance.
- Inserts common coordinate vertices for features that fall within the given x,y tolerance and will add vertices where feature segments intersect.



Union

Analysis Tools > Union

Computes a geometric union of the input features. All features and their attributes will be written to the output feature class.



Multipart To Singlepart

Data Management Tools > Features > Multipart To Singlepart

Creates a feature class containing singlepart features generated by separating multipart input features.

Input Features: The input features that can be any feature type.

Output Feature Class: The output feature class containing features that vary with input feature type.

Eliminate

Data Management Tools > Generalization > Eliminate

Eliminates polygons by merging them with neighboring polygons that have the largest area or the longest shared border. Eliminate is often used to remove small sliver polygons that are the result of overlay operations, such as Intersect or Union.

Input Layer: The layer whose polygons will be merged into neighboring polygons.

Output Feature Class: The feature class to be created.

Eliminating polygon by border (optional): These options specify which method will be used for eliminating features.

Checked—Merges a selected polygon with a neighboring unselected polygon by dropping the shared border. The neighboring polygon is the one with the longest shared border. This is the default.

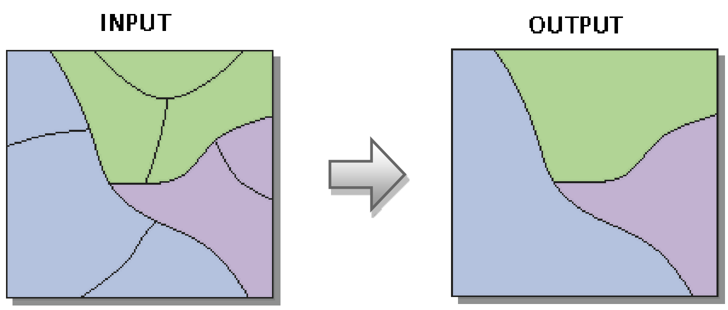
Unchecked—Merges a selected polygon with a neighboring unselected polygon by dropping the shared border. The neighboring polygon is the one with the largest area.

*Only selected features will be eliminated, so if you want to eliminate polygons smaller than 1ha, select polygons by attributes first, then use eliminate tool

Dissolve

Data Management Tools > Generalization > Dissolve

Aggregates features based on specified attributes.



Join Field

Data Management Tools > Joins > Join Field

Joins the contents of a table to another table based on a common attribute field. The input table is updated to contain the fields from the join table. You can select which fields from the join table will be added to the input table.

The records in the Input Table are matched to the records in the Join Table based on the values of Input Join Field and the Output Join Field. Optionally, only desired fields can be selected from the Join Table and appended to the Input Table during the join.

Input Table: The table or feature class to which the join table will be joined.

Input Join Field: The field in the input table on which the join will be based.

Join Table: The table to be joined to the input table.

Output Join Field: The field in the join table that contains the values on which the join will be based.

Join Fields (optional): The fields from the join table to be included in the join.

Export Topology Errors ** ArcGIS 10 doesn't have this command.*

Data Management Tools > Topology > Export Topology Errors

Exports the errors from a geodatabase topology to the target geodatabase. All information associated with the errors and exceptions, such as the features referenced by the error or exception, are exported.

Input Topology: The topology from which the errors will be exported.

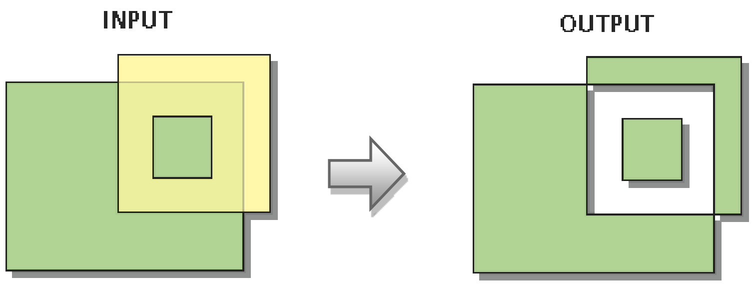
Output Location: The output workspace to which the feature classes will be created. The default is the workspace where the topology is located.

Base Name: Name to prepend to each output feature class. This allows you to specify unique output names when running multiple exports to the same workspace. The default is the topology name.

Symmetrical Difference

Analysis Tools > Overlay > Symmetrical Difference

Features or portions of features in the input and update features that do not overlap will be written to the output feature class.



J. Accuracy assessment of the Forest Base Map

Accuracy assessment of the Forest Base Map

Error Matrix: Forest/Non-forest (PNG)

Accuracy evaluation of land cover categoly 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 categoly 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%

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Error Matrix: 7 categories (PNG)

Accuracy evaluation of land cover categoly 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 categoly in PNG (8 categolies)

			NFI									
			Forest			Grassland	Cropland	Wetlands	Other land	Settlements		
			Forest	Woodland	avanna/Scrul	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/Scru	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: IPCC 6 categories (PNG, Provinces)

Accuracy evaluation of land cover categoly in PNG (6 categolies)

			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%

Accuracy evaluation of land cover categoly in Central (6 categolies)

			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 categoly in National Capital District (6 categolies)

			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 categoly in Oro (6 categolies)

			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 categoly in Milne Bay (6 categolies)

			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 categoly in Gulf (6 categolies)

			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 categoly in Western (6 categolies)

			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 categoly in Morobe (6 categolies)

			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 categoly in Madang (6 categolies)

			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 categoly in East Sepik (6 categolies)

			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 categoly in West Sepik (6 categolies)

			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 categoly in Chimbu (6 categolies)

			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 categoly in Enga (6 categolies)

			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 categoly in Eastern Hilands (6 categolies)

			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 categoly in Southern Hilands (6 categolies)

			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 categoly in Hela (6 categolies)

			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 categoly in Western Highlands (6 categolies)

			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 categoly in Jiwaka (6 categolies)

			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 categoly in West New Britain (6 categolies)

			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 categoly in East New Britain (6 categolies)

			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 categoly in Manus (6 categolies)

			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 categoly in New Ireland (6 categolies)

			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 categoly in Autonomous Region of Bougainville (6 categolies)

			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: forests and other land use class (PNG)

Accuracy evaluation of forest base map in PNG

					NFI																					
					Forest													Grassland		Cropland		Wetla	Other	Settle		
					Forest										Woodl	Savanna/Sc		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	Fores	P	Low Altitude Forest on Plain	2446	1138	4		40	21	70	309	31	16	65	9	18	41		184	26	80		31	4529	54%
			H	Low Altitude Forest on Uplar	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%
		oodla	W	Woodland	267	33	1		326	5	16	247	7		307	115	40	51		36	5	104		2	1562	20%
		Sav	Sa	Savanna	5	1	1		34			8	3		77	132	8	27		11		9	1	6	323	41%
		ann	Sc	Scrub	2	1	1	1	33			3			58	85	11	8		1		2			206	5%
	Grassland	assla	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/Subalpine g			7	12									2	23	70	2				1	117	60%
	Cropland	roplar	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 forest	13	6				1		1		2			2	10		66	132			9	242	55%
	Wetlands	etlan	E	Lakes and larger rivers	13	18	3		2		4	6	3		1	2	1	19		2		209		2	285	73%
	Other land	her la	Z	Bare areas	2	1	1										1	4				3	2	1	15	13%
	Settlements	tleme	U	Settlements and larger urbar														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%

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K. Excel tips

Excel tips

How to use **VLOOKUP**

This is one of the examples that you use VLOOKUP function.

When you have NFI information table which includes unique id, land use class, land use category, etc., you can call their information into another table which has the same unique id as NFI's.

NFI information table

Unique id

	A	B	C
1	SN	land_use_category	land_use_subdivision
2	1	cropland	subsistence_agriculture
3	2	forest	low_altitude_forest_on_plainsand
4	3	cropland	subsistence_agriculture
5	4	cropland	subsistence_agriculture
6	5	cropland	subsistence_agriculture
7	6	cropland	subsistence_agriculture
8	7	cropland	subsistence_agriculture
9	8	forest	low_altitude_forest_on_plainsand
10	9	cropland	subsistence_agriculture
11	10	cropland	subsistence_agriculture
12	11	forest	low_altitude_forest_on_upland
13	12	cropland	other_crop
14	13	cropland	subsistence_agriculture
15	14	grassland	herbland
16	15	noData	sea
17	16	forest	low_altitude_forest_on_upland
18	17	forest	low_altitude_forest_on_upland

sheet1 Sheet2

First, you set NFI information table as a database.

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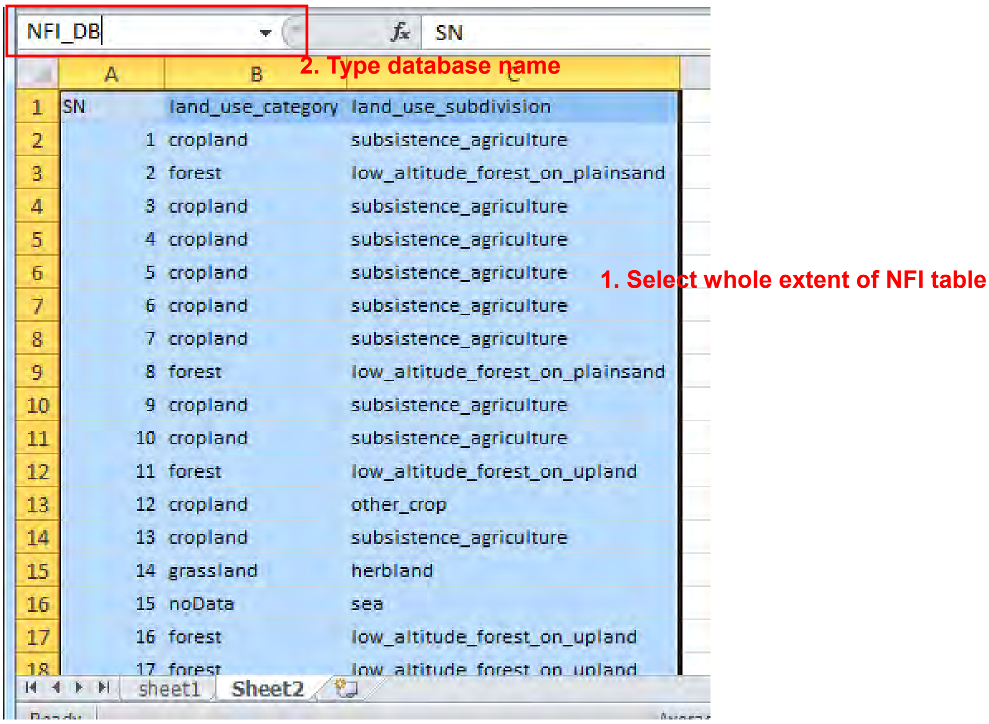
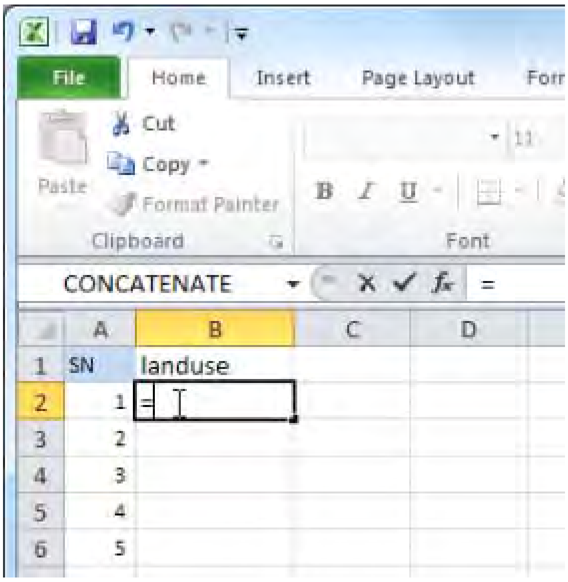
Select whole extent (sells) of NFI information table which includes needed information, then type database name in the top-left box. You can use any name but unique one in that Excel file.

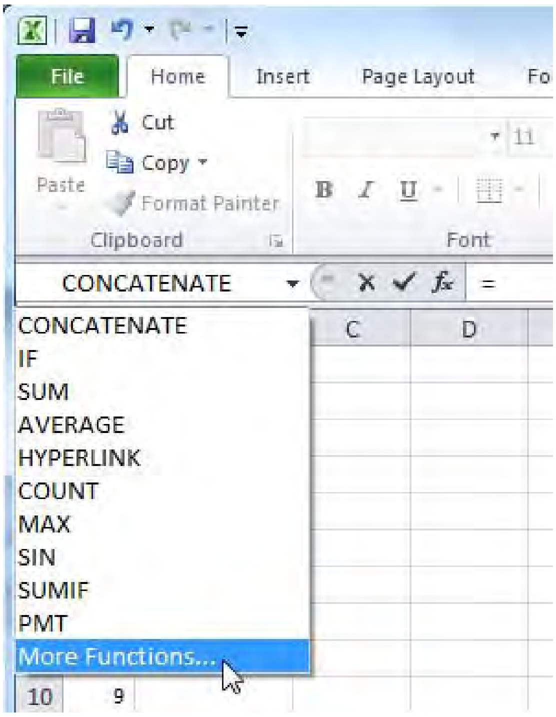


Now, you can call NFI information into other table. Table below has unique id "SN" column which is the same as "SN" of NFI information table.

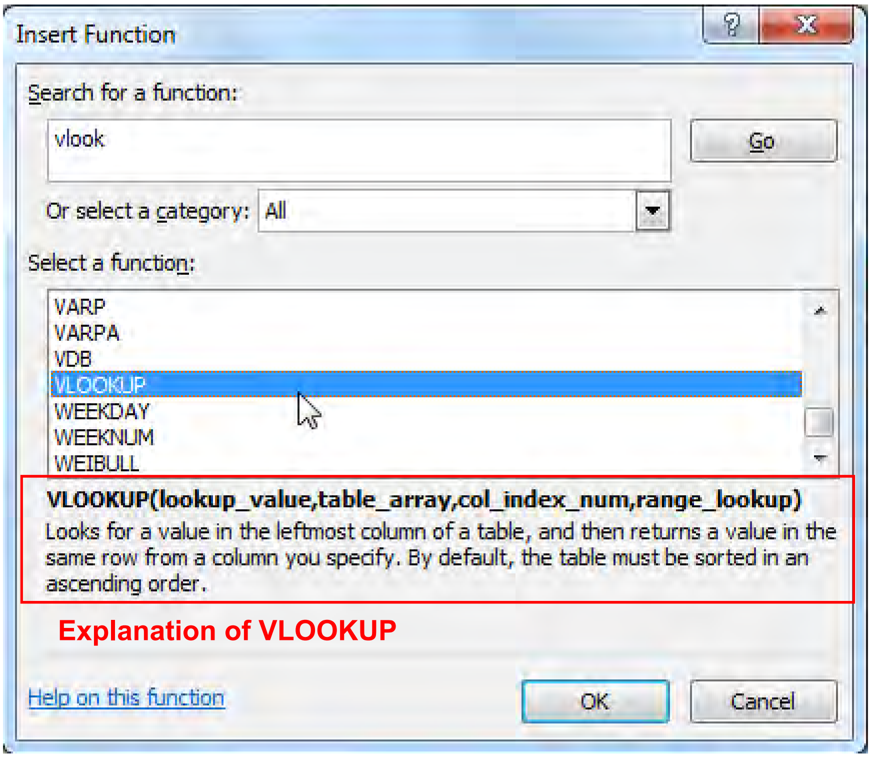
Type "=" in the cell where you want load land use information.



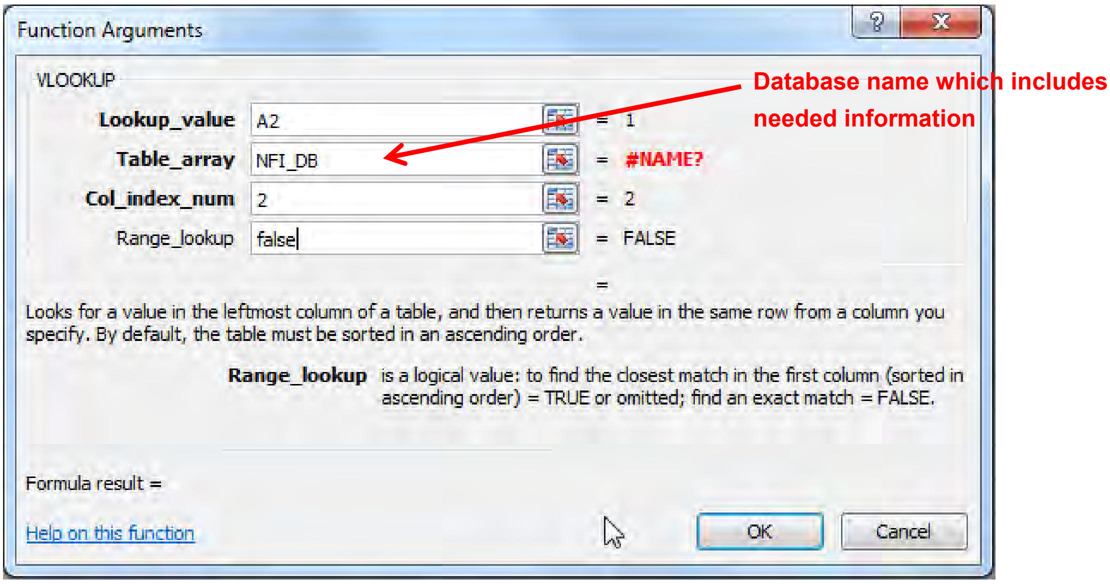
Click pull-down menu, and select "More Functions…" in the top-left box.



In Insert Function dialog, search FLOOKUP function, then select it and click OK.

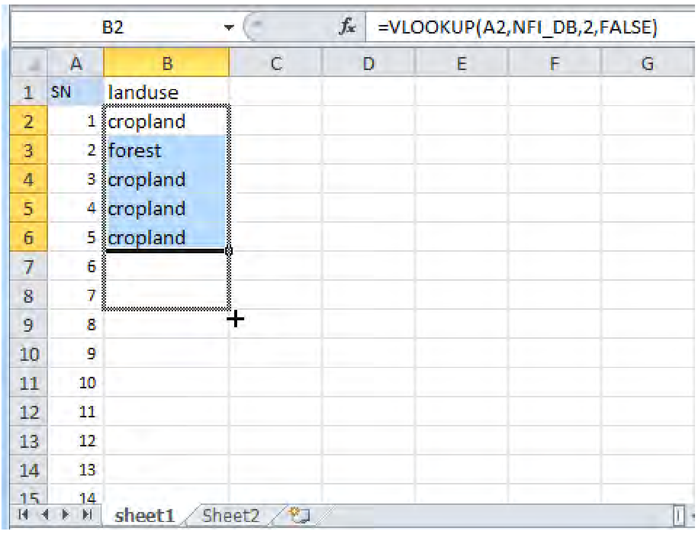


In Function Arguments window, set **lookup value**, **table array**, **column index number** and **range lookup**, and then click OK.



Now you got land use information from NFI information table in B2 cell by using A2 cell value. You can expand this function to other cells of B column.

Point the cursor to right-bottom corner of B2 cell, then click and drug or just double-click after the cursor changes to plus (+) symbol.



If you want more information in detail, please take a look in Excel help.

How to use PivotTable

This is one of the examples that you use PivotTable.

PivotTables make it easy to arrange and summarize complicated data and drill down on details.

Now you have a result of accuracy evaluation which is comparison between NFI land use and Forest Base Map land use. You can create error matrix from it by using PivotTable.

Results of accuracy evaluation

	NFI land use	NFI land category	No. of NFI land category	Forest Base Map land code	Forest Base Map land category	No. of Forest Base Map land category
	A	B	C	D	E	F
1	NFI_LU	NFI_Category1	NFI_Order1	FM_LU	FM_Category1	FM_Order1
2	lower_montane_forest	Forest	1	L	Forest	1
3	lower_montane_forest	Forest	1	L	Forest	1
4	lower_montane_forest	Forest	1	L	Forest	1
5	lower_montane_forest	Forest	1	O	Cropland	3
6	lower_montane_forest	Forest	1	L	Forest	1
7	lower_montane_forest	Forest	1	L	Forest	1
8	lower_montane_forest	Forest	1	L	Forest	1
9	herbland	Grassland	2	O	Cropland	3
10	lower_montane_forest	Forest	1	L	Forest	1
11	lower_montane_forest	Forest	1	L	Forest	1
12	subsistence_agriculture_permanent	Cropland	3	O	Cropland	3
13	lower_montane_forest	Forest	1	L	Forest	1
14	lower_montane_forest	Forest	1	L	Forest	1
15	lower_montane_forest	Forest	1	L	Forest	1
16	lower_montane_forest	Forest	1	L	Forest	1
17	subsistence_agriculture_permanent	Cropland	3	O	Cropland	3
18	lower_montane_forest	Forest	1	L	Forest	1
19	lower_montane_forest	Forest	1	L	Forest	1
20	lower_montane_forest	Forest	1	L	Forest	1
21	lower_montane_forest	Forest	1	L	Forest	1
22	subsistence_agriculture_permanent	Cropland	3	G	Grassland	2
23	lower_montane_forest	Forest	1	L	Forest	1
24	low_altitude_forest_on_upland	Forest	1	H	Forest	1

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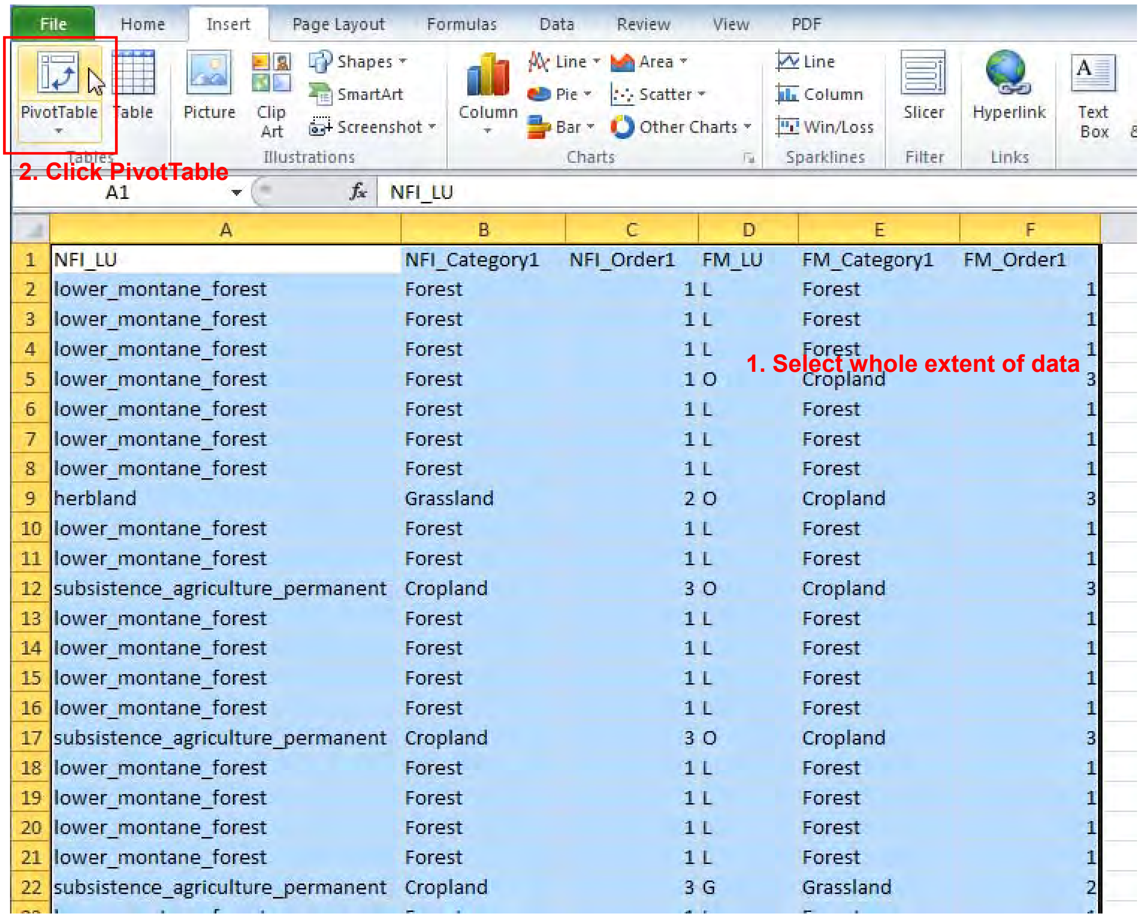
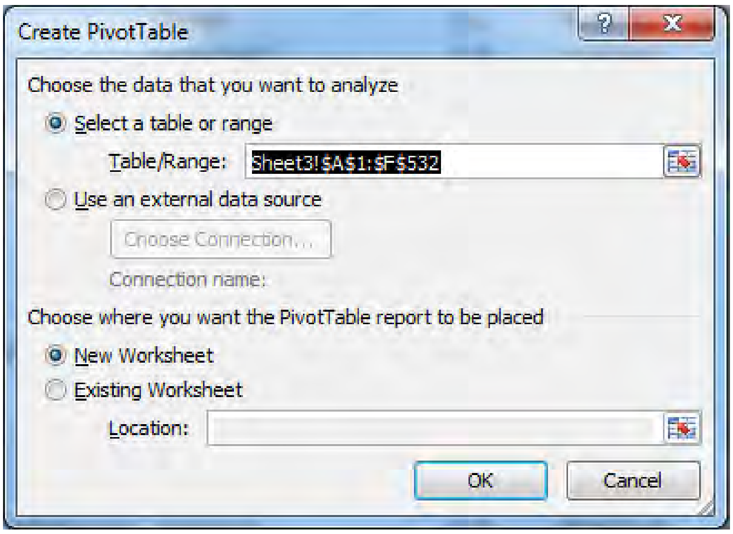
Select whole extent of data, and then click PivotTable under Insert menu.



In Create PivotTable dialog, just click OK.



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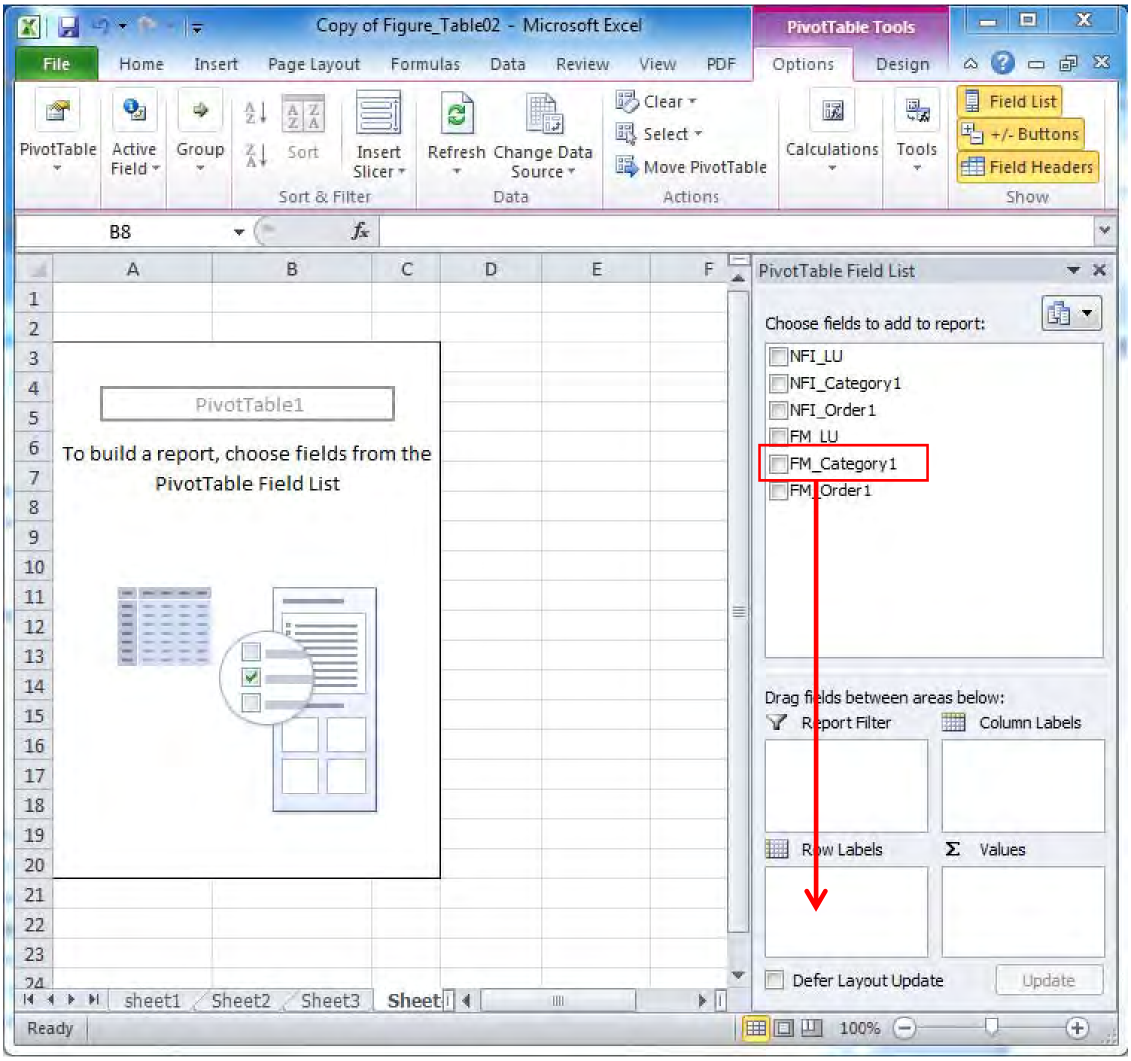
Now you can see a blank PivotTable like capture below. This time you create matrix of Forest Base Map land category and NFI land category.

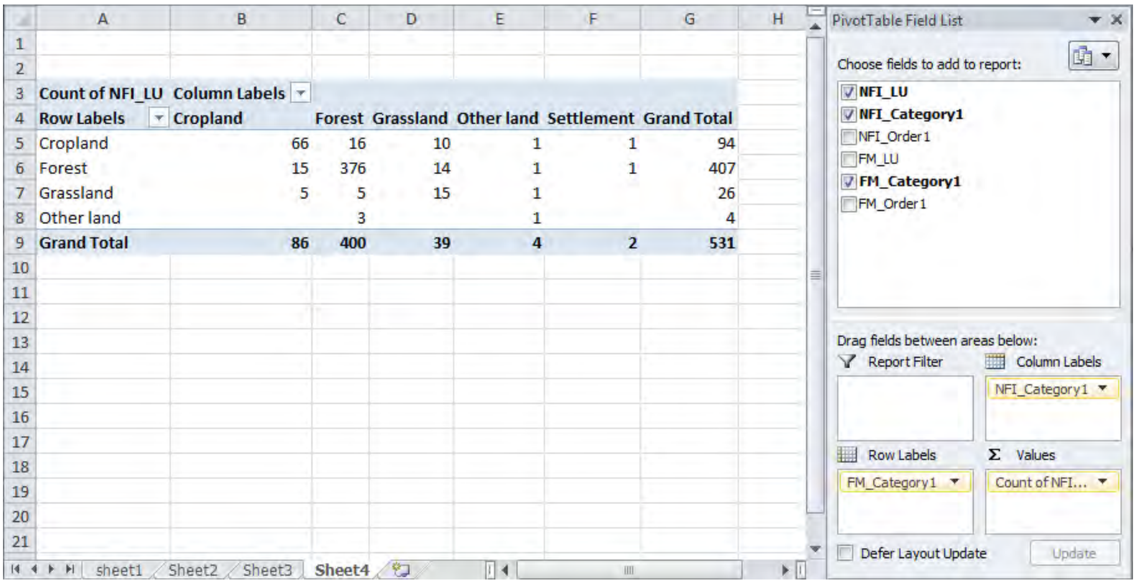


In PivotTable Field List, select [FM_Category1] and drag into Row Labels box.

Select [NFI_Category1] and drag into Column Labels box.

Select [NFI_LU] and drag into Values box. In this case, you can choose other fields because you want just count of records.

Now you can see a matrix of Forest Base Map land category in row and NFI land category in column. Numbers in the table are count of data.



Count of NFI_LU	Column Labels					
Row Labels	Cropland	Forest	Grassland	Other land	Settlement	Grand Total
Cropland	66	16	10	1	1	94
Forest	15	376	14	1	1	407
Grassland	5	5	15	1		26
Other land		3		1		4
Grand Total	**86**	**400**	**39**	**4**	**2**	**531**

If you want more information in detail, please take a look in Excel help.

L. Driver interpretation card

Driver interpretation card

Mining #1-4

Road construction #1-4

Facility construction #1-3

Forest plantation #1-8

Perennial plantation #1-10

Logging #1-6

Flooding #1-5

Landslide #1-5

Volcano #1-2

Submergence #1

Agriculture #1-5

Fire #1-3

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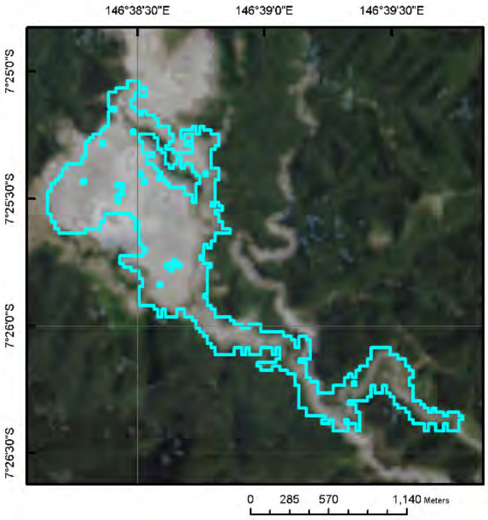
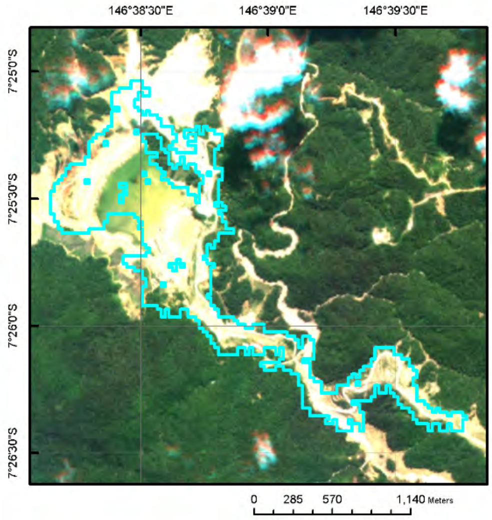
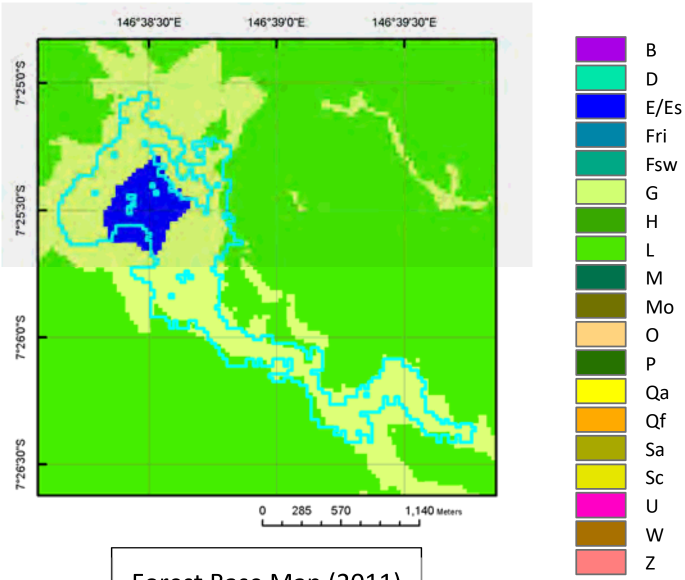
Mining #1



LANDSAT (2015)



RapidEye (2011)

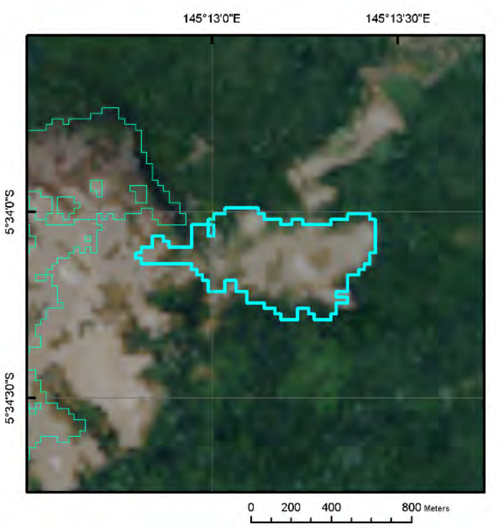


Forest Base Map (2011)

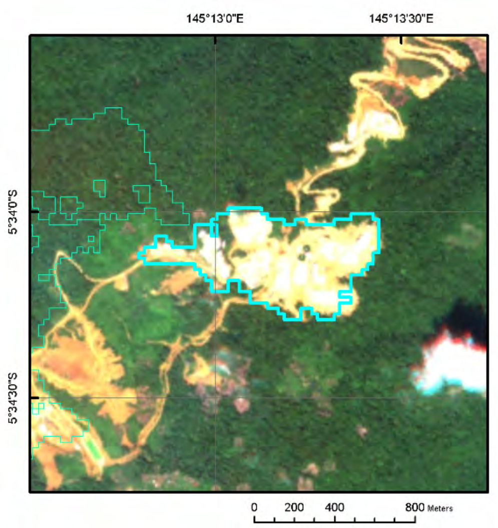
+Within boundaries of "MRA Mining Leases"

+Huge deforested area connected with access roads.

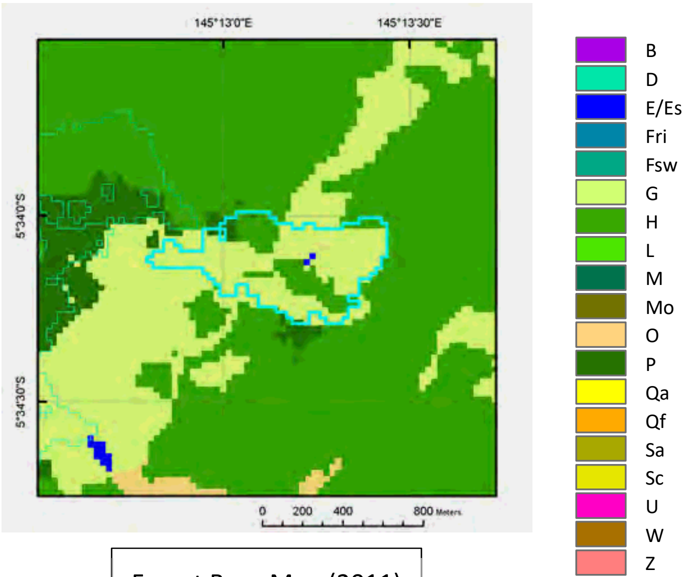
Mining #2



LANDSAT (2015)



RapidEye (2011)



Forest Base Map (2011)

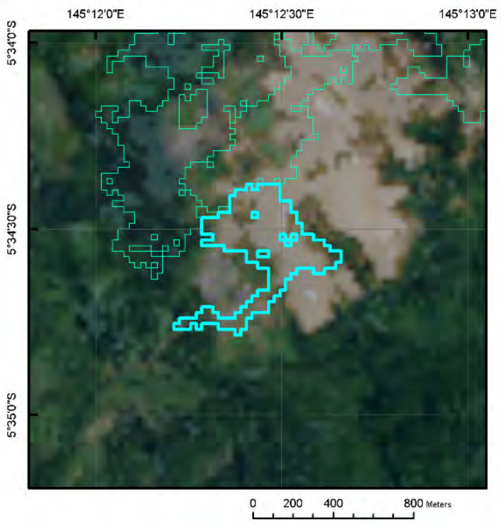
+Within boundaries of "MRA Mining Leases"

+Huge deforested area connected with access roads.

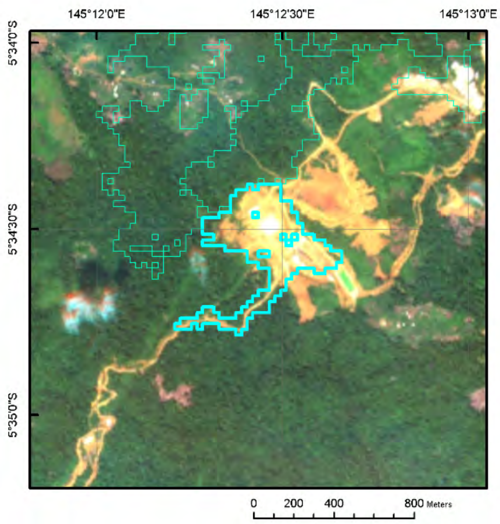
+The deforested area is expanding year by year.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

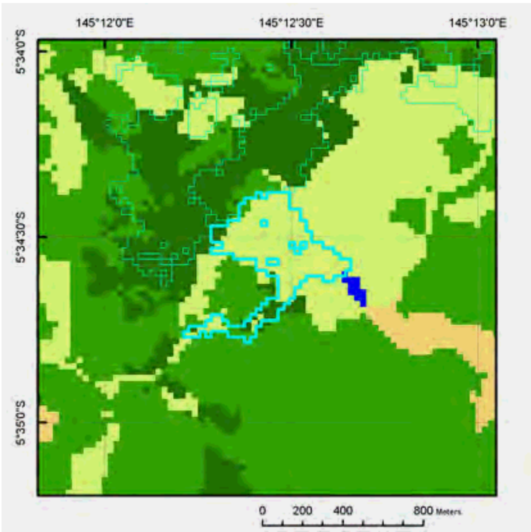
Mining #3

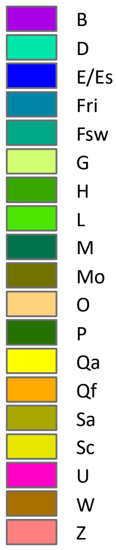


LANDSAT (2015)



RapidEye (2011)





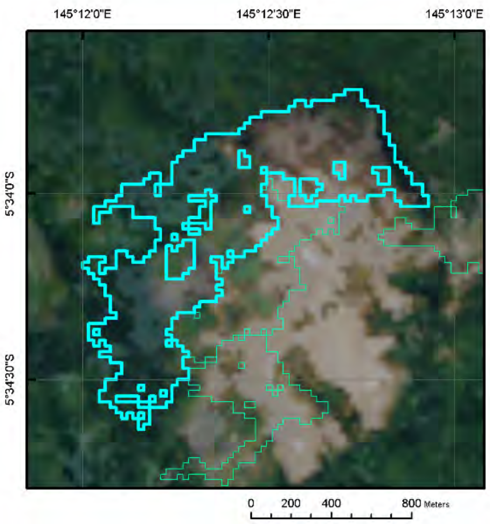
Forest Base Map (2011)

+Within boundaries of “MRA Mining Leases”

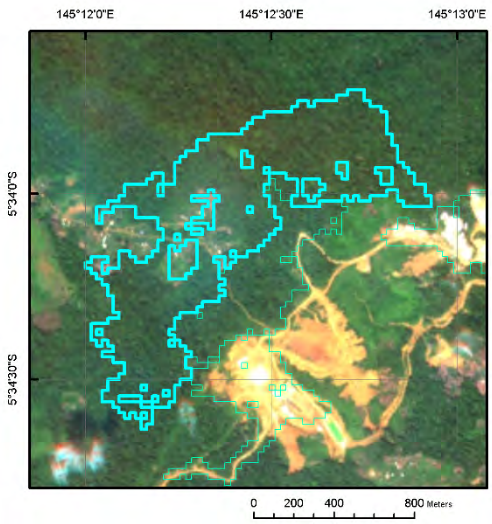
+Huge deforested area connected with access roads.

+The deforested area is expanding year by year.

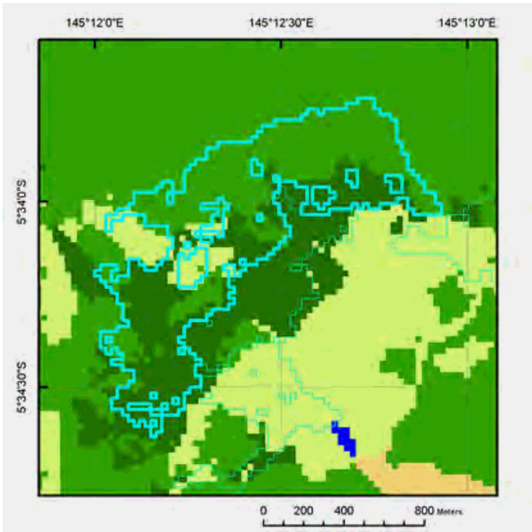
Mining #4

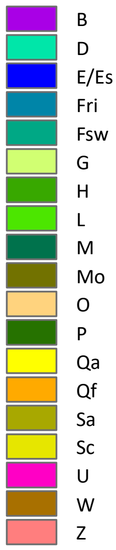


LANDSAT (2015)



RapidEye (2011)





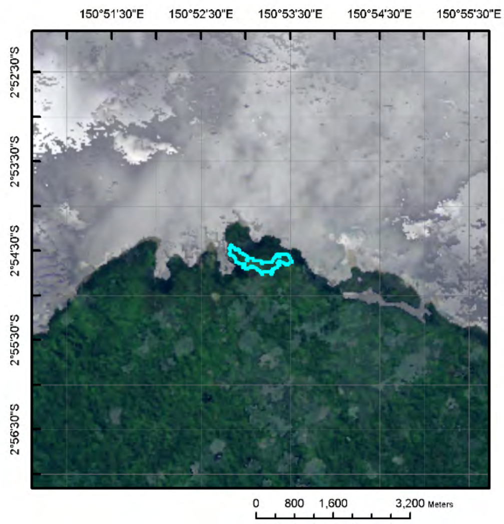
Forest Base Map (2011)

+Within boundaries of “MRA Mining Leases”

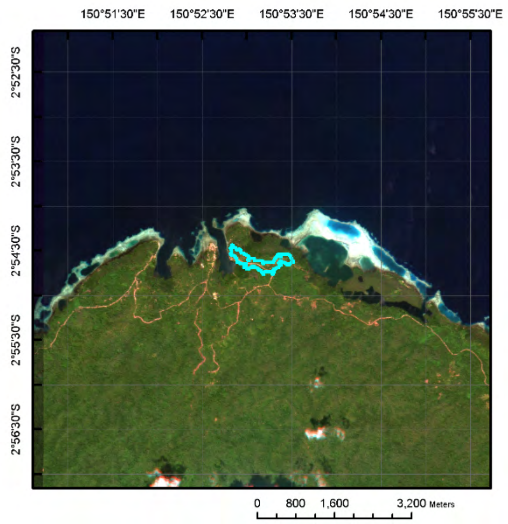
+Huge deforested area connected with access roads.

+The deforested area is expanding year by year.

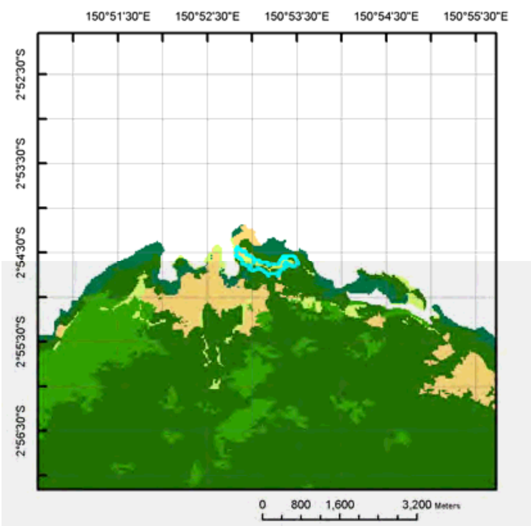
Road construction #1

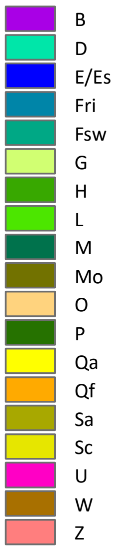


LANDSAT (2015)



RapidEye (2011)

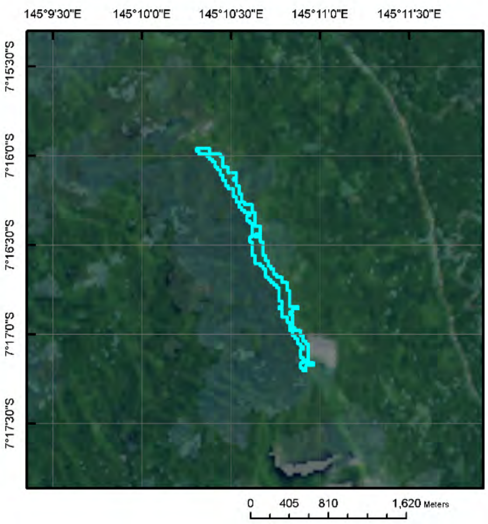




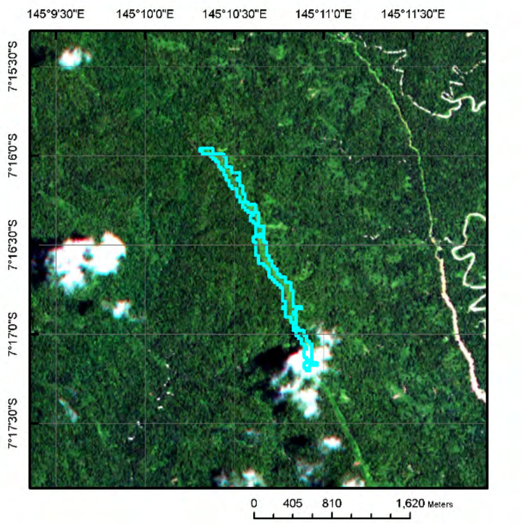
Forest Base Map (2011)

+Roads located at areas not likely to be affected by logging activity such as coastal areas.

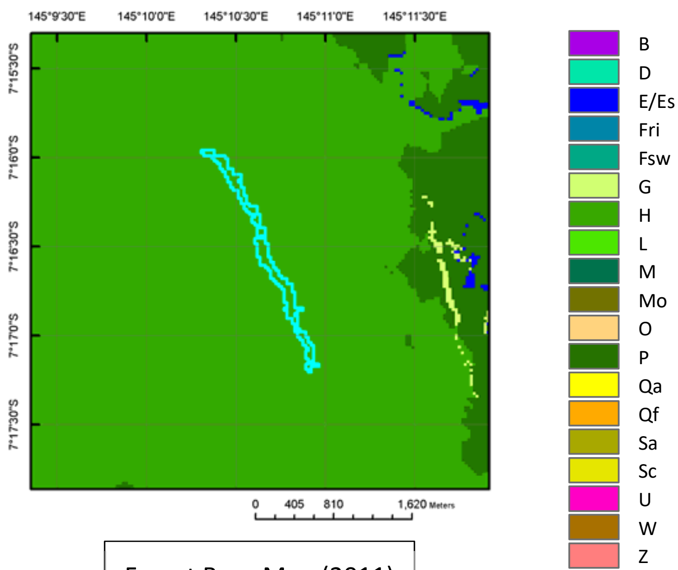
Road construction #2



LANDSAT (2015)



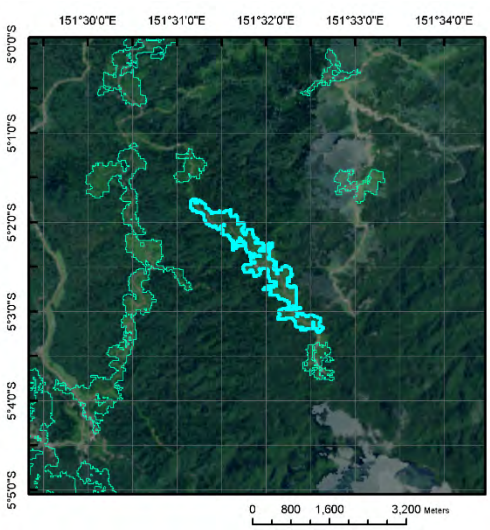
RapidEye (2011)



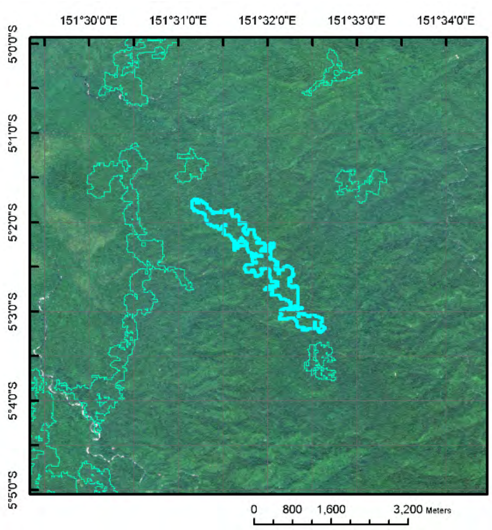
Forest Base Map (2011)

+Long and narrow shape of deforestation not winding so much.

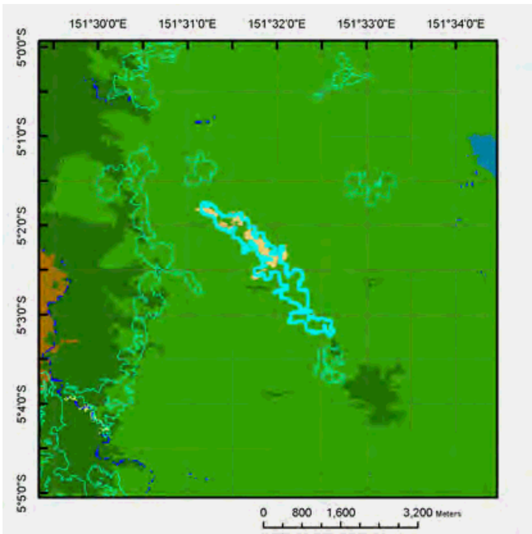
<u>Road construction #3</u>

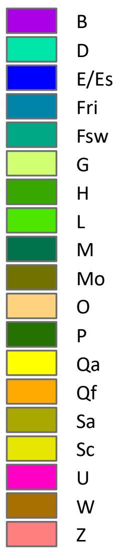


LANDSAT (2015)



RapidEye (2011)



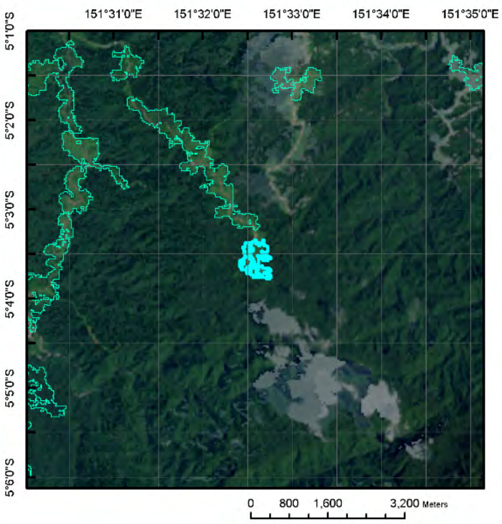


Forest Base Map (2011)

+Long and narrow shape of deforestation with wide width as logging road (more than 100 - 200 m)[1].

[1] Usually, width of logging road is equal to or less than 40 m.

Road construction #4



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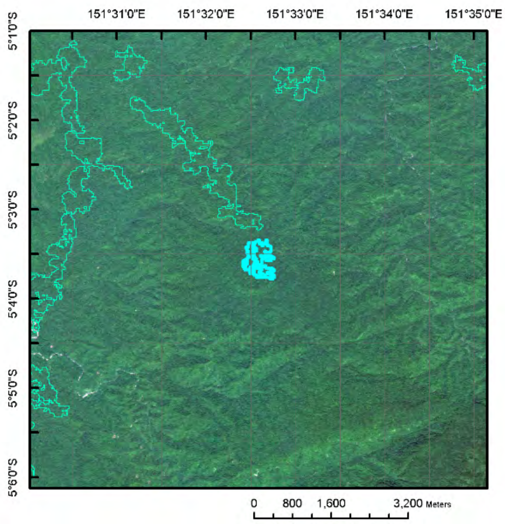
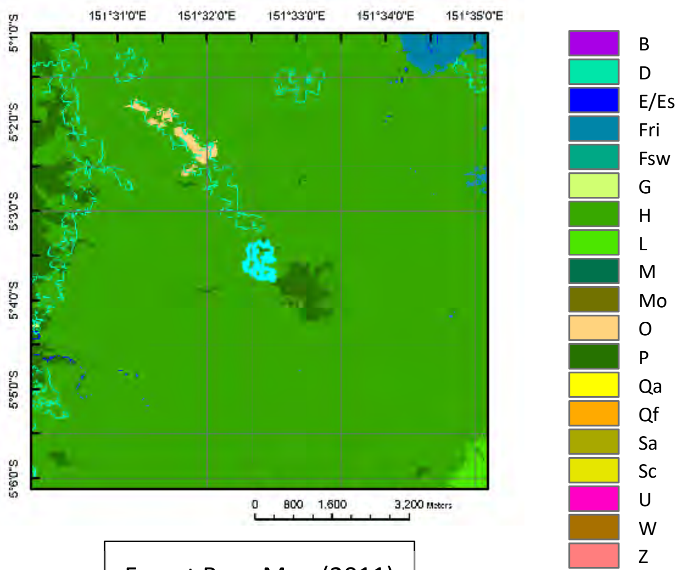


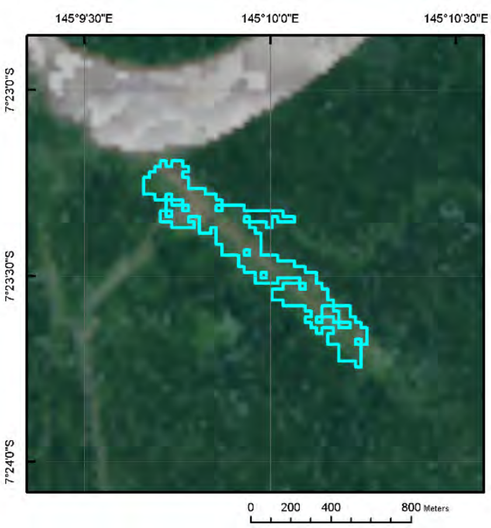
RapidEye (2011)



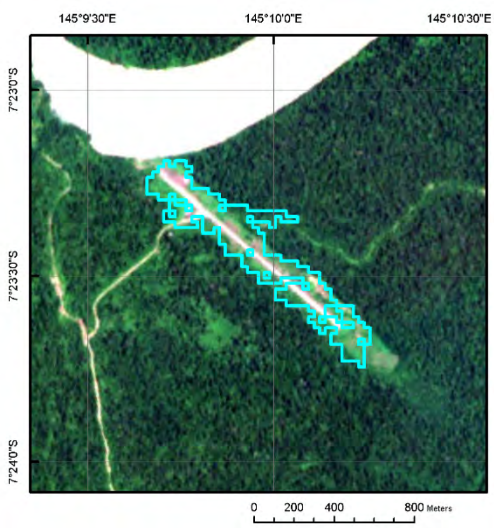
Forest Base Map (2011)

+Deforested area next to the tip of deforested area caused by road construction.

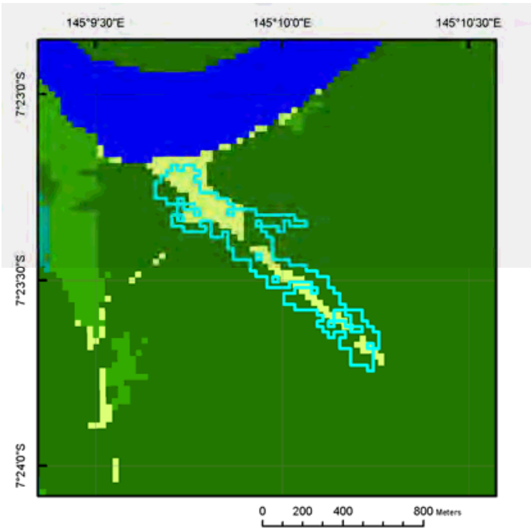
Facility construction #1

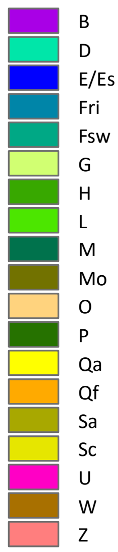


LANDSAT (2015)



RapidEye (2011)





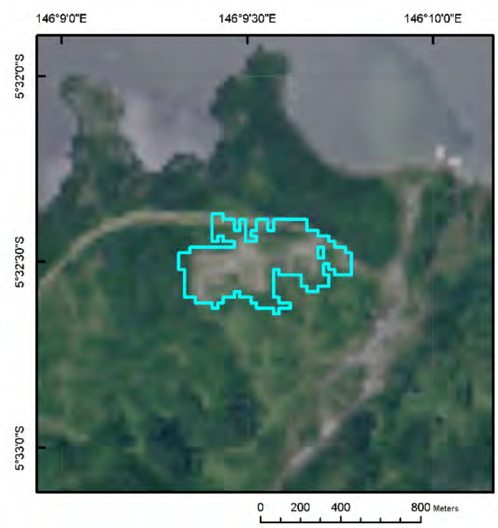
Forest Base Map (2011)

+Characteristic shape of an airport.

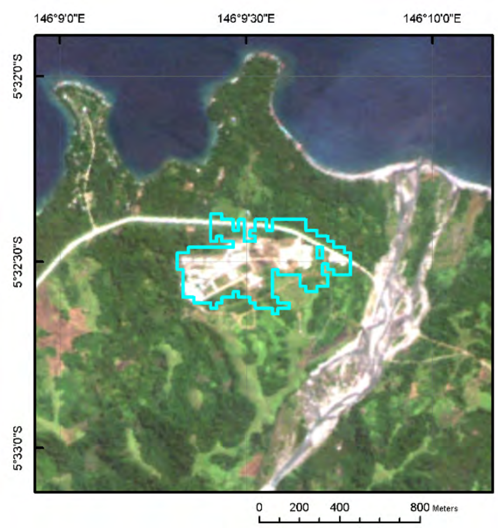
+Road connection to the area also supports the idea.

+DEM data may also be useful information to identify the topographic specification of the area (airport must be located at a flat area).

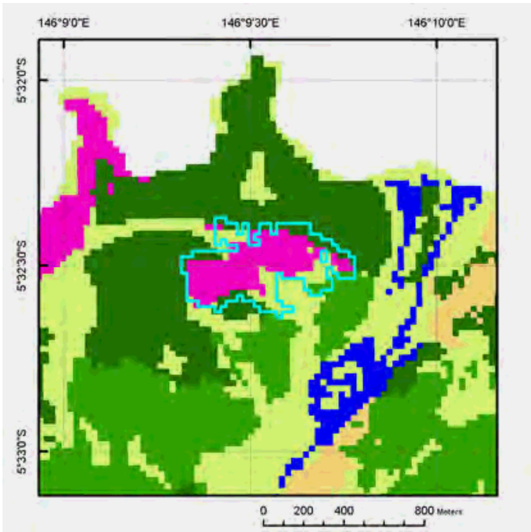
Facility construction #2

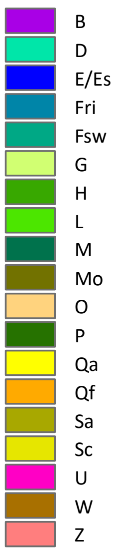


LANDSAT (2015)



RapidEye (2011)





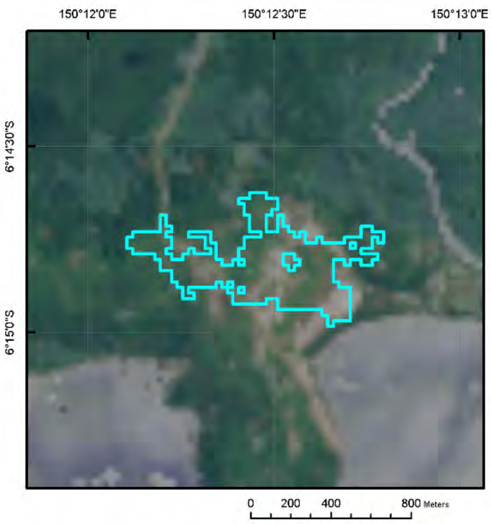
Forest Base Map (2011)

+Characteristic shape of town area.

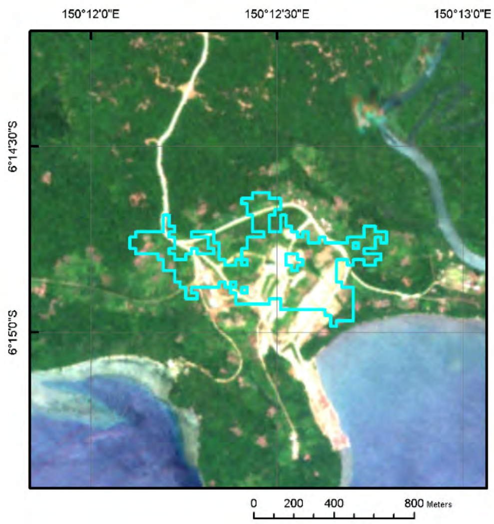
+Road connection to the area also supports the idea.

+Town area tends to be nearby another town area.

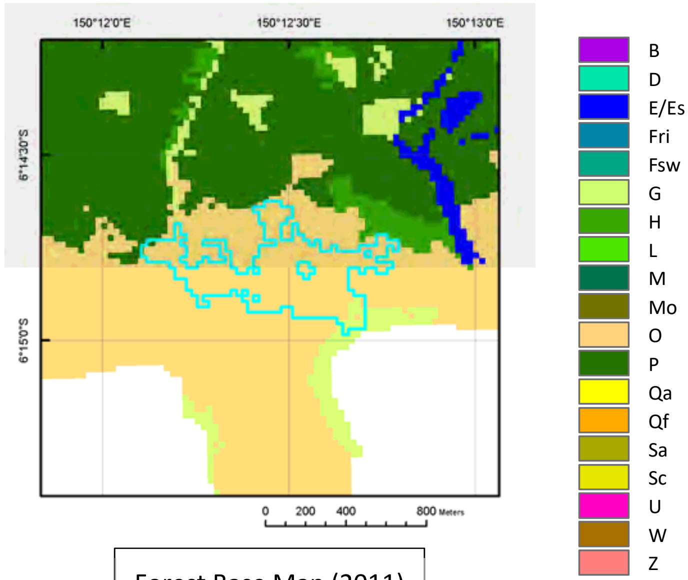
Facility construction #3



LANDSAT (2015)



RapidEye (2011)



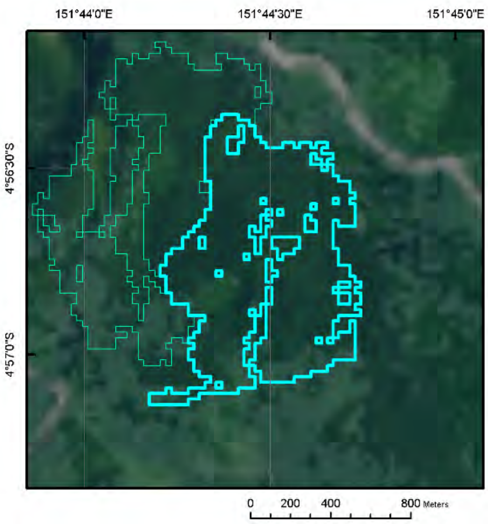
Forest Base Map (2011)

+Characteristic shape of town area.

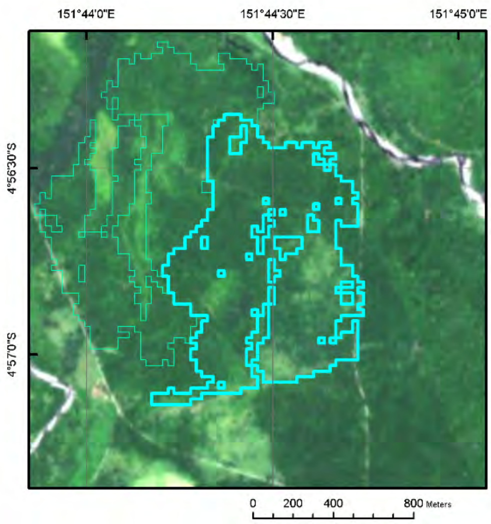
+Road connection to the area also supports the idea.

+New towns are constructed along seaside, riverside, or roadside.

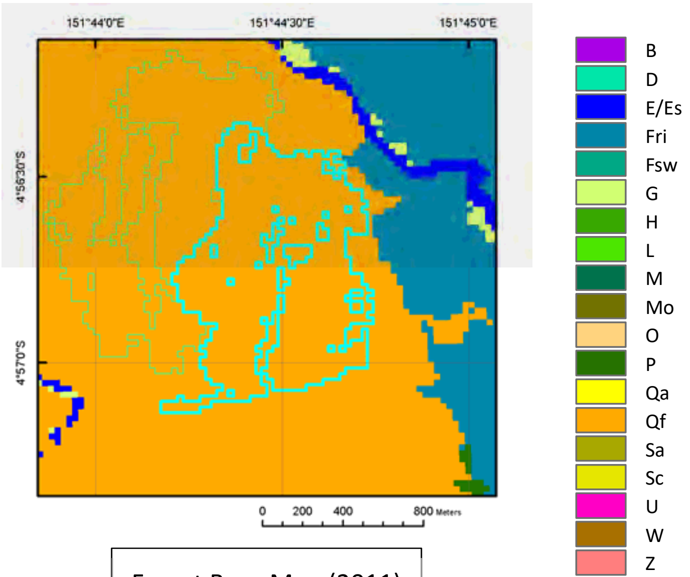
Forest plantation #1



LANDSAT (2015)



RapidEye (2011)

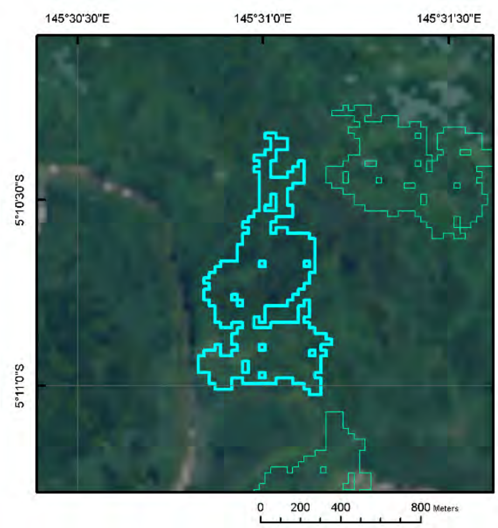


Forest Base Map (2011)

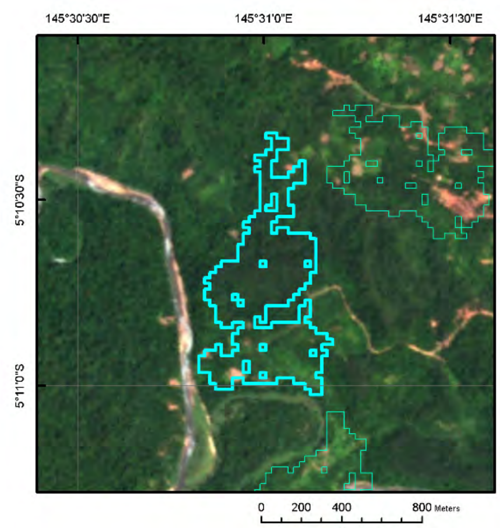
+Certain size of deforested area within forest plantation boundary of the Forest Base Map.

+Road connection to the area.

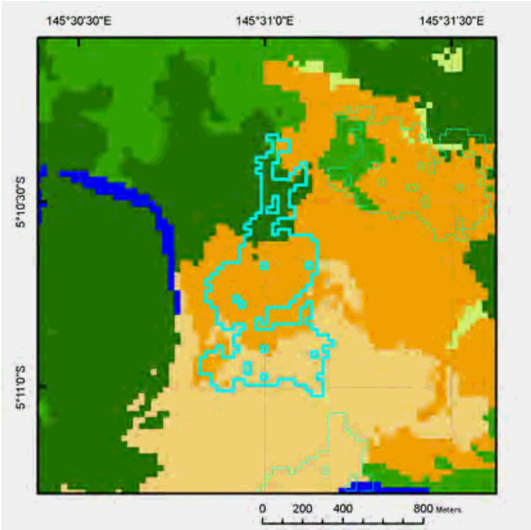
Forest plantation #2

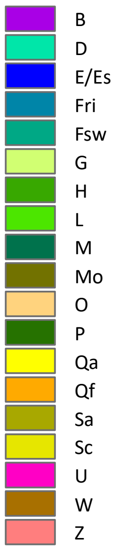


LANDSAT (2015)



RapidEye (2011)



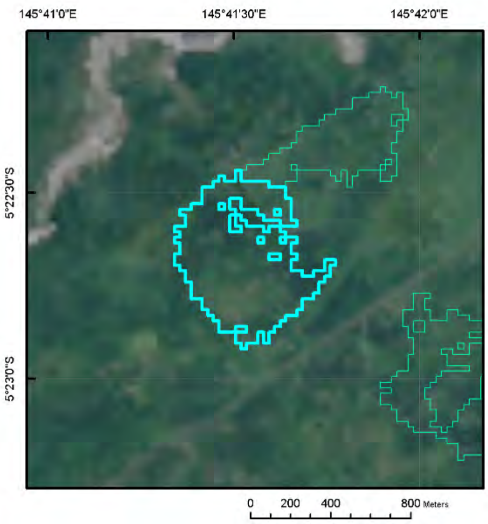


Forest Base Map (2011)

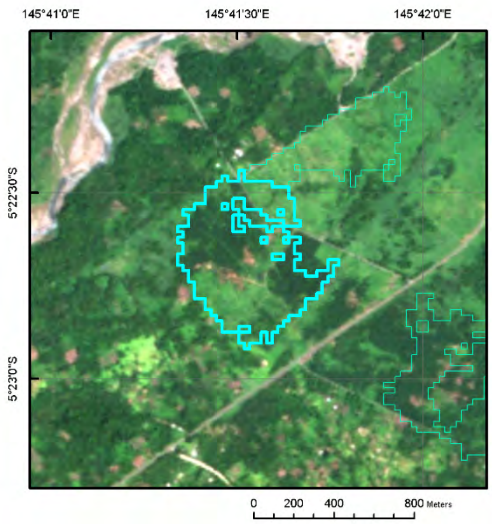
+Certain size of deforested area within or near forest plantation boundary of the Forest Base Map.

+Road connection to the area.

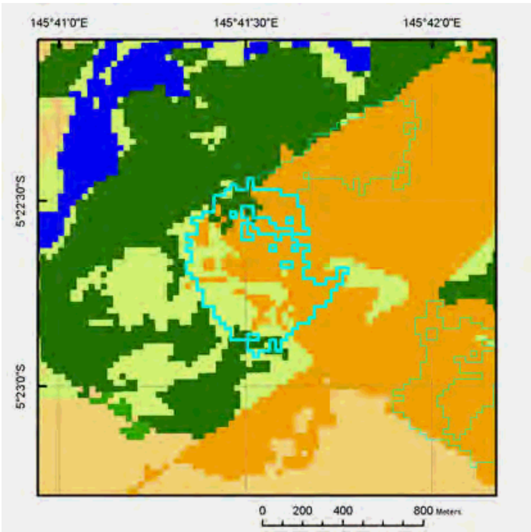
Forest plantation #3

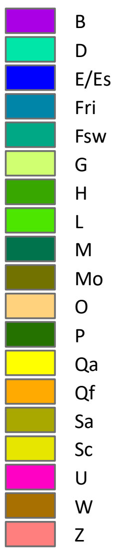


LANDSAT (2015)



RapidEye (2011)



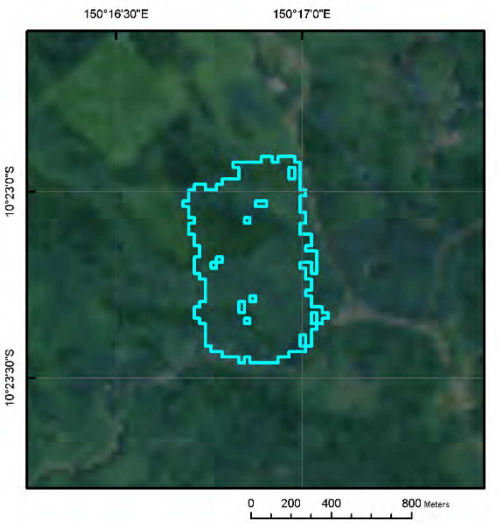


Forest Base Map (2011)

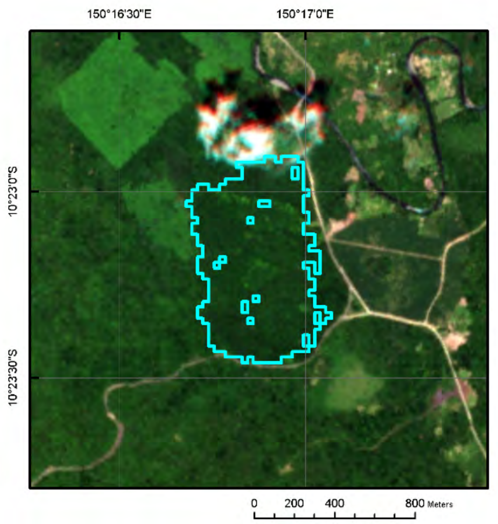
+Certain size of deforested area within or near forest plantation boundary of the Forest Base Map.

+Road connection to the area.

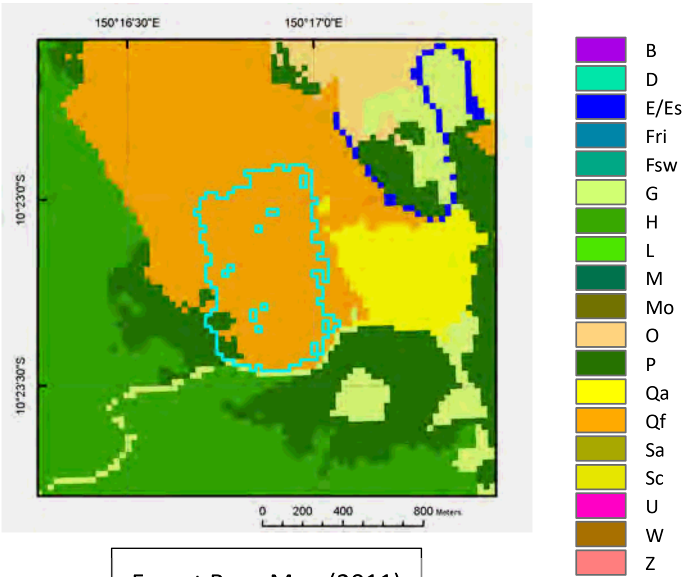
Forest plantation #4



LANDSAT (2015)



RapidEye (2011)



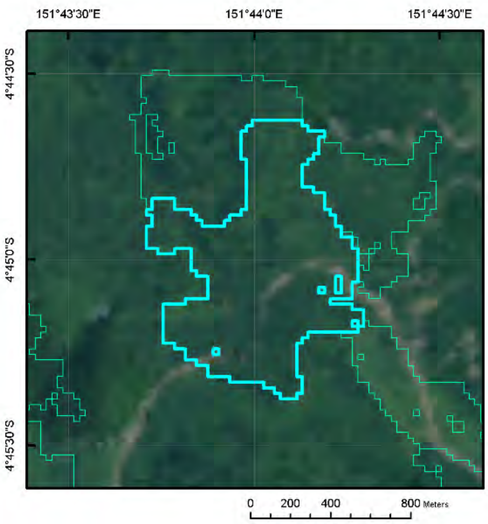
Forest Base Map (2011)

+Certain size of deforested area within forest plantation boundary of the Forest Base Map.

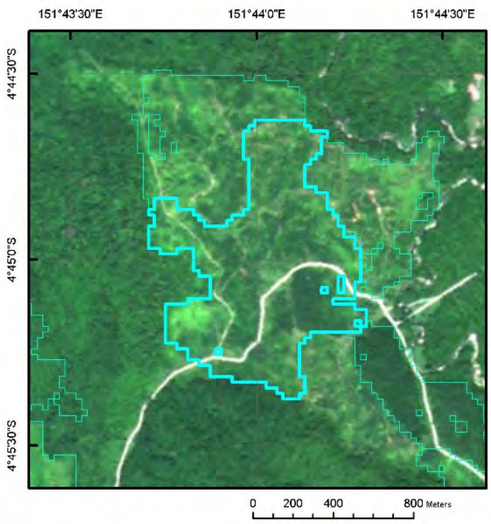
+Homogeneous dark green color, indicating presence of single species of trees with similar ages, may be confirmed inside of the area with high-resolution imagery.

+Road connection to the area.

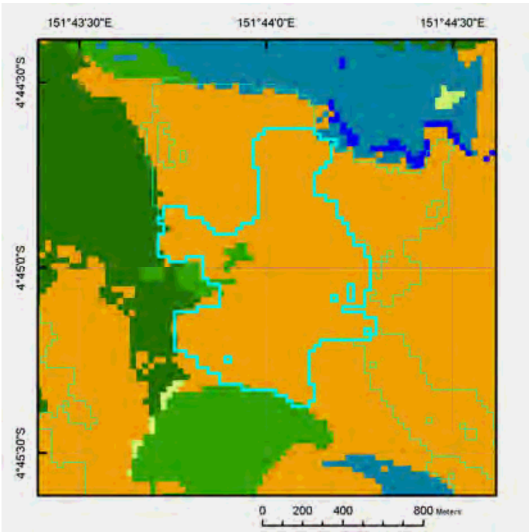
Forest plantation #5

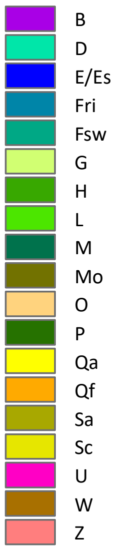


LANDSAT (2015)



RapidEye (2011)





Forest Base Map (2011)

+Certain size of deforested area within forest plantation boundary of the Forest Base Map.

+Light green color with dark green dot, indicating presence of uniformly young tree, may be confirmed inside of the area with high-resolution imagery.

+Road connection to the area.

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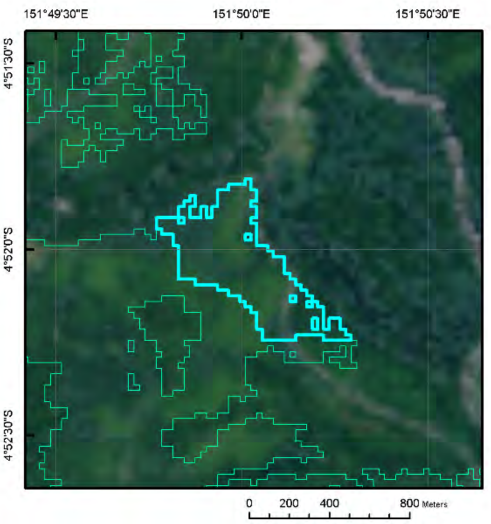
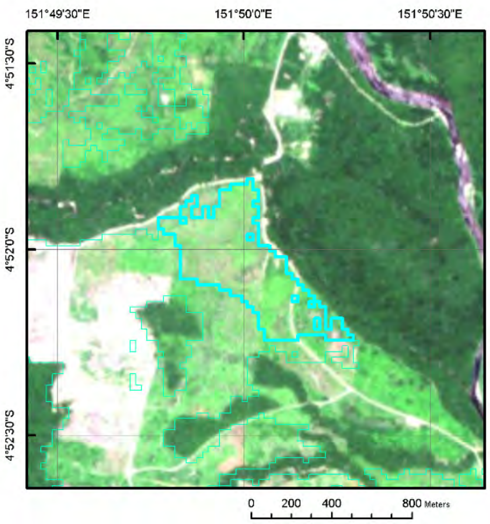
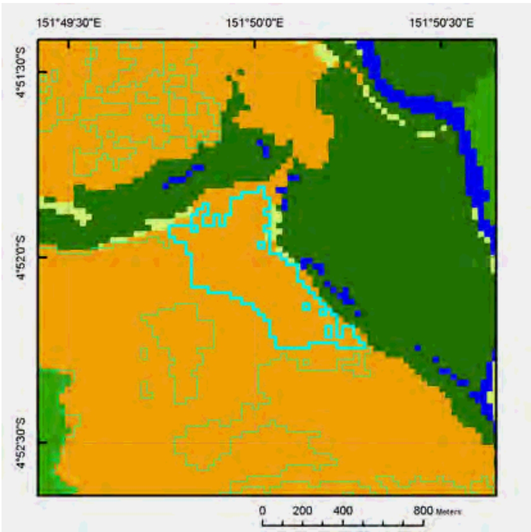
Forest plantation #6

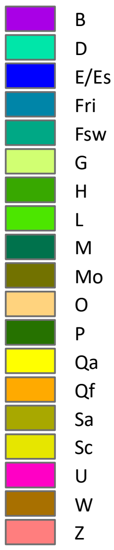


LANDSAT (2015)



RapidEye (2011)





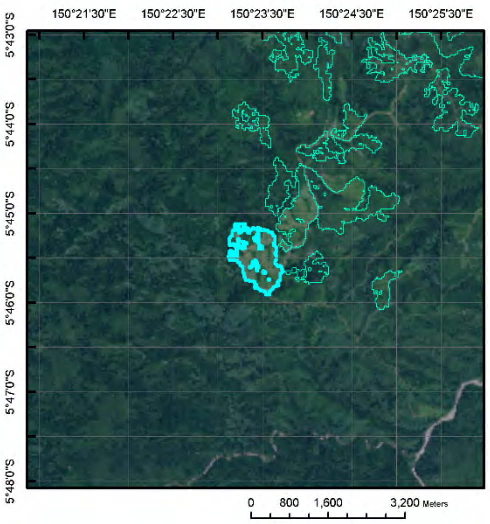
Forest Base Map (2011)

+Certain size of deforested area within forest plantation boundary of the Forest Base Map.

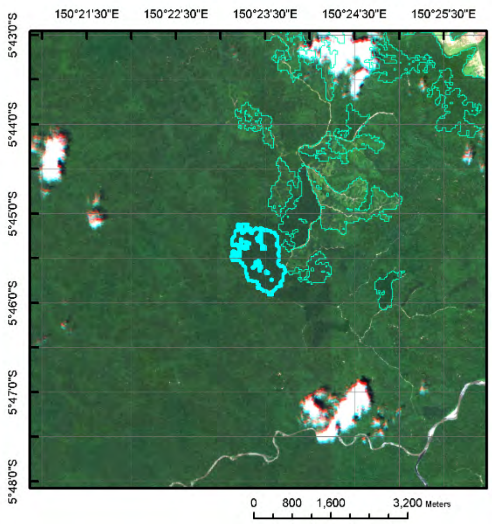
+Homogeneous light green color, indicating presence of very young trees, may be confirmed inside of the area with high-resolution imagery.

+Road connection to the area.

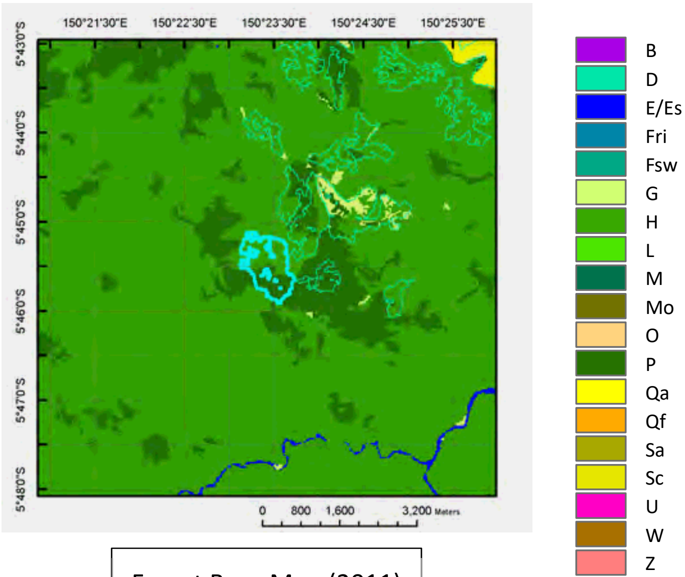
Forest plantation #7



LANDSAT (2015)



RapidEye (2011)



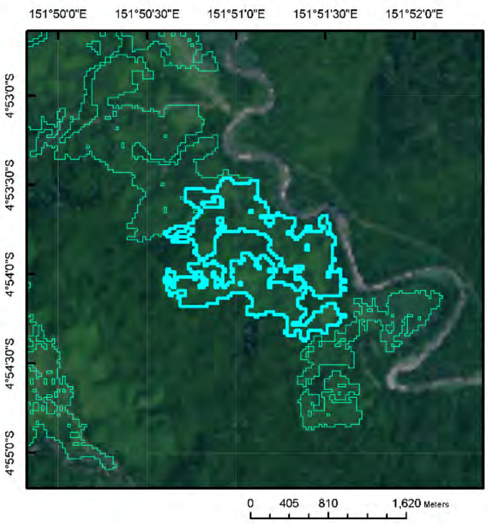
Forest Base Map (2011)

+Cluster of deforested area in hilly zone located at 5-10 km from human activity.

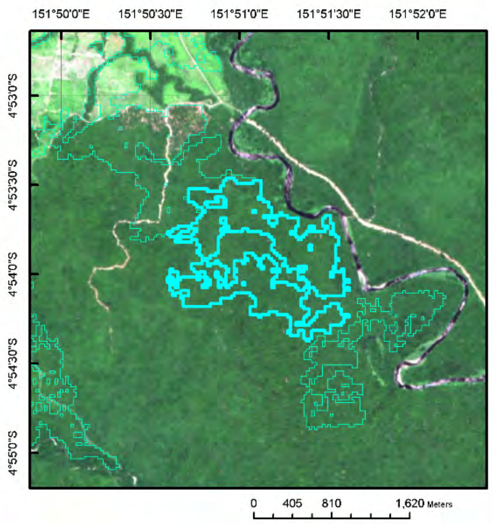
+Road connection to the area.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

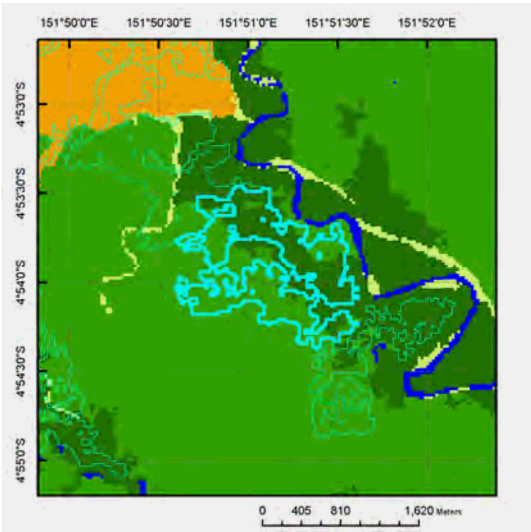
Forest plantation #8

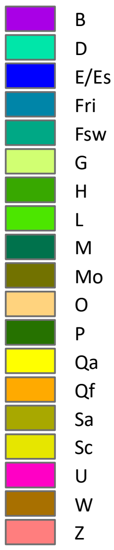


LANDSAT (2015)



RapidEye (2011)



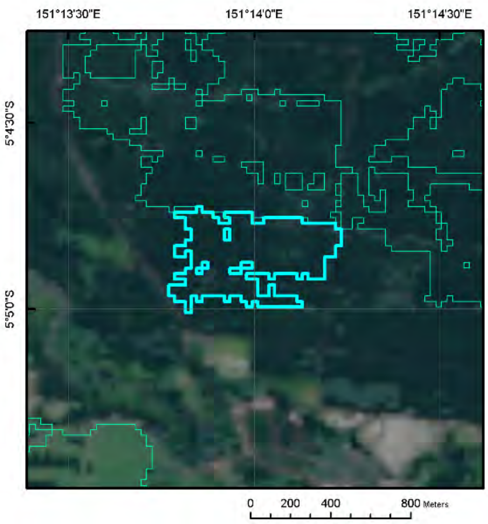


Forest Base Map (2011)

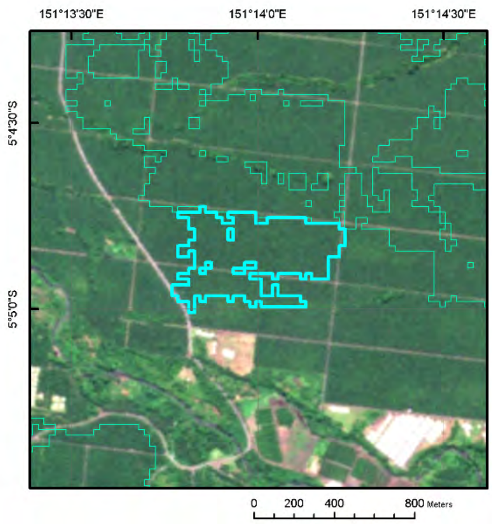
+Cluster of deforested area connected to forest plantation boundary of the Forest Base Map.

+Road connection to the area.

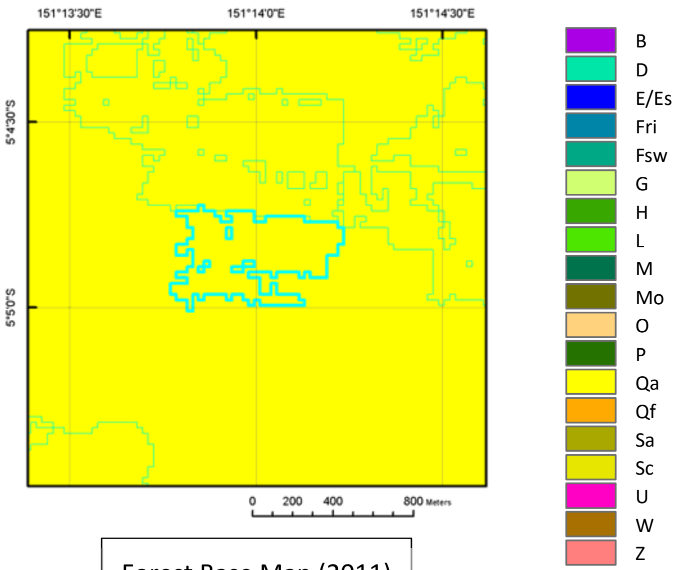
Perennial plantation #1



LANDSAT (2015)



RapidEye (2011)

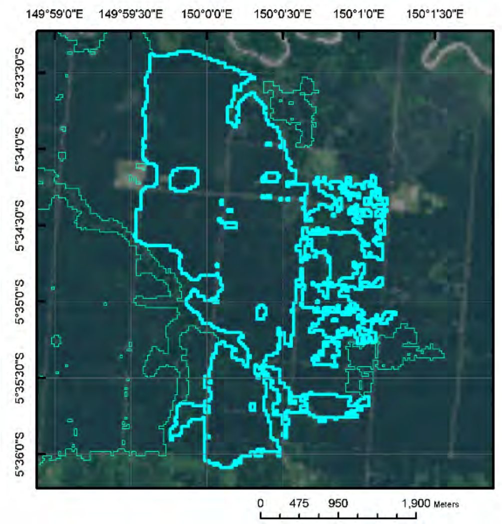


Forest Base Map (2011)

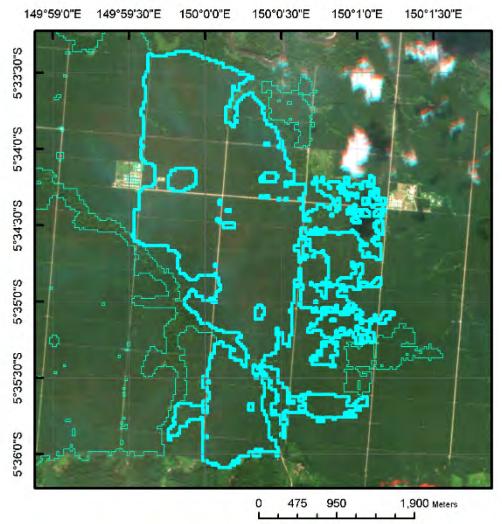
+Geometric shape of deforestation within perennial plantation boundary of the Forest Base Map.

+Grid road can be confirmed with satellite imagery.

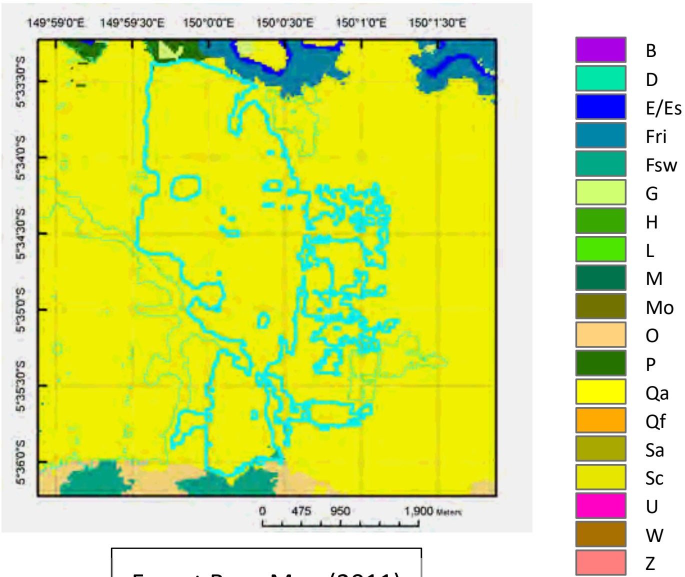
Perennial plantation #2



LANDSAT (2015)



RapidEye (2011)

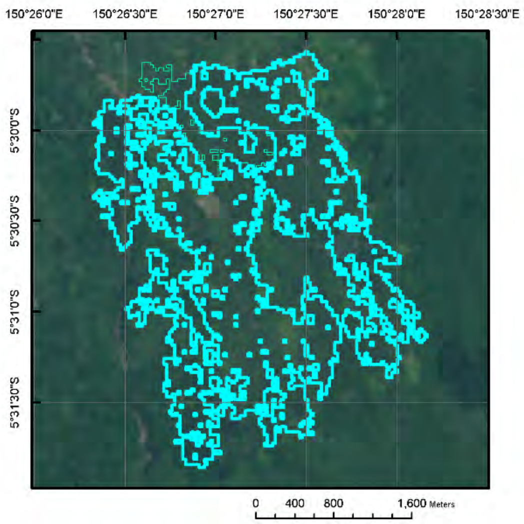


Forest Base Map (2011)

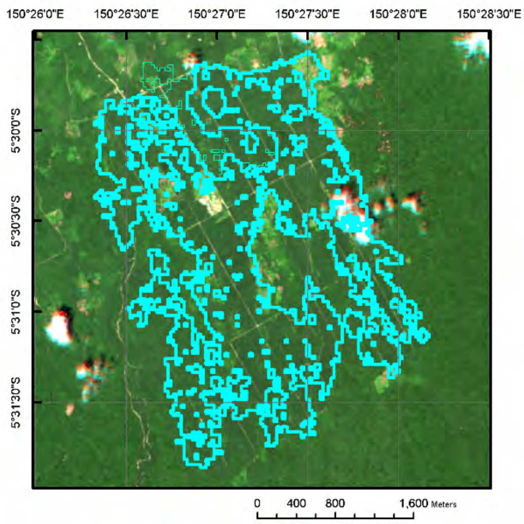
+Geometric shape of deforestation within perennial plantation boundary of the Forest Base Map.

+Grid road can be confirmed with satellite imagery.

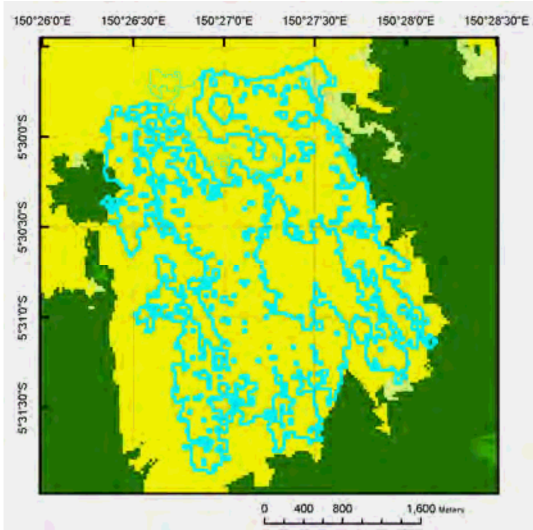
Perennial plantation #3

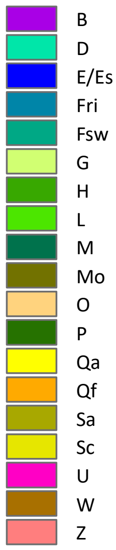


LANDSAT (2015)



RapidEye (2011)



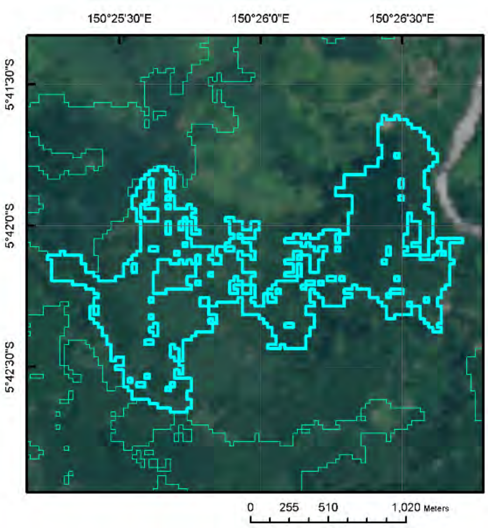


Forest Base Map (2011)

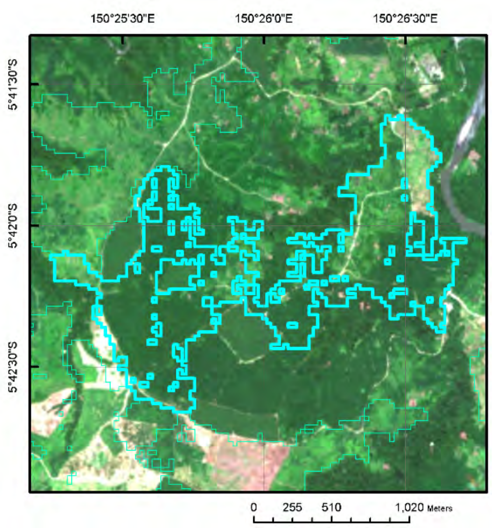
+Large size of deforested area within perennial plantation boundary of the Forest Base Map.

+Grid road can be confirmed with satellite imagery.

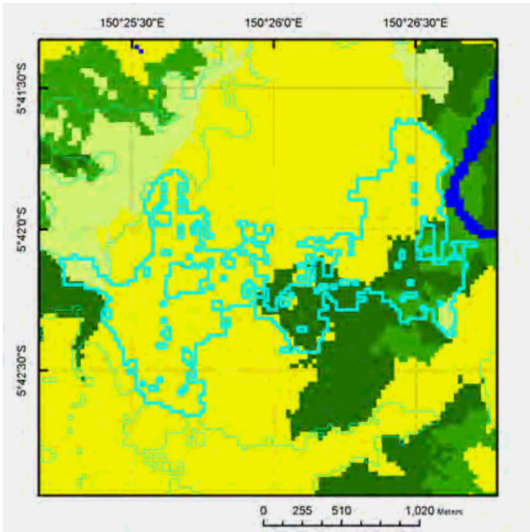
Perennial plantation #4

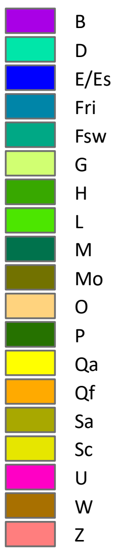


LANDSAT (2015)



RapidEye (2011)



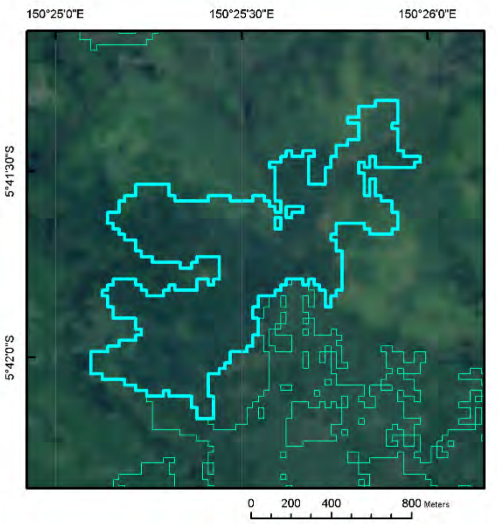


Forest Base Map (2011)

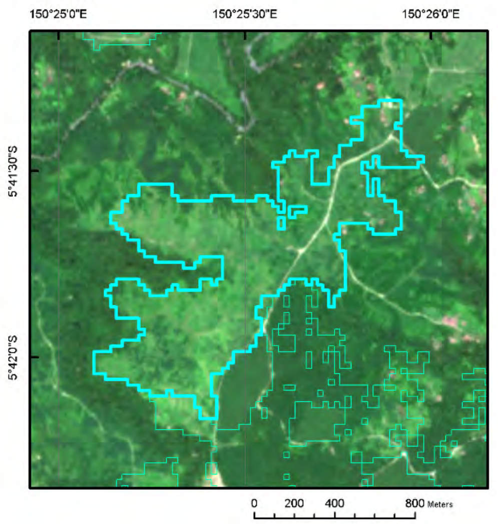
+Large size of deforested area within or near perennial plantation boundary of the Forest Base Map.

+Road connection to the area.

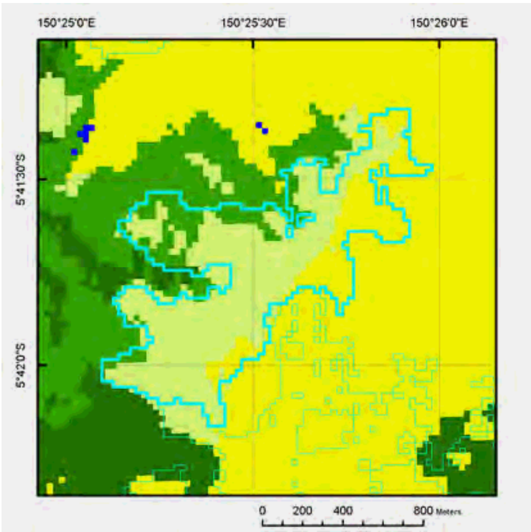
Perennial plantation #5

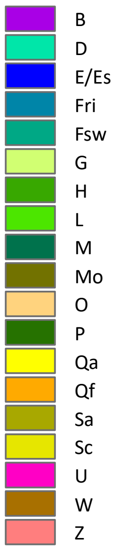


LANDSAT (2015)



RapidEye (2011)



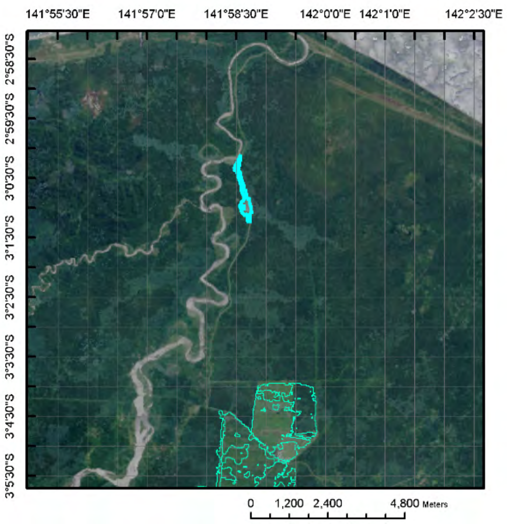


Forest Base Map (2011)

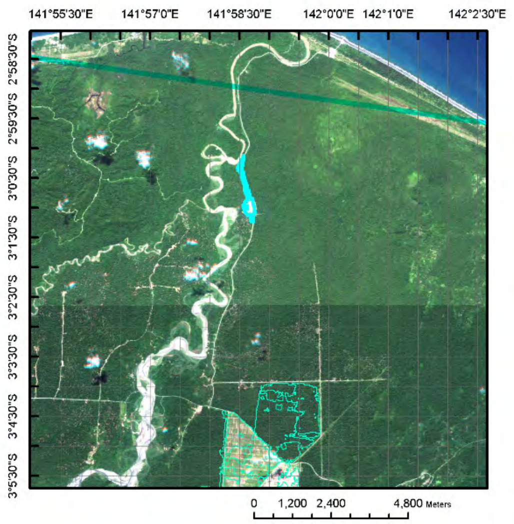
+Deforested area within or near perennial plantation boundary of the Forest Base Map.

+Road connection to the area.

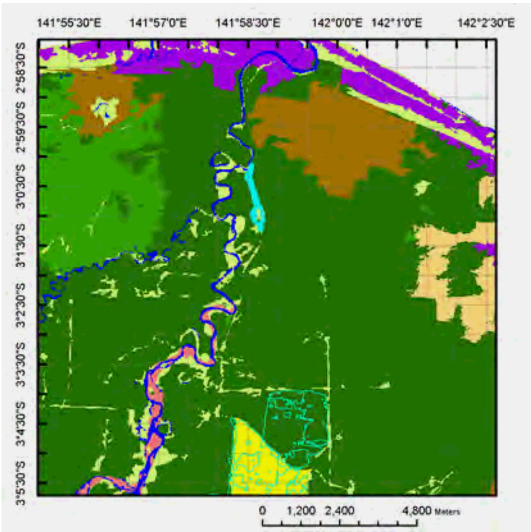
Perennial plantation #6

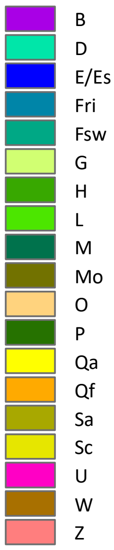


LANDSAT (2015)



RapidEye (2011)





Forest Base Map (2011)

+Deforested area caused by road construction to connect perennial plantation and sea, river, or other roads.

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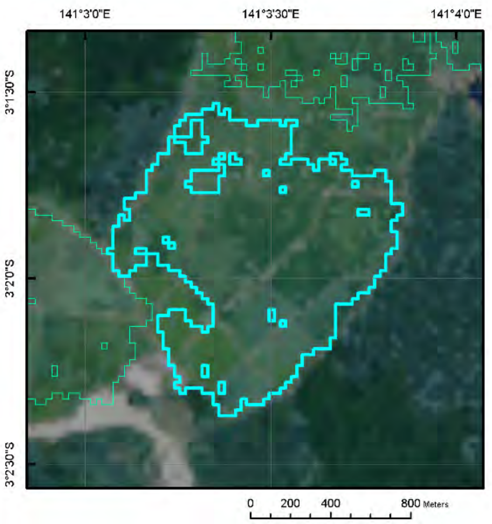
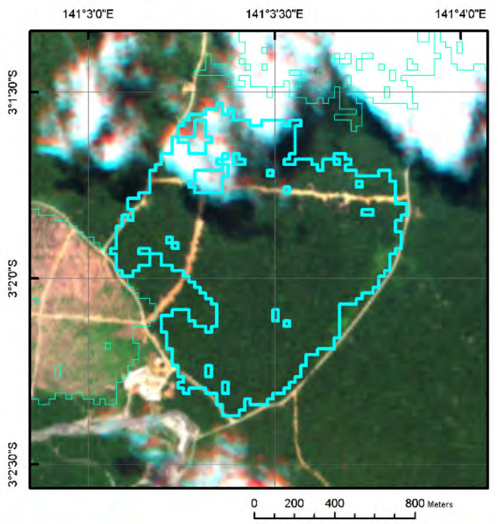
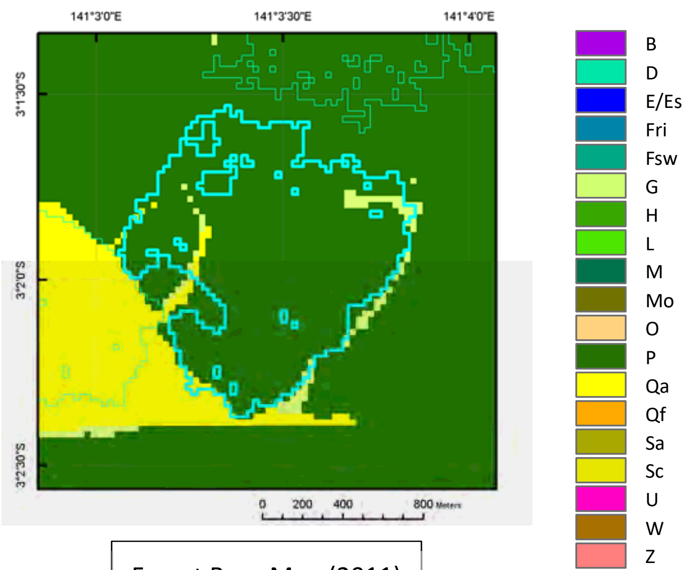
Perennial plantation #7



LANDSAT (2015)



RapidEye (2011)

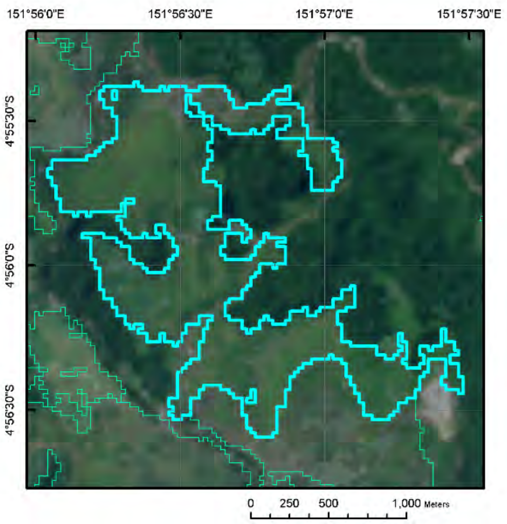


Forest Base Map (2011)

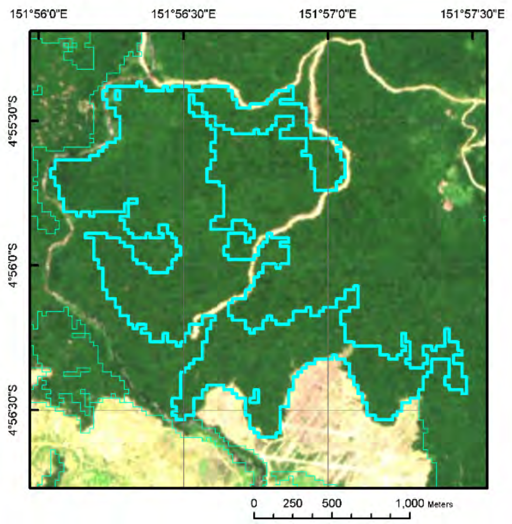
+Deforested area located at next to perennial plantation boundary of the Forest Base Map.

+Road connection to the area.

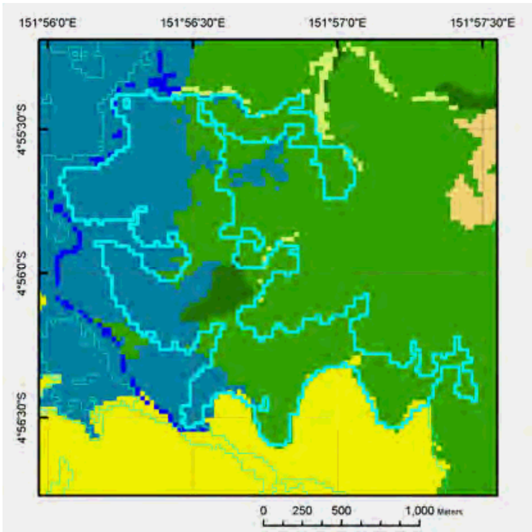
Perennial plantation #8

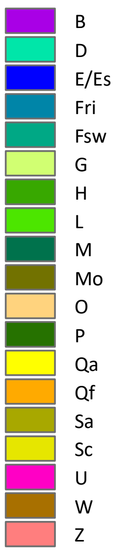


LANDSAT (2015)



RapidEye (2011)



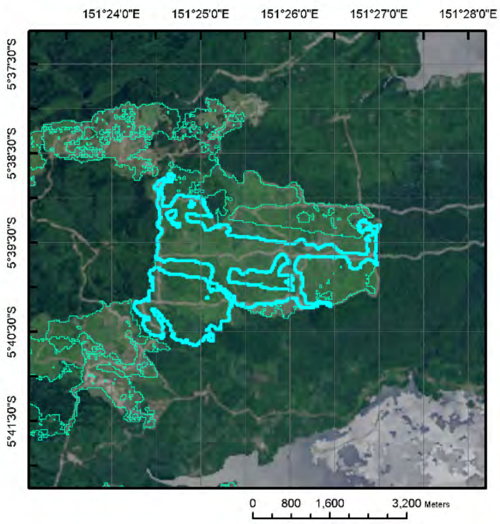


Forest Base Map (2011)

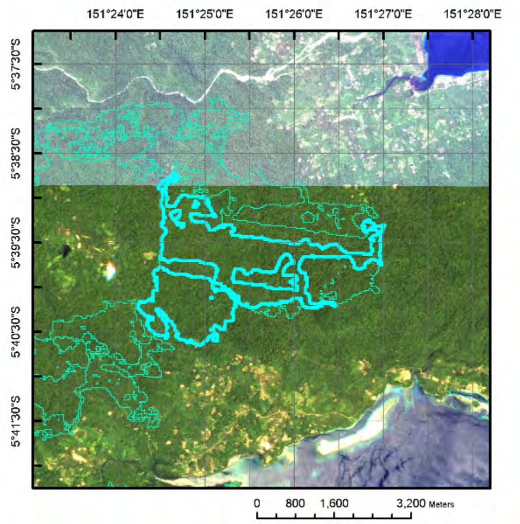
+Deforested area located at next to perennial plantation boundary of the Forest Base Map.

+Road connection to the area.

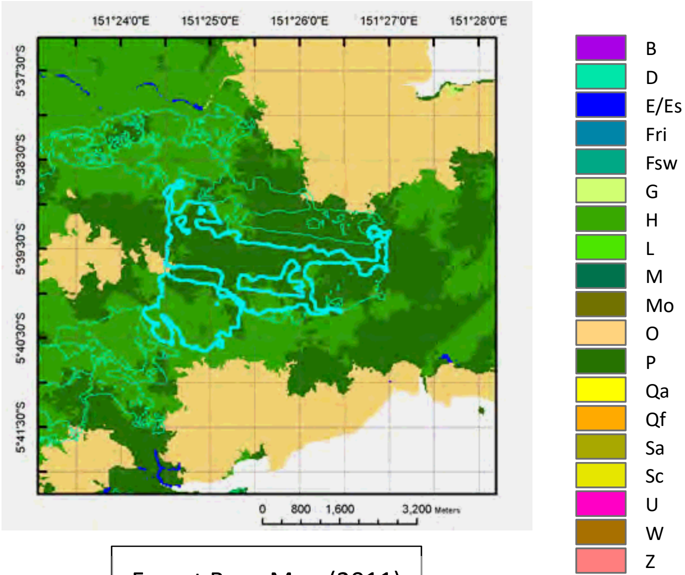
Perennial plantation #9



LANDSAT (2015)



RapidEye (2011)

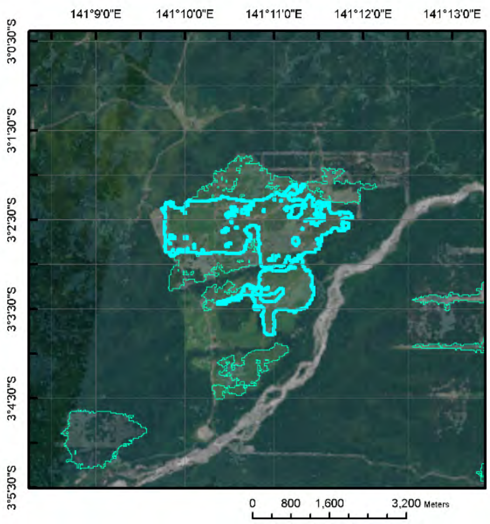


Forest Base Map (2011)

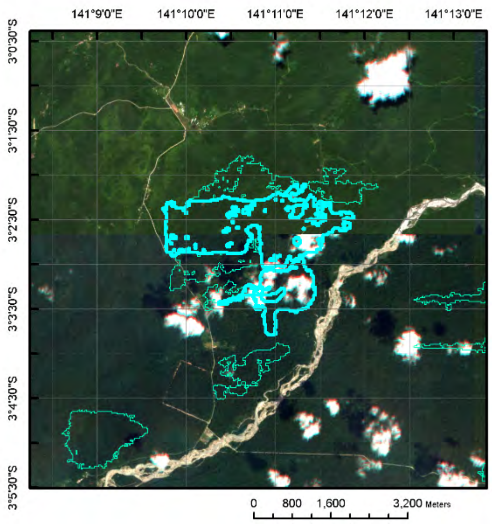
+Geometric shape of deforestation within FCA boundary.

+Road connection to the area.

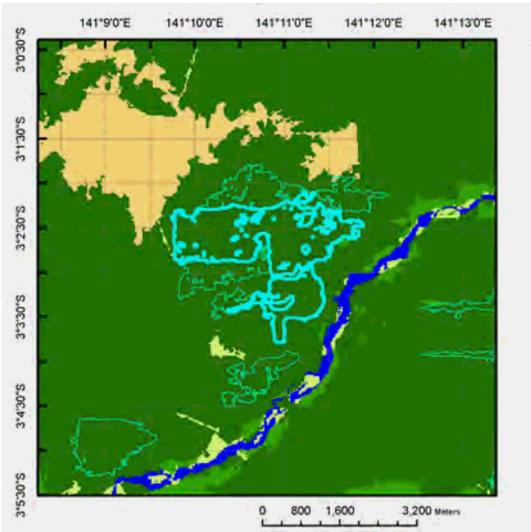
Perennial plantation #10

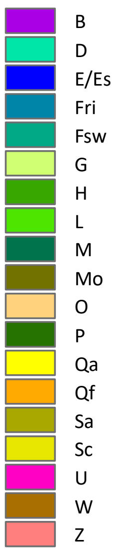


LANDSAT (2015)



RapidEye (2011)



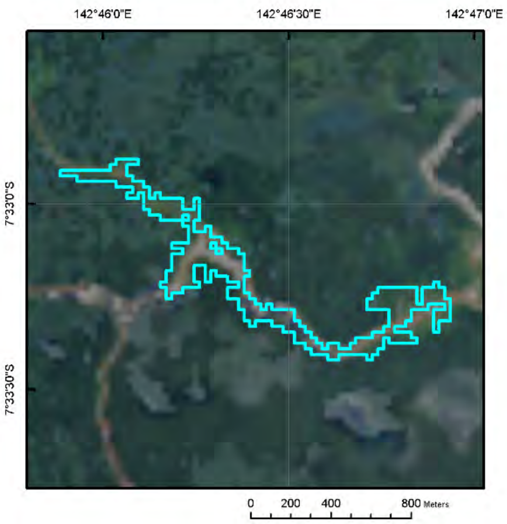


Forest Base Map (2011)

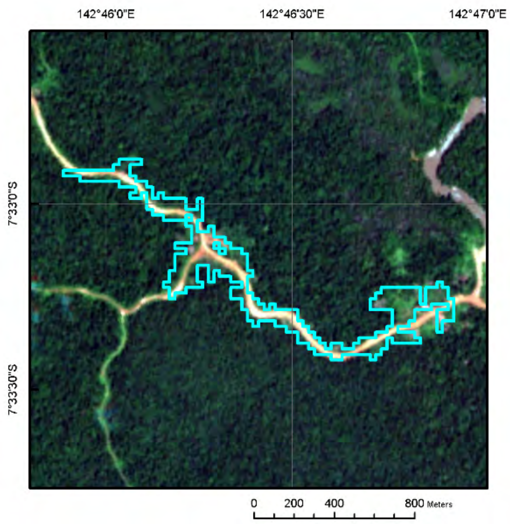
+Geometric shape of deforestation within FCA boundary.

+Road connection to the area.

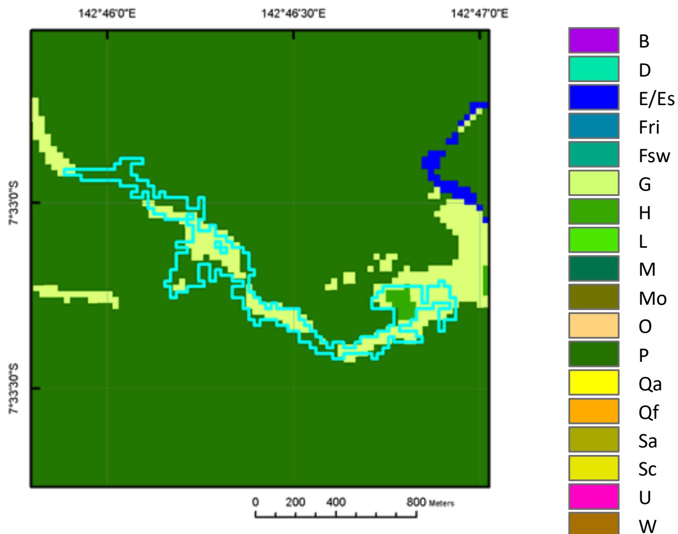
Logging #1



LANDSAT (2015)



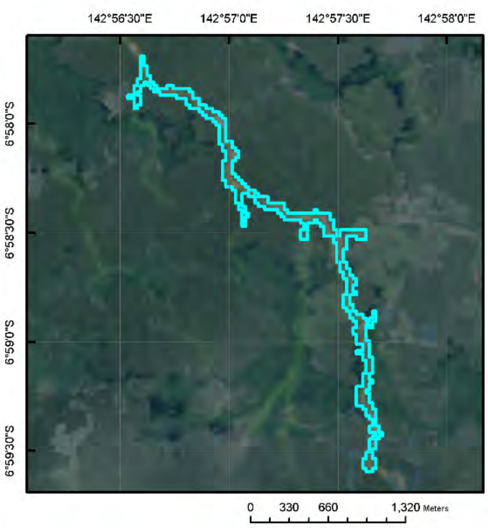
RapidEye (2011)



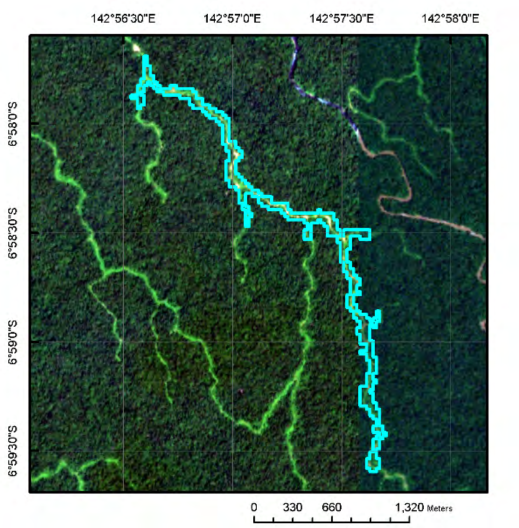
Forest Base Map (2011)

+Winding long and narrow shape of deforestation in forest boundary of the Forest Base Map, indicating logging road.

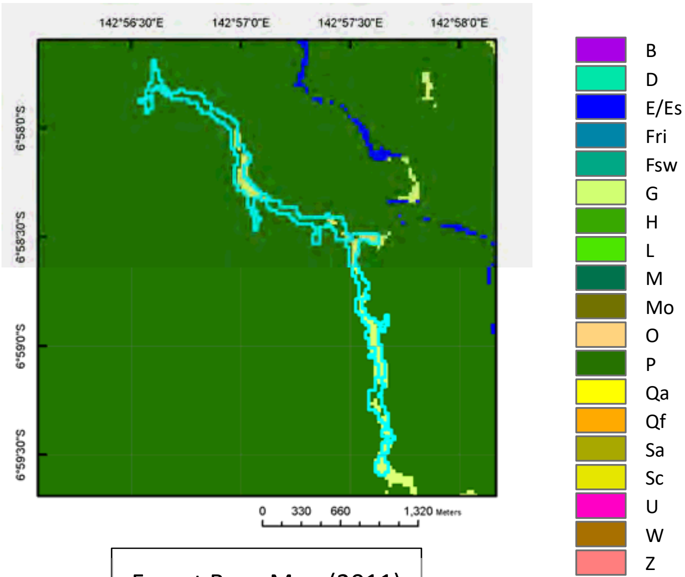
Logging #2



LANDSAT (2015)



RapidEye (2011)

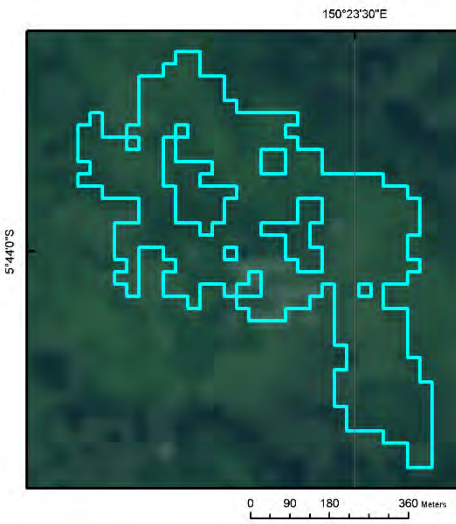


Forest Base Map (2011)

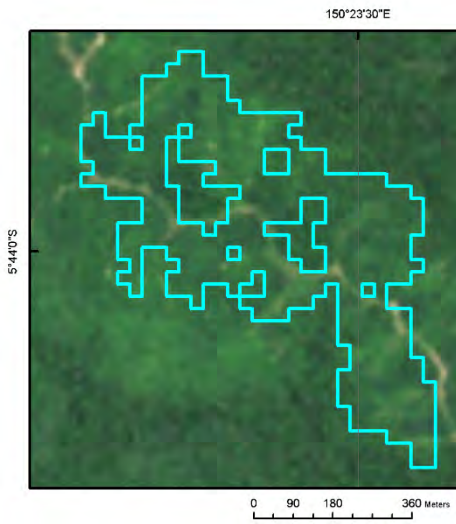
+Winding long and narrow shape of deforestation in forest boundary of the Forest Base Map, indicating logging road.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

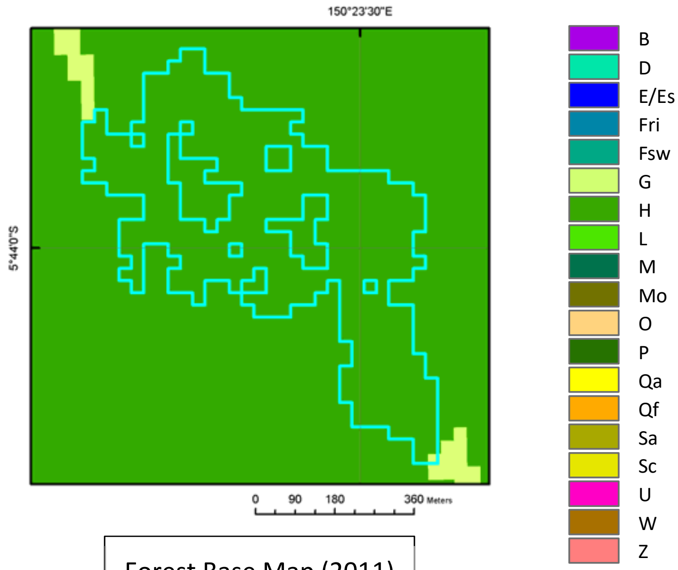
Logging #3



LANDSAT (2015)



RapidEye (2011)

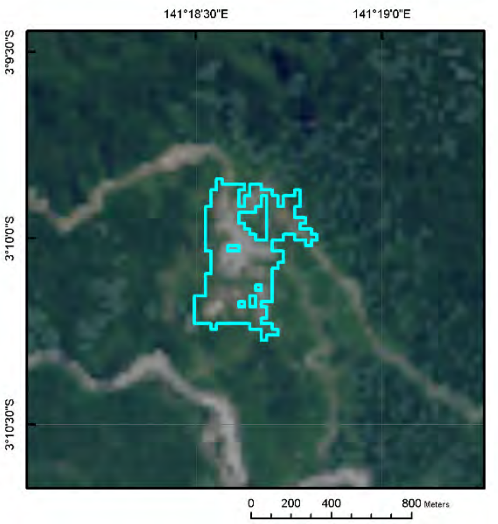


Forest Base Map (2011)

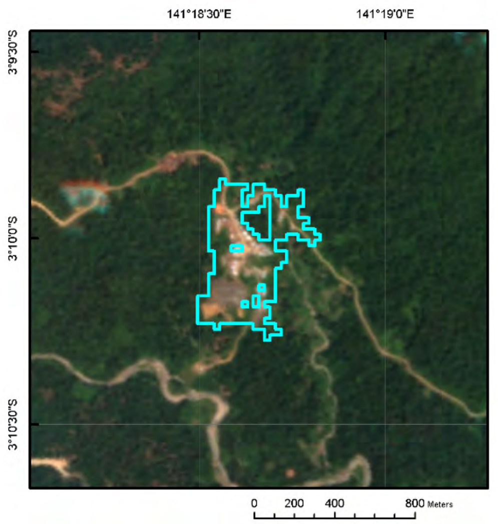
+Deforestation along logging roads.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

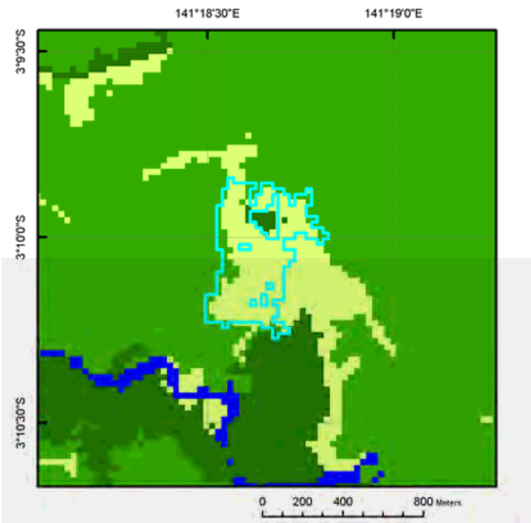
Logging #4

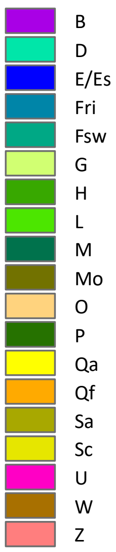


LANDSAT (2015)



RapidEye (2011)

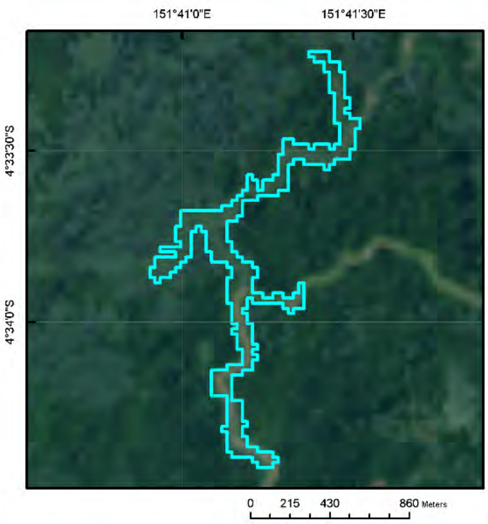




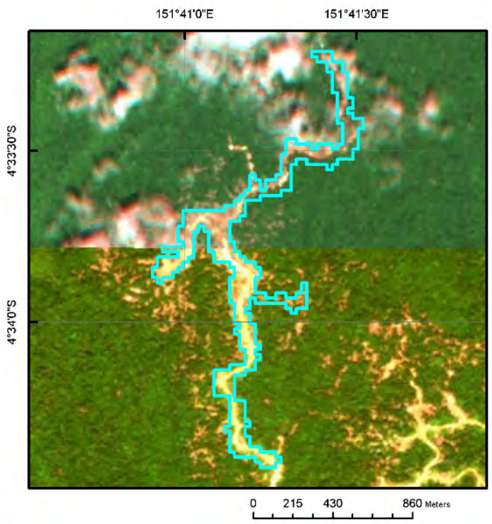
Forest Base Map (2011)

+Geometric shape connected to winding long and narrow shape, indicating presence of logging camp.

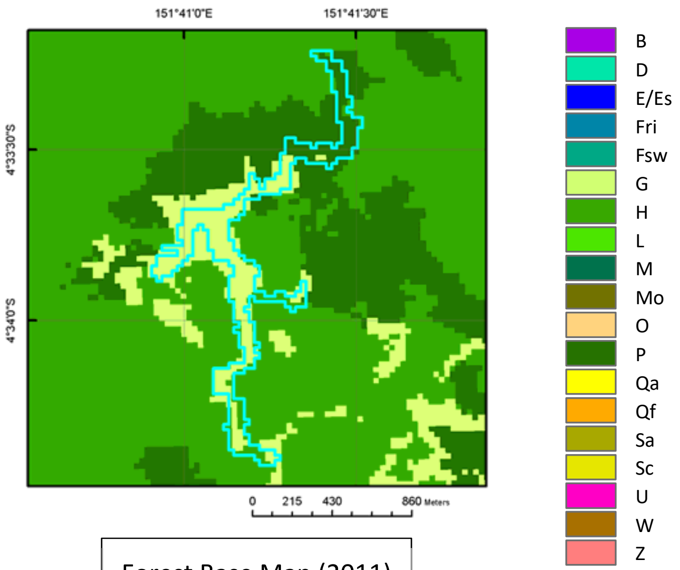
Logging #5



LANDSAT (2015)



RapidEye (2011)

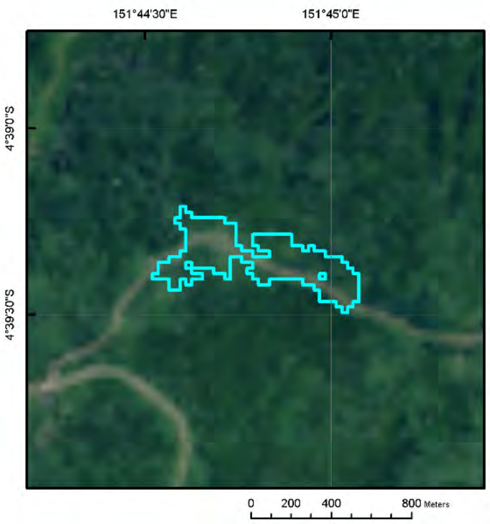


Forest Base Map (2011)

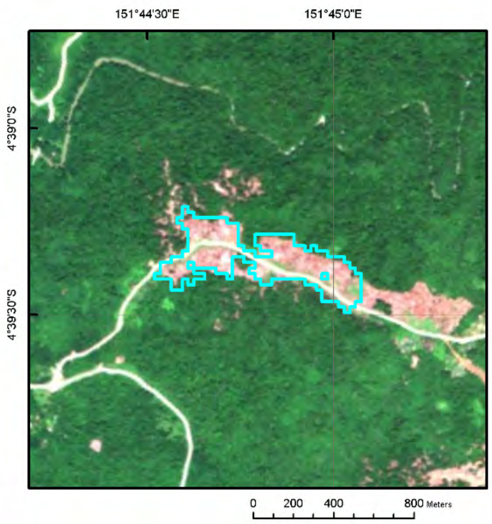
+Winding long and narrow shape in forest boundary of the Forest Base Map, indicating logging road.

+Brown spots, indicating marks of selective logging, could be found along the logging road by high-resolution satellite imagery.

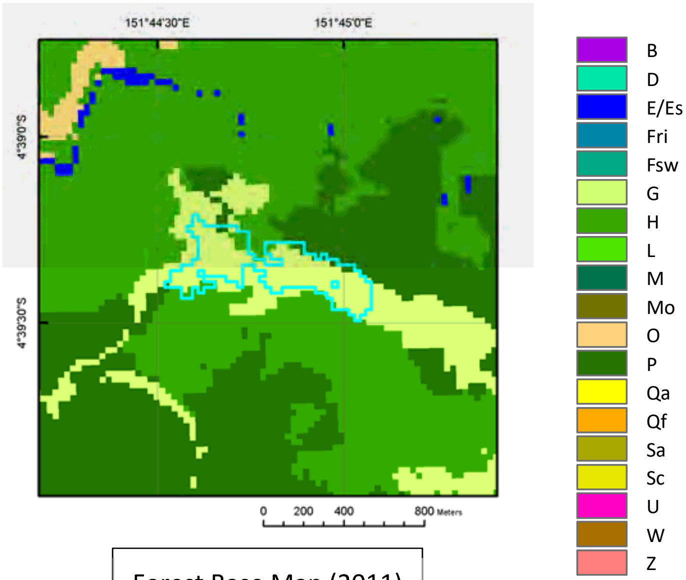
Logging #6



LANDSAT (2015)



RapidEye (2011)

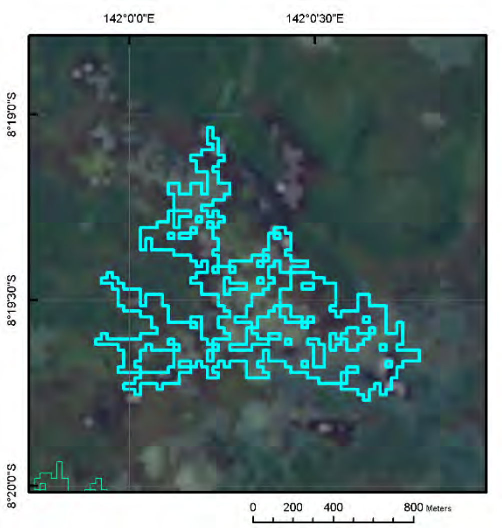


Forest Base Map (2011)

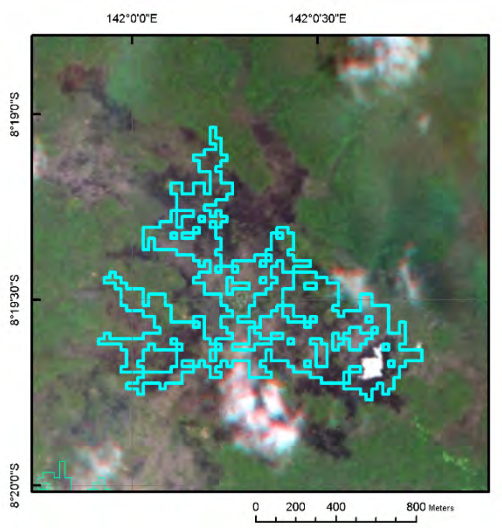
+Deforestation along logging roads.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

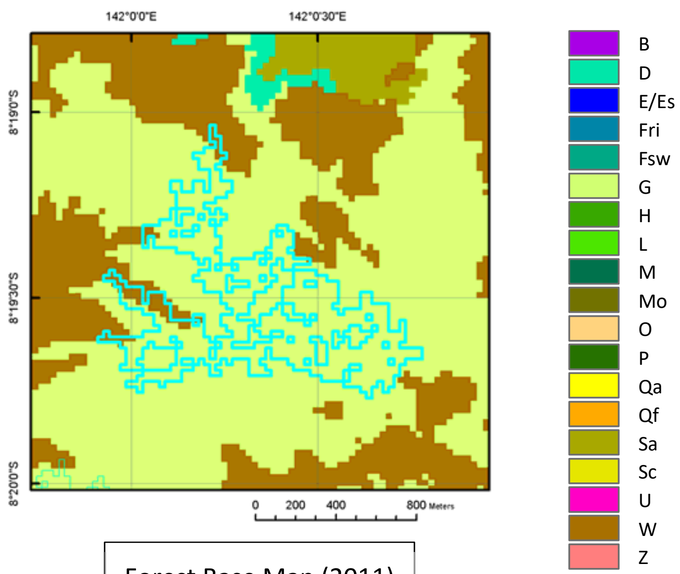
Flooding #1



LANDSAT (2015)



RapidEye (2011)



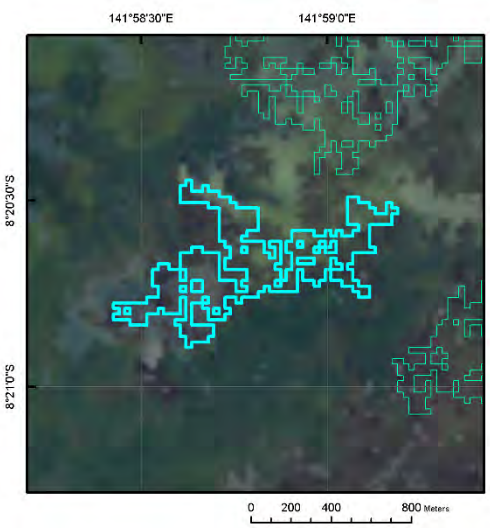
Forest Base Map (2011)

+Irregular shape of deforestation located at flat area.

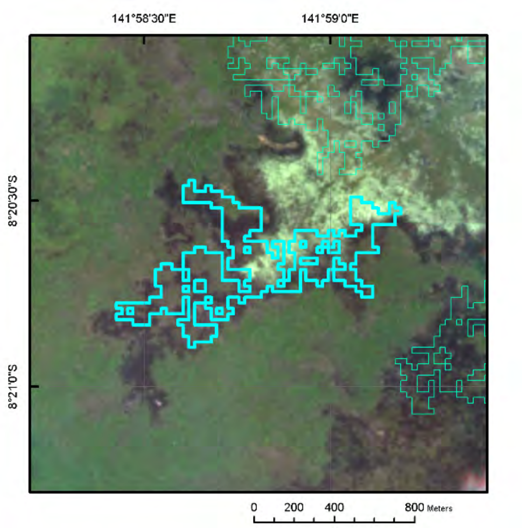
+Dark gray color may be found inside of the shape, indicating presence of water body.

+No or little human activity is found around the area.

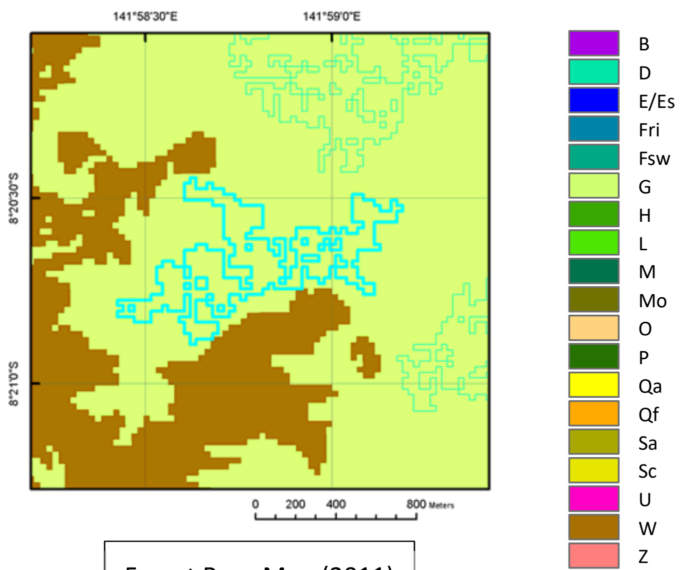
Flooding #2



LANDSAT (2015)



RapidEye (2011)



Forest Base Map (2011)

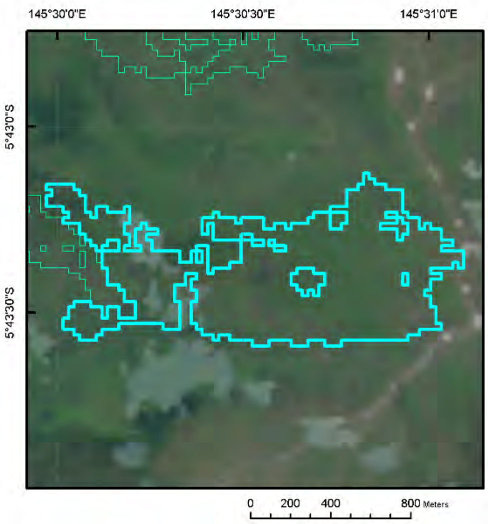
+Irregular shape of deforestation located at flat area.

+Dark gray color may be found inside of the shape, indicating presence of water body.

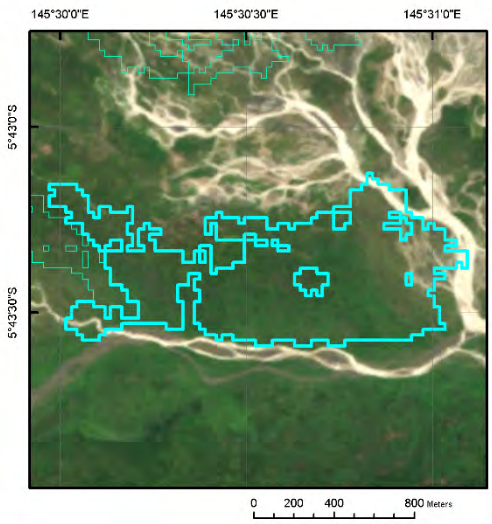
+No or little human activity is found around the area.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

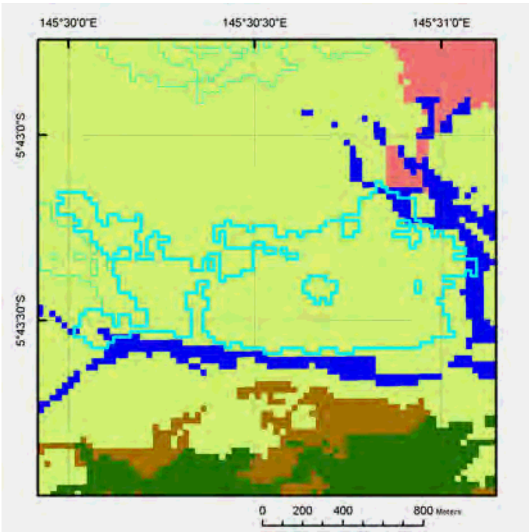
Flooding #3

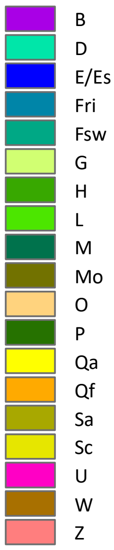


LANDSAT (2015)



RapidEye (2011)



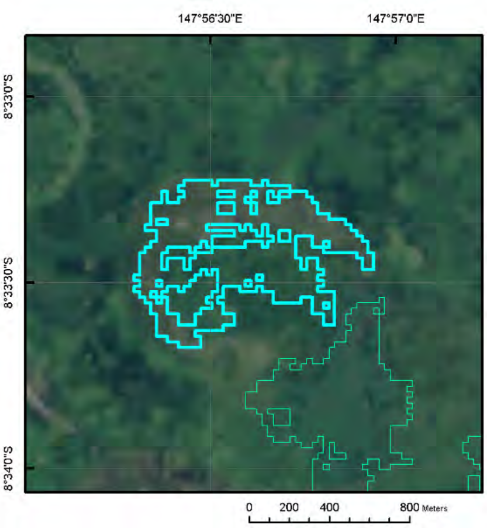


Forest Base Map (2011)

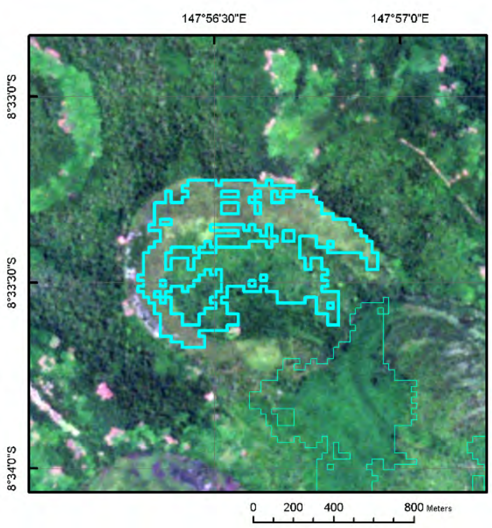
+Large deforested area along rivers.

+No or little human activity is found around the area.

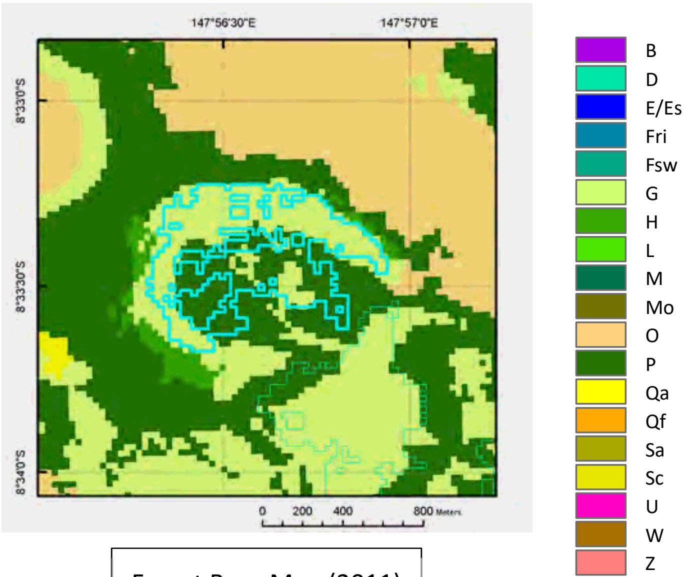
Flooding #4



LANDSAT (2015)



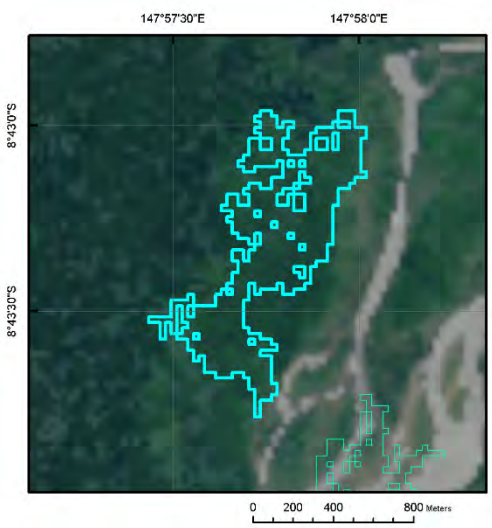
RapidEye (2011)



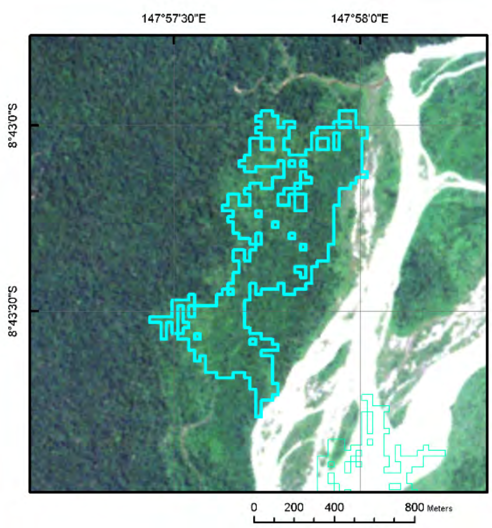
Forest Base Map (2011)

+Deforestation caused by formulation of oxbow lakes.

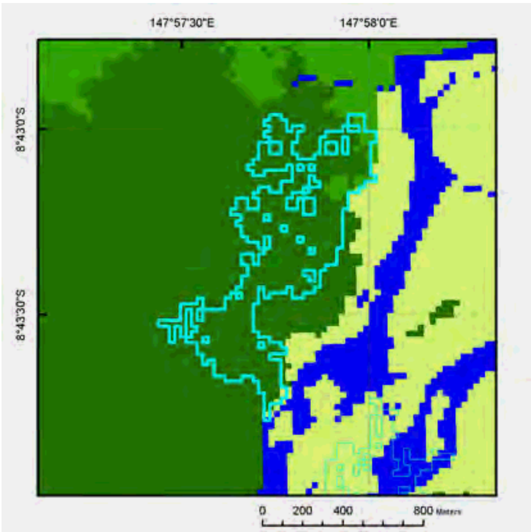
Flooding #5

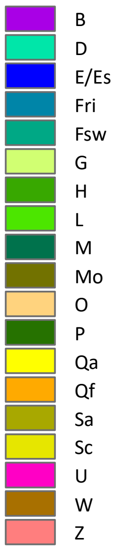


LANDSAT (2015)



RapidEye (2011)



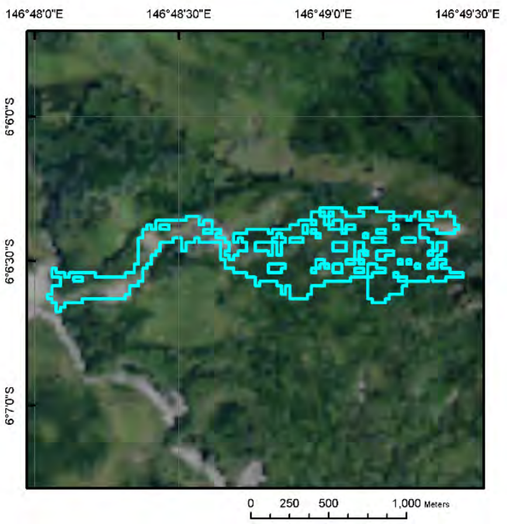


Forest Base Map (2011)

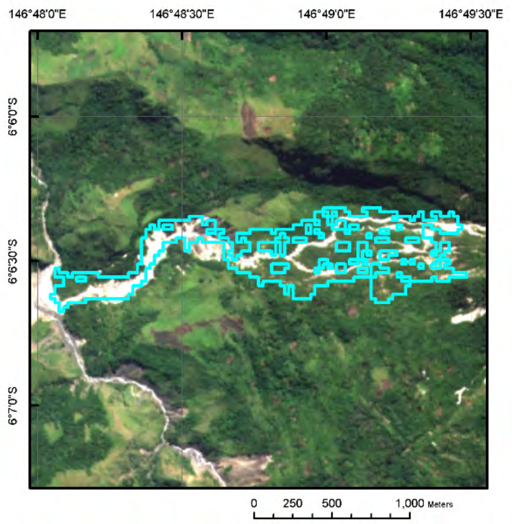
+Deforested area along rivers.

+No or little human activity is found around the area.

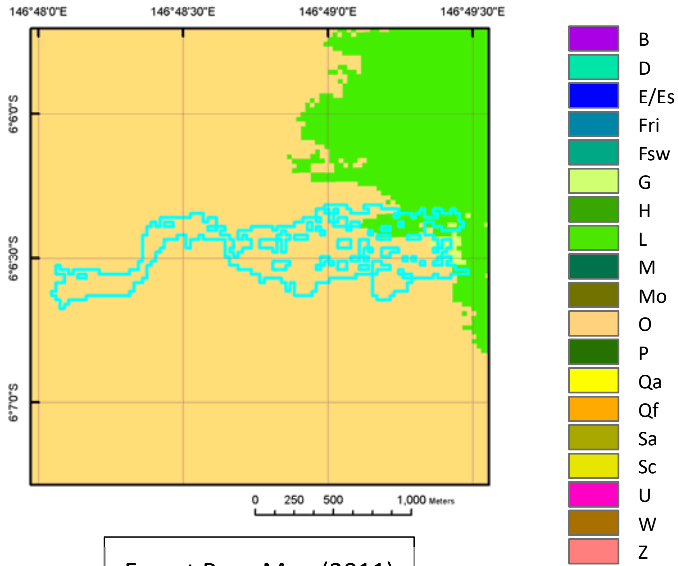
Landslide #1



LANDSAT (2015)



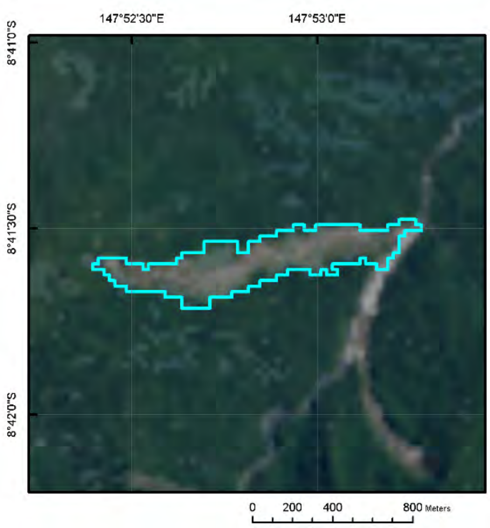
RapidEye (2011)



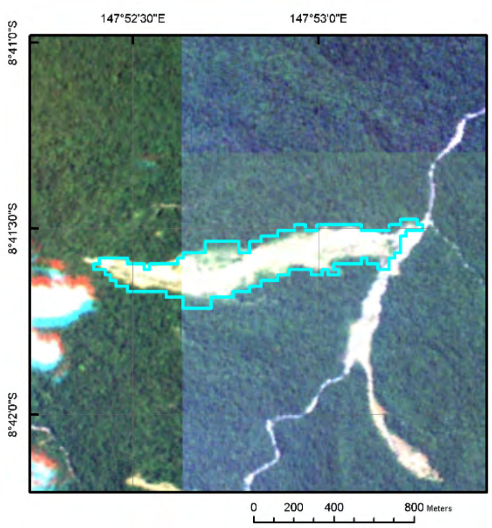
Forest Base Map (2011)

+Deforestation along river in hilly zone.

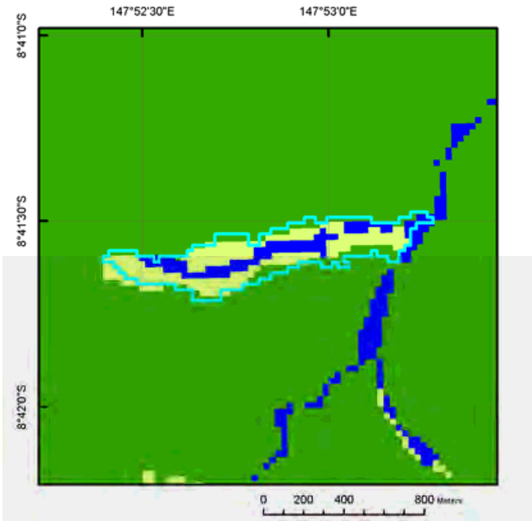
Landslide #2

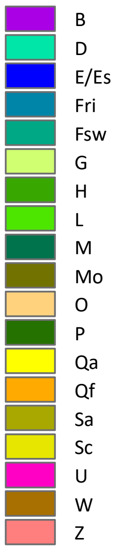


LANDSAT (2015)



RapidEye (2011)

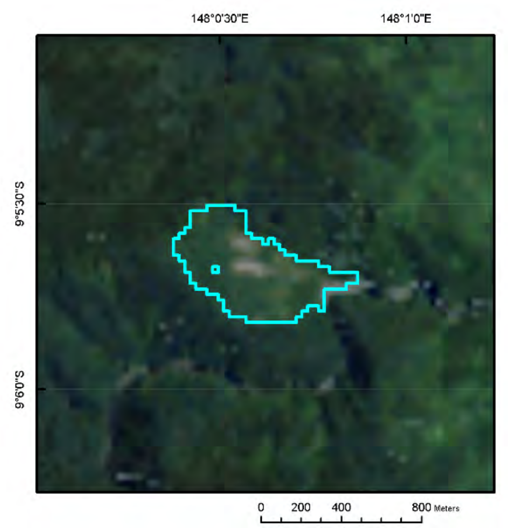




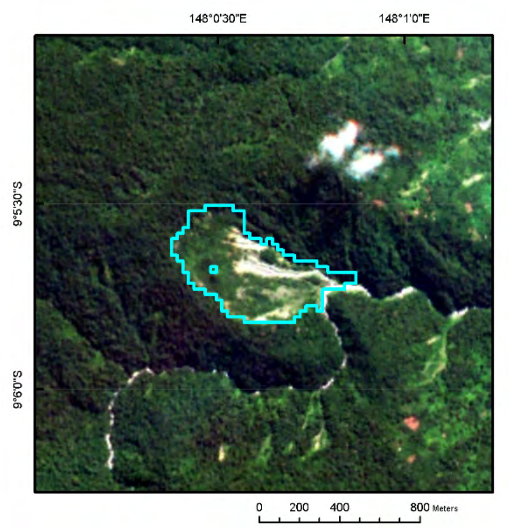
Forest Base Map (2011)

+Long and narrow deforested area extended from top or middle of a slope to the bottom of the valley.

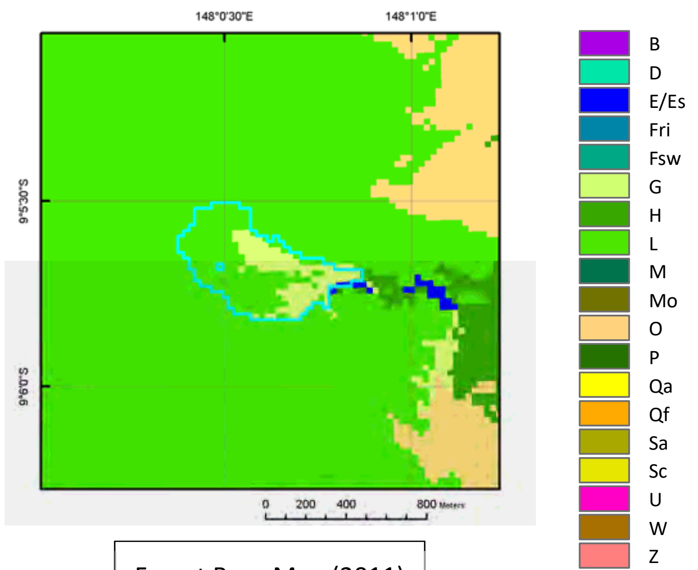
Landslide #3



LANDSAT (2015)



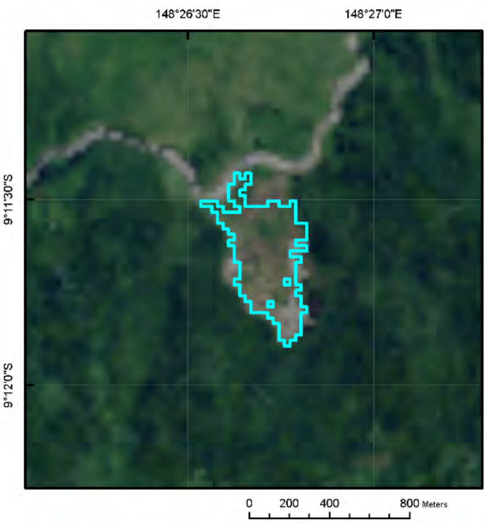
RapidEye (2011)



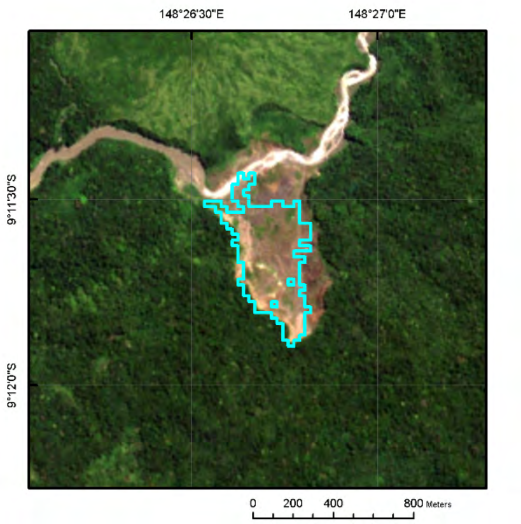
Forest Base Map (2011)

+Deforested area located on steep slope not caused by human activities.

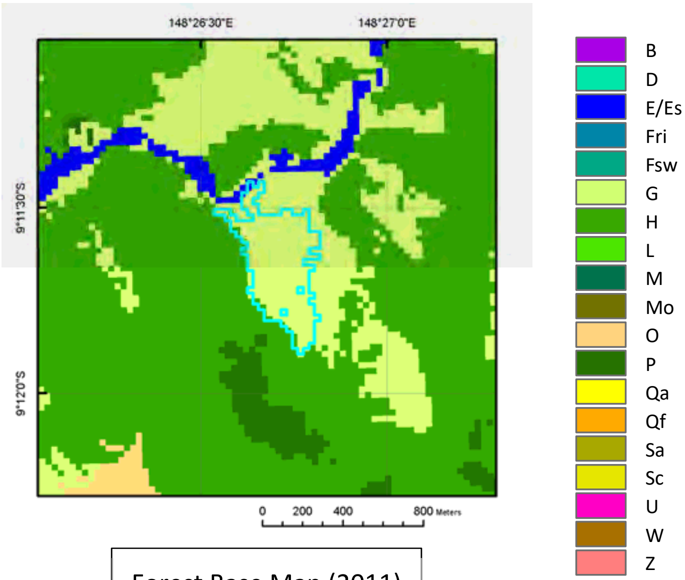
Landslide #4



LANDSAT (2015)



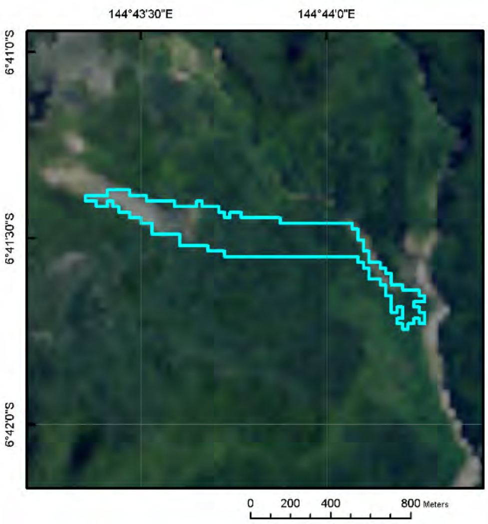
RapidEye (2011)



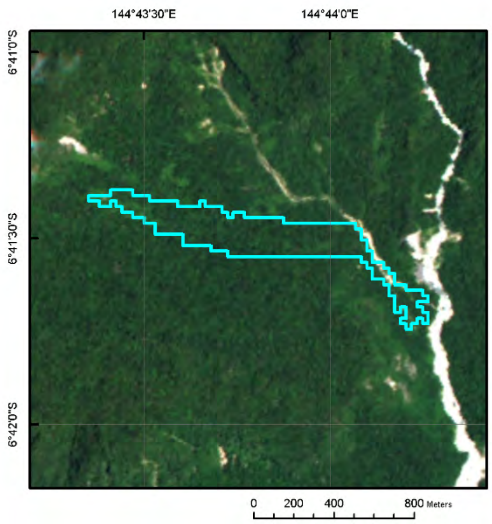
Forest Base Map (2011)

+Deforested area located on steep slope not caused by human activities.

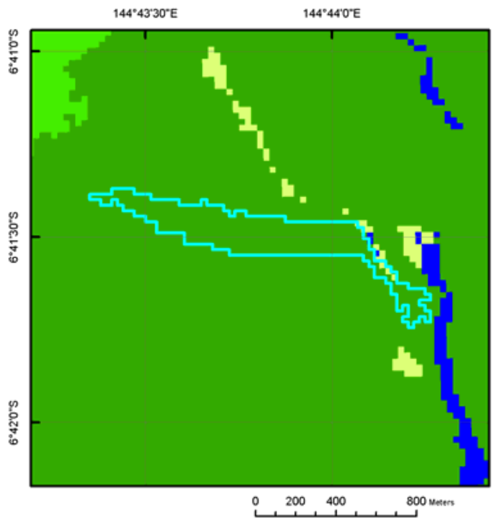
Landslide #5

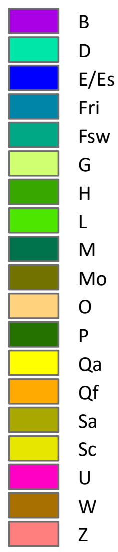


LANDSAT (2015)



RapidEye (2011)



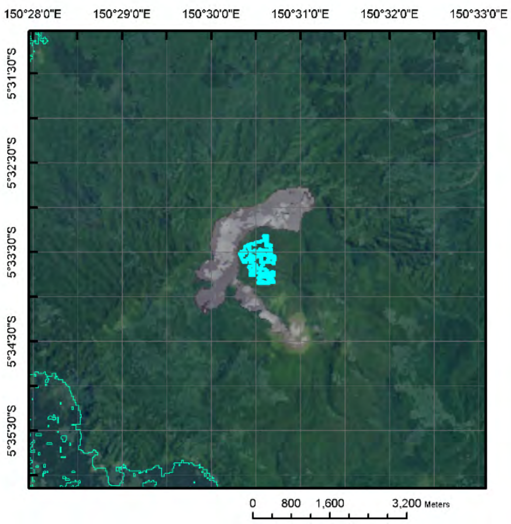


Forest Base Map (2011)

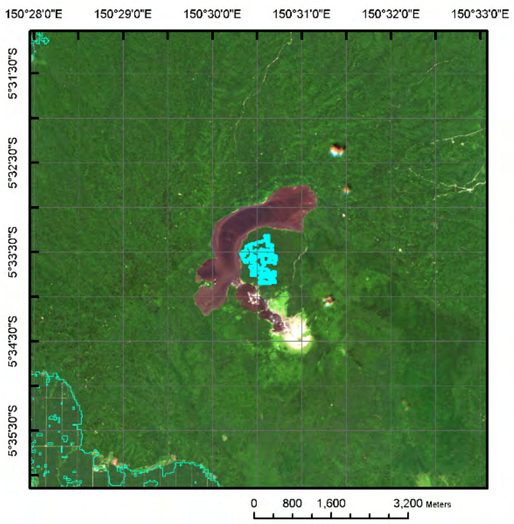
+Long and narrow deforested area extended from top or middle of a slope to the bottom of the valley.

Papua New Guinea Forest Resource Information Management System © PNGFA & JICA

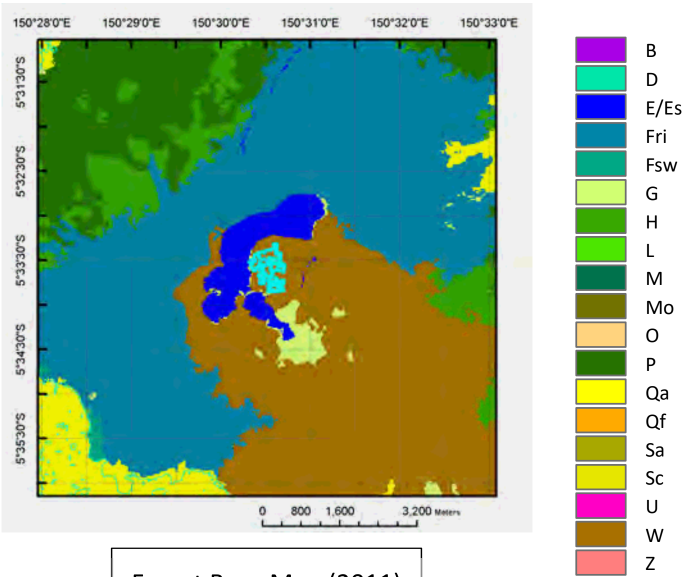
Volcano #1



LANDSAT (2015)



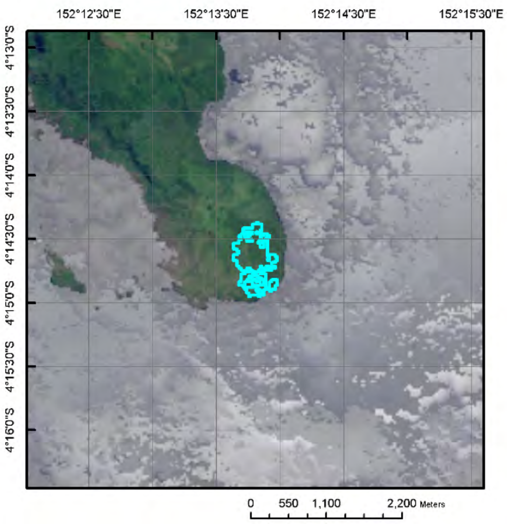
RapidEye (2011)



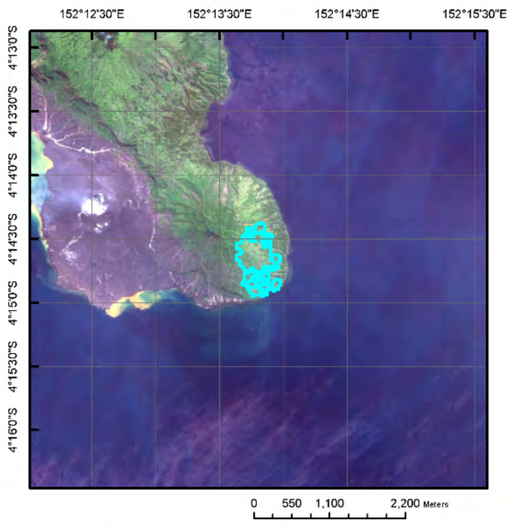
Forest Base Map (2011)

+Deforested area nearby a volcano. The year of deforestation and that of eruption must be compared to confirm whether the deforestation is caused by volcanic activities.

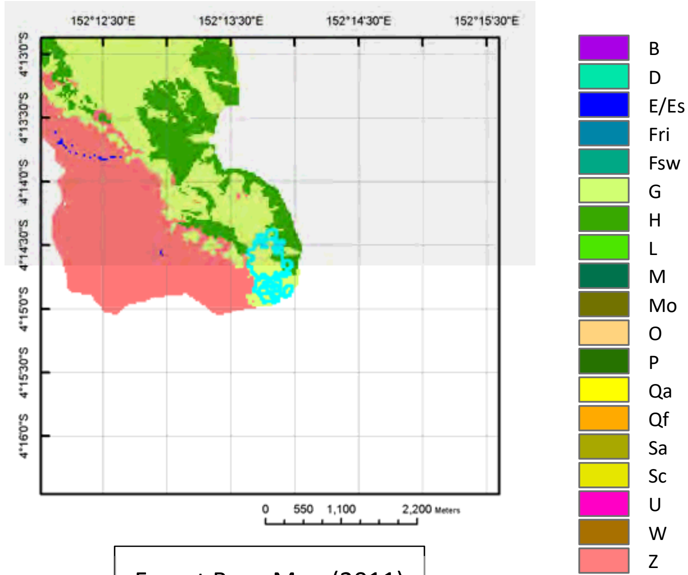
Volcano #2



LANDSAT (2015)



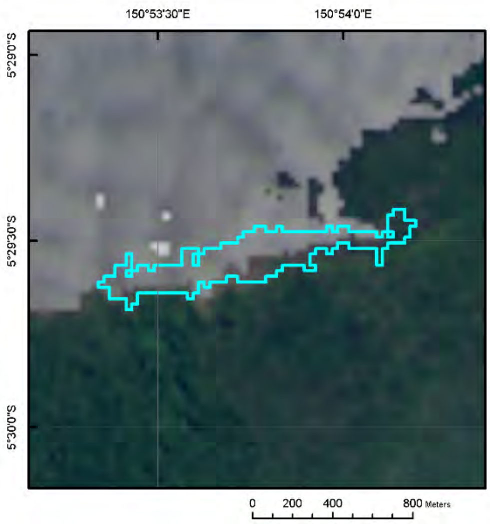
RapidEye (2011)



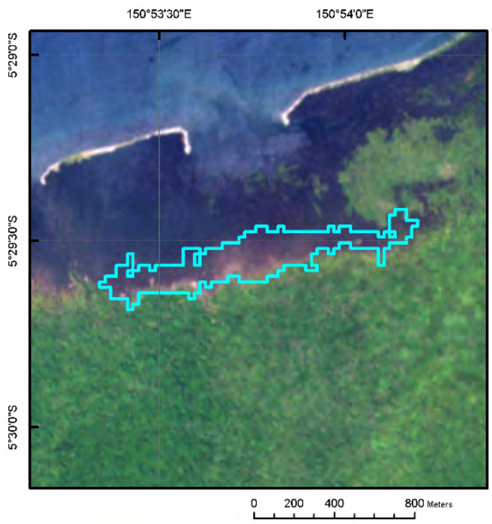
Forest Base Map (2011)

+Deforested area nearby a volcano. The year of deforestation and that of eruption must be compared to confirm whether the deforestation is caused by volcanic activities.

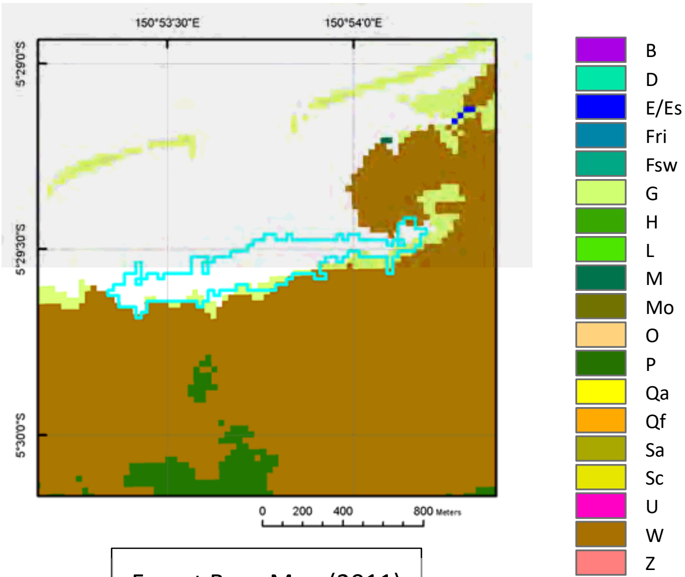
Submergence #1



LANDSAT (2015)



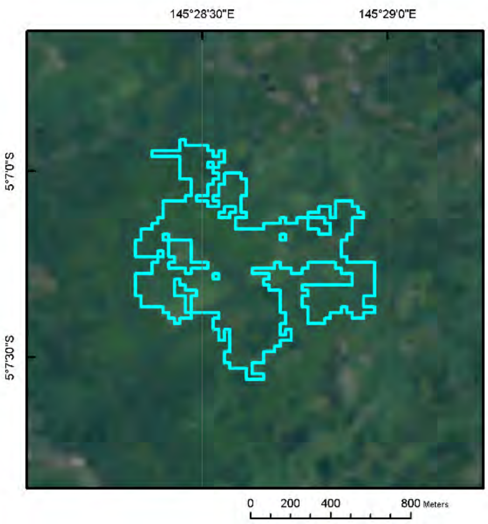
RapidEye (2011)



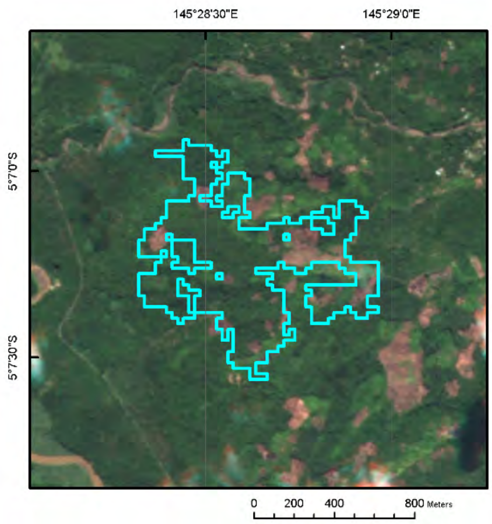
Forest Base Map (2011)

+Deforestation caused by disappearance of land along coast.

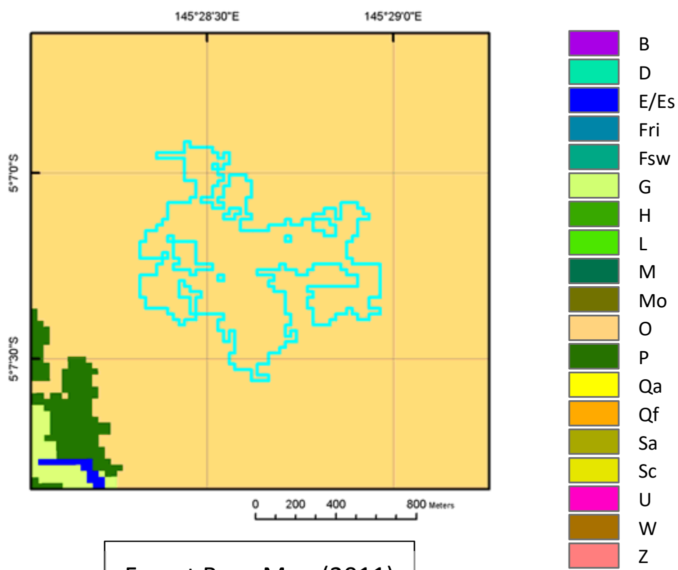
Agriculture #1



LANDSAT (2015)



RapidEye (2011)

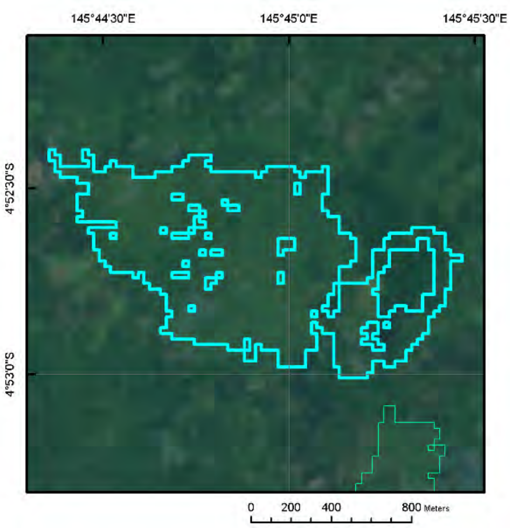


Forest Base Map (2011)

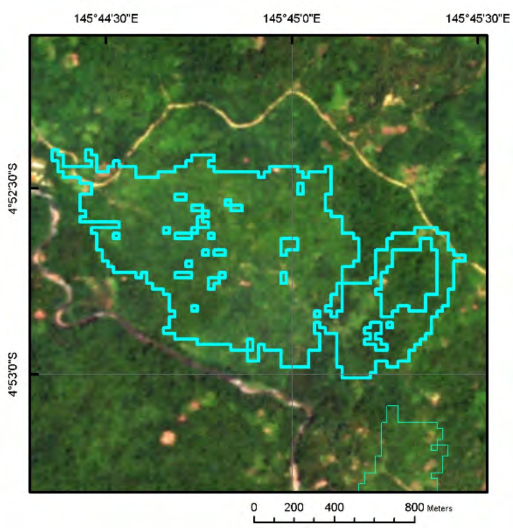
+Deforestation within agriculture boundary of the Forest Base Map.

+Brown spots are found sparsely inside of the deforested area.

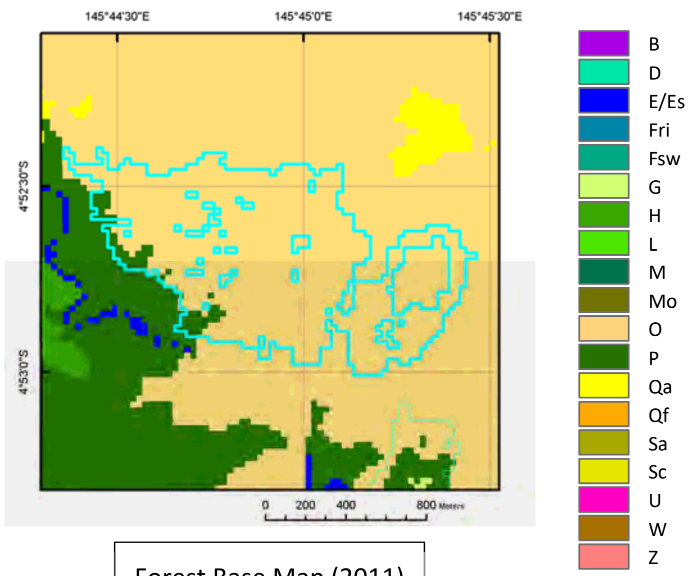
Agriculture #2



LANDSAT (2015)



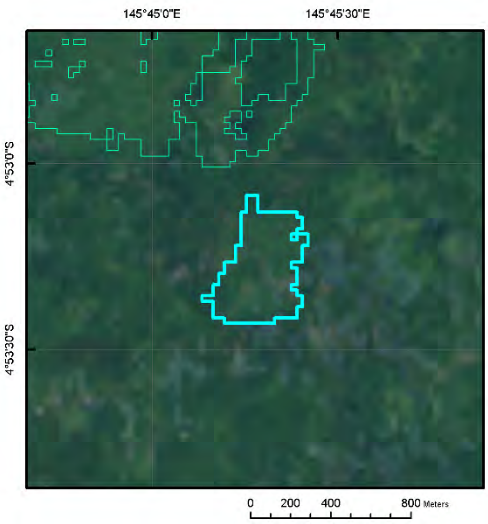
RapidEye (2011)



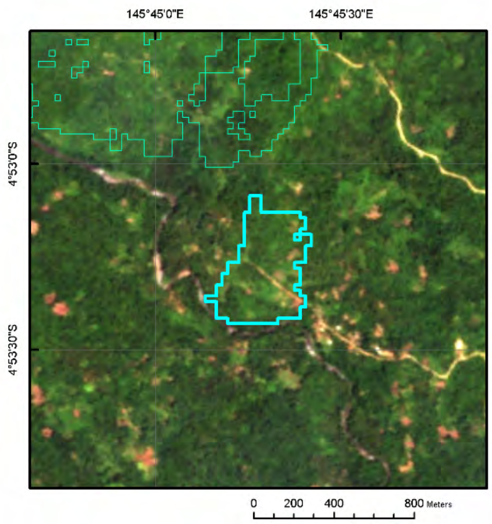
Forest Base Map (2011)

+Deforestation within agriculture boundary of the Forest Base Map.

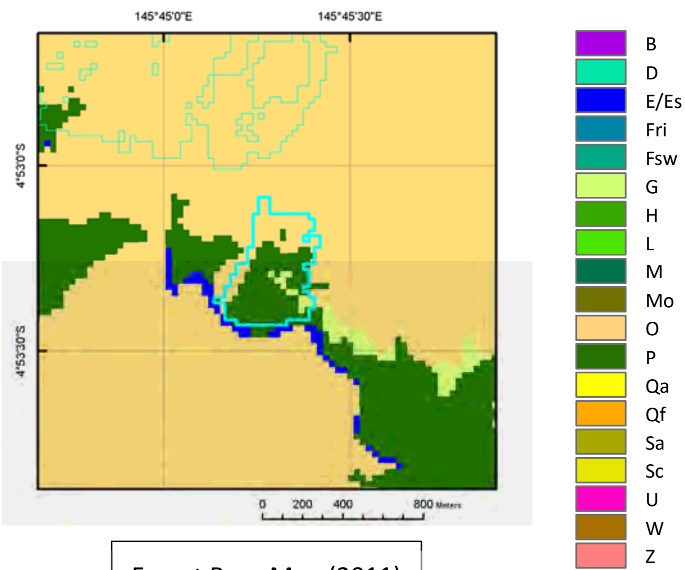
Agriculture #3



LANDSAT (2015)



RapidEye (2011)

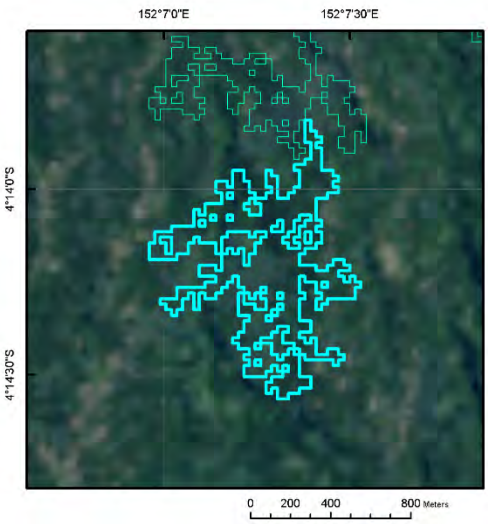


Forest Base Map (2011)

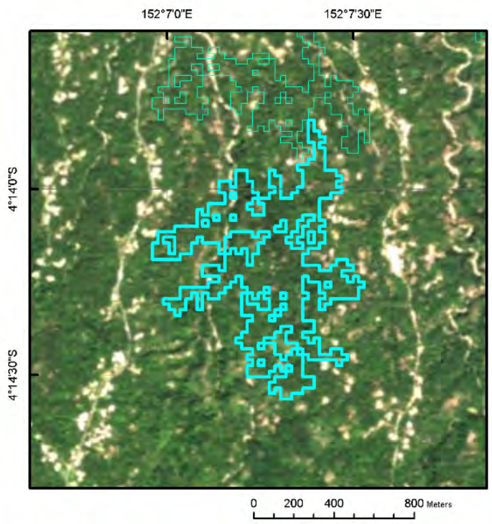
+Deforestation within or near agriculture boundary of the Forest Base Map.

+Brown spots are found sparsely inside of the deforested area.

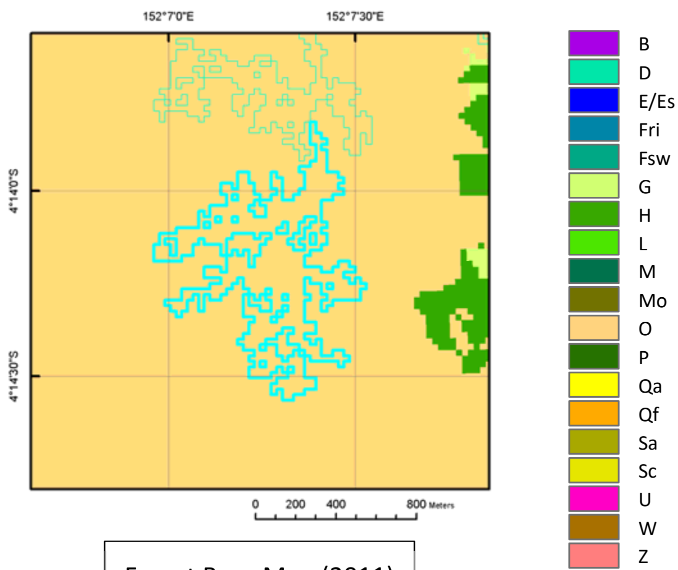
Agriculture #4



LANDSAT (2015)



RapidEye (2011)

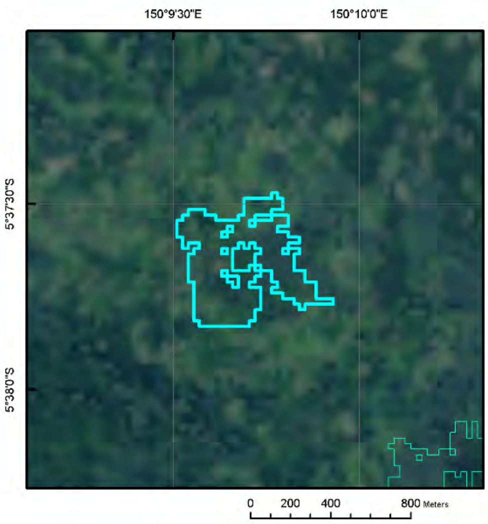


Forest Base Map (2011)

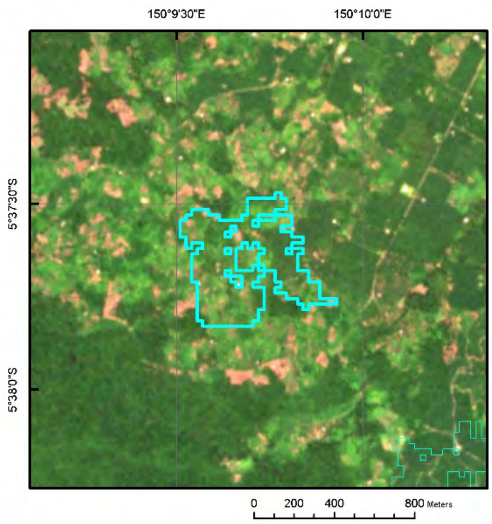
+Deforestation within agriculture boundary of the Forest Base Map.

+Brown spots are found sparsely inside of the deforested area.

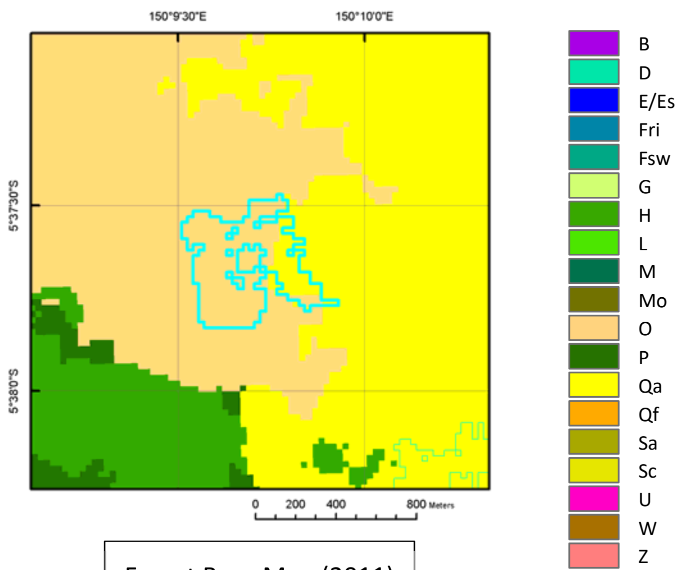
Agriculture #5



LANDSAT (2015)



RapidEye (2011)

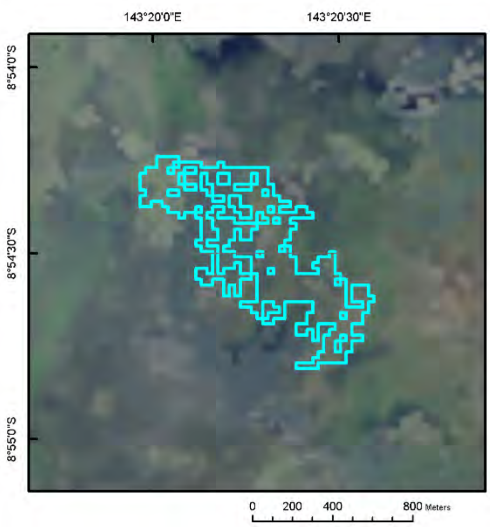


Forest Base Map (2011)

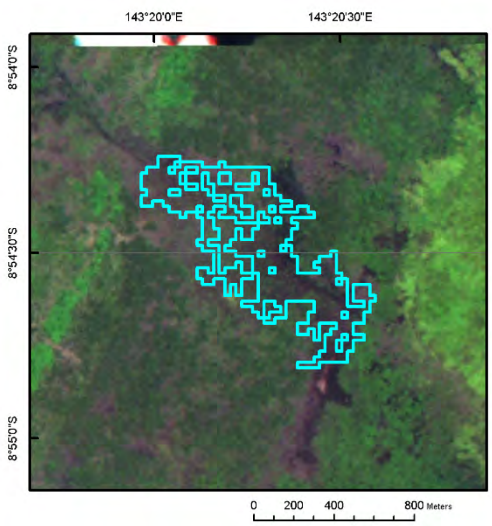
+Deforestation within or near agriculture boundary of the Forest Base Map.

+Brown spots are found sparsely inside of the deforested area.

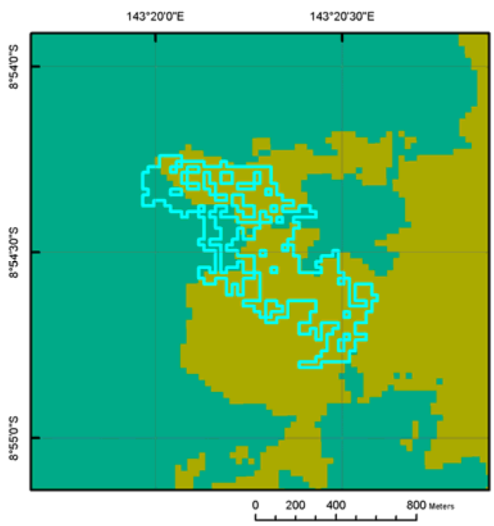
Fire #1

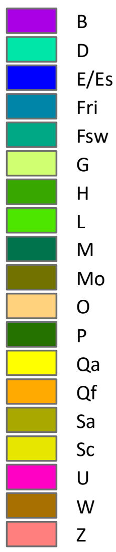


LANDSAT (2015)



RapidEye (2011)





Forest Base Map (2011)

+Irregular shape of deforestation.

+Point(s) of fire occurred in the same year as the deforestation must be found within 1 km from the deforested area referring FireWatch PNG website[2].

[2] http://fire.pngsdf.com/home.php

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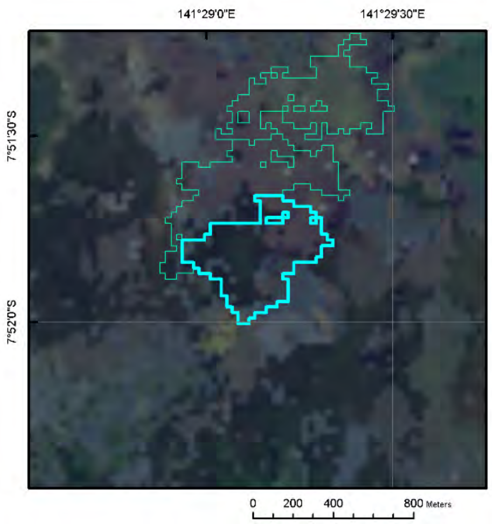
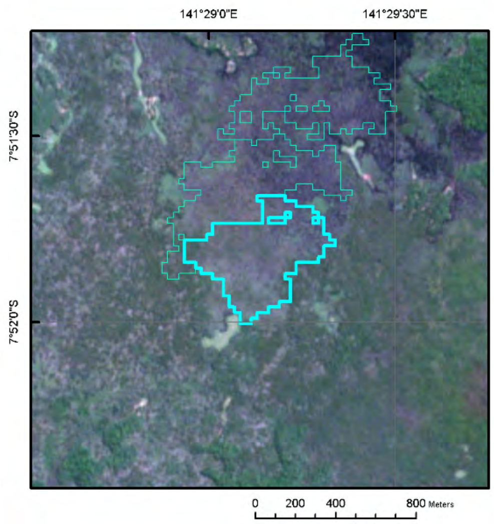
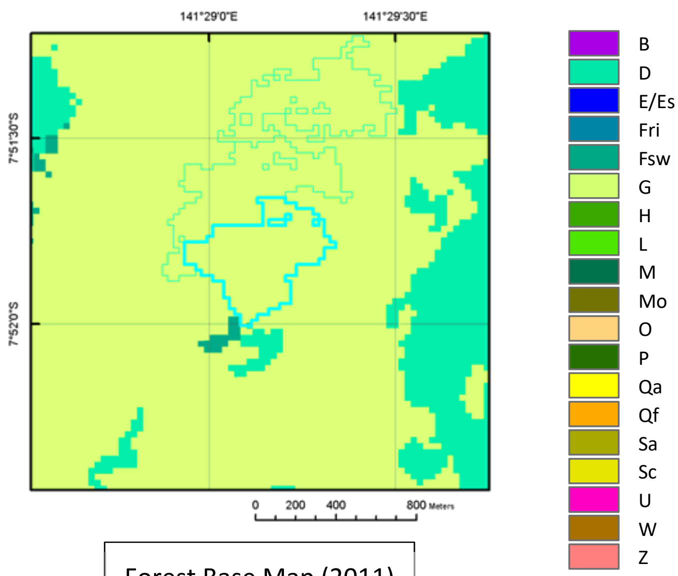
Fire #2



LANDSAT (2015)



RapidEye (2011)

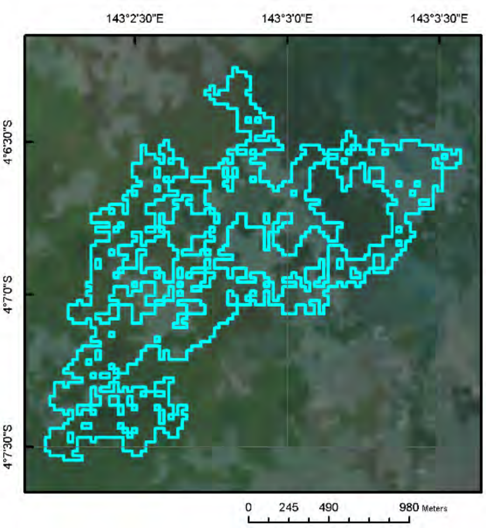


Forest Base Map (2011)

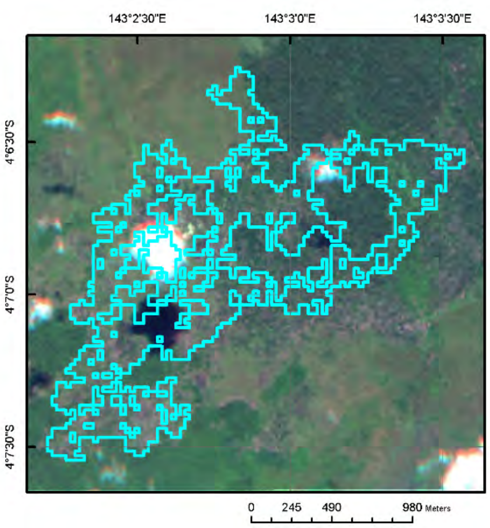
+Irregular shape of deforestation.

+Point(s) of fire occurred in the same year as the deforestation must be found within 1 km from the deforested area referring FireWatch PNG website.

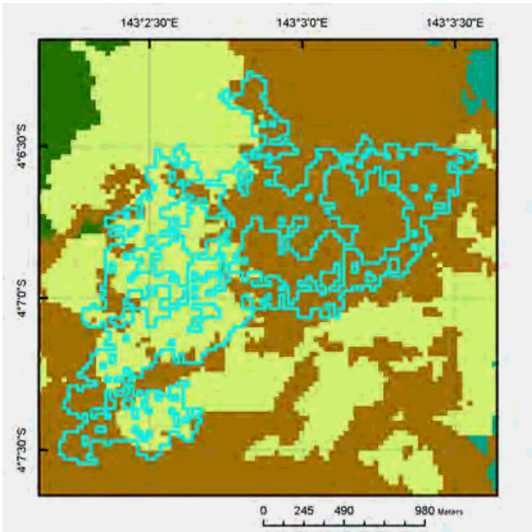
Fire #3

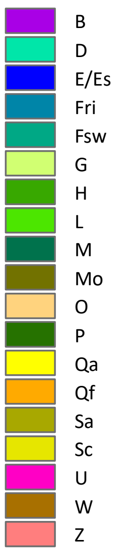


LANDSAT (2015)



RapidEye (2011)





Forest Base Map (2011)

+Irregular shape of deforestation.

+Point(s) of fire occurred in the same year as the deforestation must be found within 1 km from the deforested area referring FireWatch PNG website.

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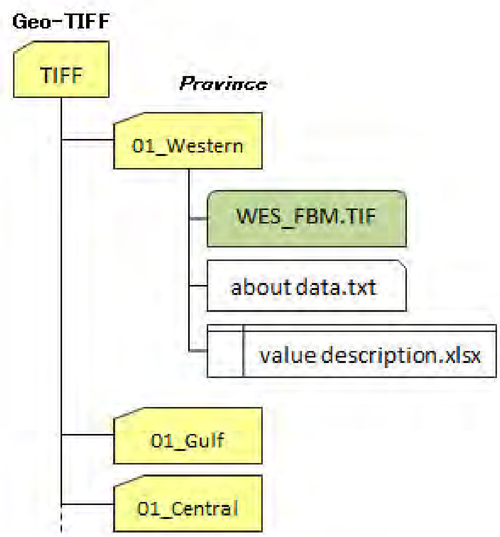
M. Procedure to create raster data (Geo-TIFF) with colormap file

Procedure to create raster data (Geo-TIFF with colormap file

The Forest Cover Maps were developed in file geodatabase format, which is powerful ArcGIS file format, and has no limitation in data size and can contain lots of attributes. However, it takes time to preview the Forest Cover Maps on ArcGIS since the size of them is very large. Therefore, it is better to prepare the Forest Cover Maps in raster format as well. The Forest Cover Maps in raster format are useful to be previewed and provided.



Here, procedure to create raster data (Geo-TIFF) of the Forest Base Map with color map file is shown. Additionally, you should prepare metadata file (information of the data) in the database as well.

Procedure

1. Open ArcMap
2. Add the Forest Base Map in file geodatabase on the Map document, and then change its symbol by importing the layer file (*.lyr) to show the Forest Base Map in appropriate colour.

   Layer file: ForestBaseMap_ver1.1_code.lyr

   If you do not have the layer file set Forest Base Map colour, you need to prepare a layer file by yourself.

   The Forest Base Map attribute table does not have numeric field indicating landuse. Numeric field should be needed to create a colormap file (.clr) for raster data.

3. Add the numeric field indicating landuse to the Forest Base Map layer's attribute table.

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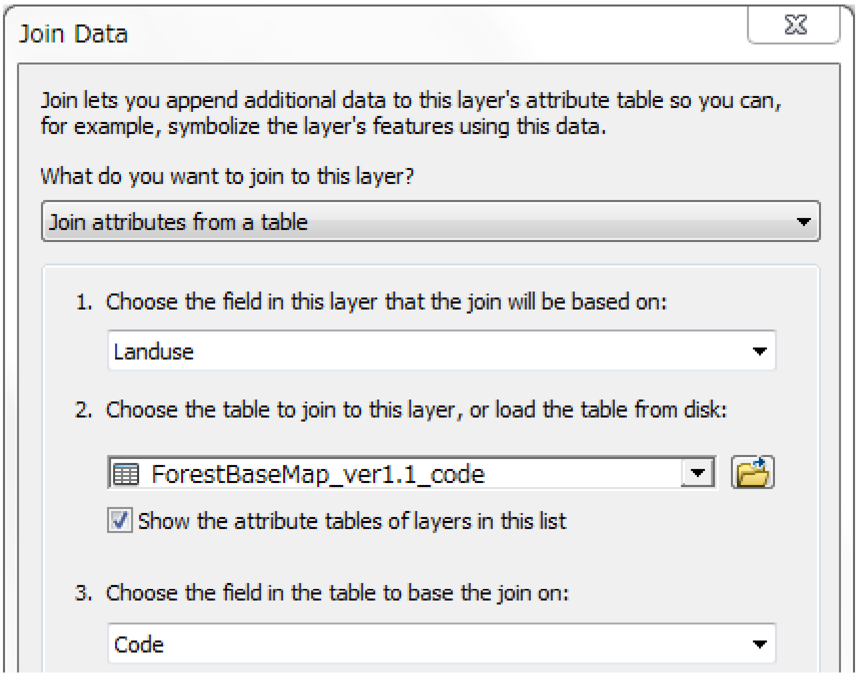
3-1. Add the table defined numeric values of landuse codes.

Table: ForestBaseMap_ver1.1_code.dbf

ForestBaseMap_ver1.1_code

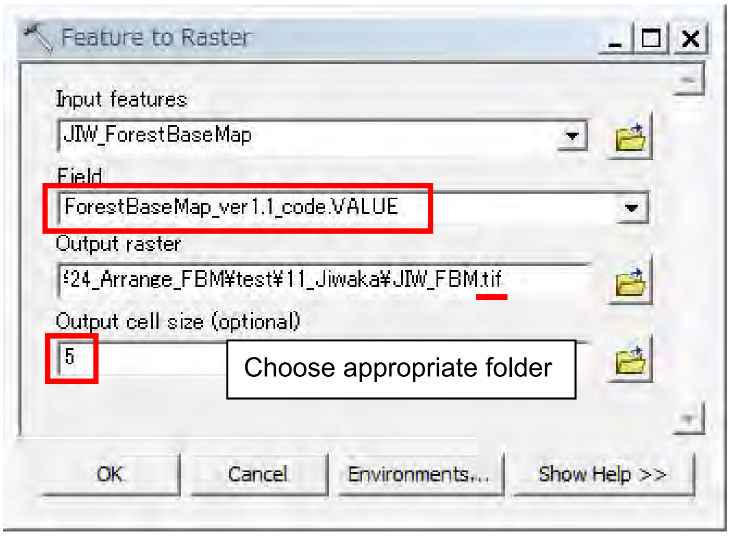
OID	VALUE	Code
0	1	P
1	2	H
2	3	L
3	4	Mo
4	5	B
5	6	D
6	7	Fri
7	8	Fsw
8	9	M
9	10	W
10	11	Sa
11	12	Sc
12	13	G
13	14	Ga
14	15	Gi
15	16	O
16	17	Qa
17	18	Qf
18	19	Z
19	20	U
20	21	E
21	22	Es

3-2. Join the table above to the Forest Base Map layer's attribute table by right-clicking on the Forest Base Map layer, chose [Join and Relates] > [Join...], set the file and the key fields in the Join Data dialog, and then click OK.



4. Convert the Forest Base Map to a raster file by “VALUE” field using Feature to Raster tool.

Tool: Conversion tools > To Raster > Feature to Raster

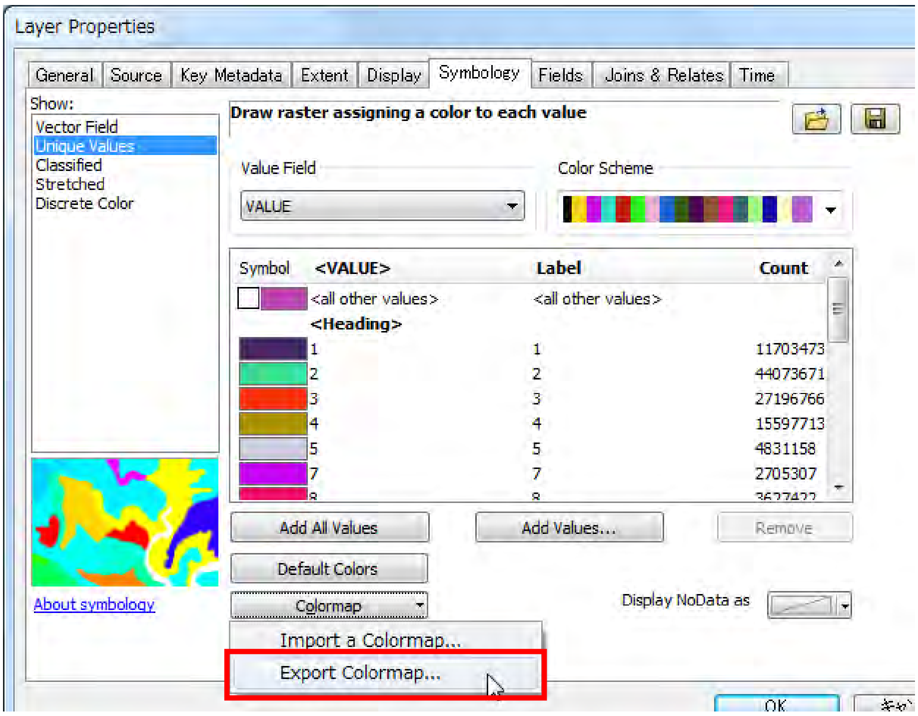


(When you export GRID file, the length of the GRID file name should be within 13 characters.)

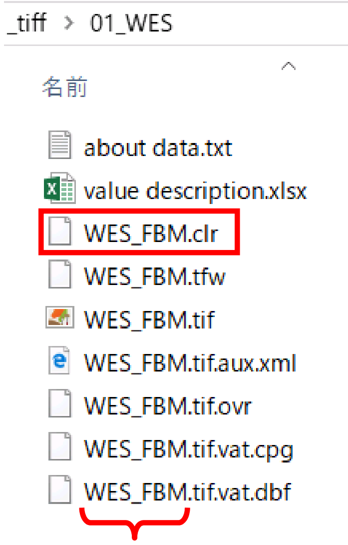
5. Add the created TIFF file on the Map document if it is not added.

6. Change the symbol to show the TIFF file in appropriate colour. If you already have the colormap file (*.clr) for the Forest Base Map, just import the colormap.

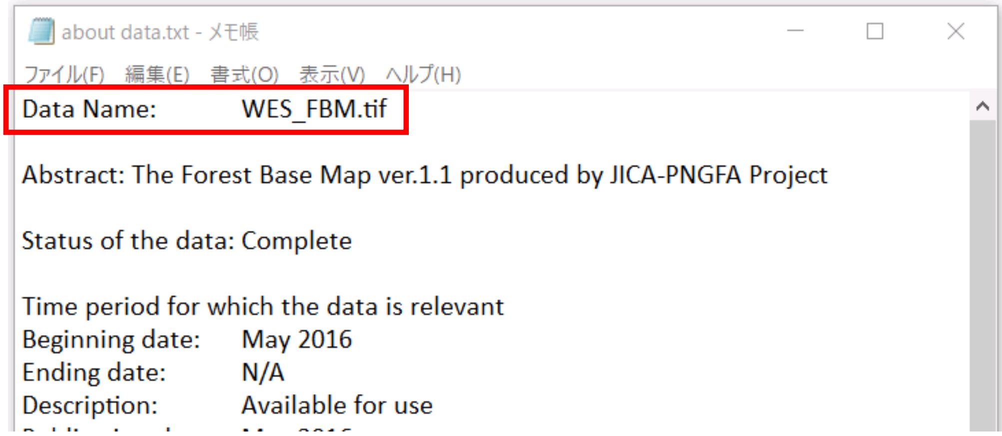
Colormap file: ForestBaseMap_ver1.1_code.clr

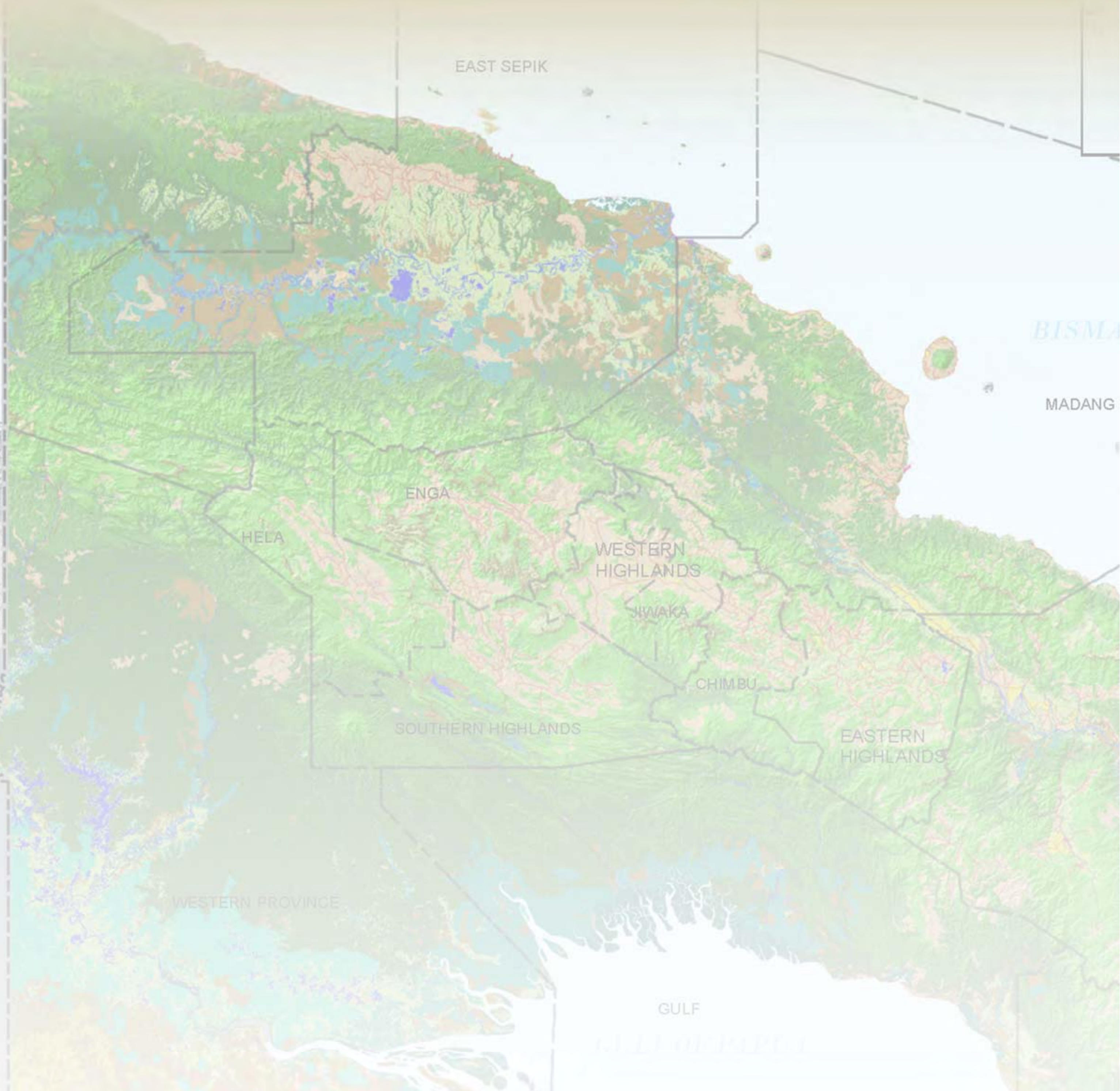


7. Export the Colormap file with the same name as the TIFF file in the folder which the TIFF file has been exported. Or, if you already have the colormap file for the Forest Base Map, you can just copy the colormap file into the folder and rename the colormap file to the same name as the TIFF file.



8. Add “about data.txt” file and “value description.xlsx” file in the folder, and write over Data Name in “about data.txt” file.





The manual documents the outcomes of a joint collaboration between PNGFA and JICA to describe the methods, procedures, workflows, guides, and processes of developing and updating the PNG Forest Base Map.

The PNG Forest Base Map indicates basis of forest cover map in PNG, which was developed in 2012 and revised in 2015, and called the "Forest Base Map". Past forest cover maps in 2000 and 2005 were created for two pilot Project provinces, West New Britain and West Sepik, based on the Forest Base Map. In addition, forest cover map in 2015 was created based on the Forest Base Map for entire PNG. The manual is subject to further update of forest cover maps according to forest cover changes in PNG every five years by PNGFA.




添付資料3

PNG-FRIMS 運用マニュアル

PNG-FRIMS インストールマニュアル

FIMS ユーザーガイド

FIPS ユーザーガイド

PNGFA イントラネット LAN Map 簡易マニュアル

PNG Forest Resource Information Management System (PNG-FRIMS)

Operation Manual

July 2019

Papua New Guinea Forest Authority (PNGFA)

Japan International Cooperation Agency (JICA)

PNG-FRIMS Installation Manual

July 2019

Papua New Guinea Forest Authority (PNGFA)

Japan International Cooperation Agency (JICA)

PNG-FRIMS

Installation Manual

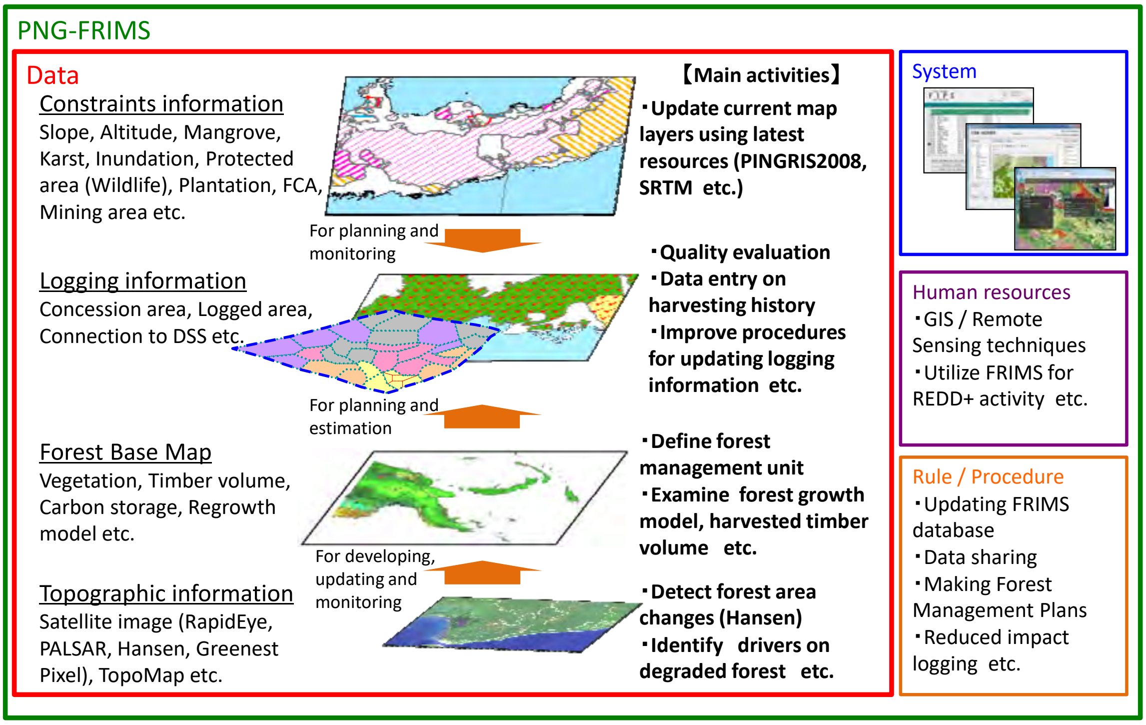
PNGFA

JICA

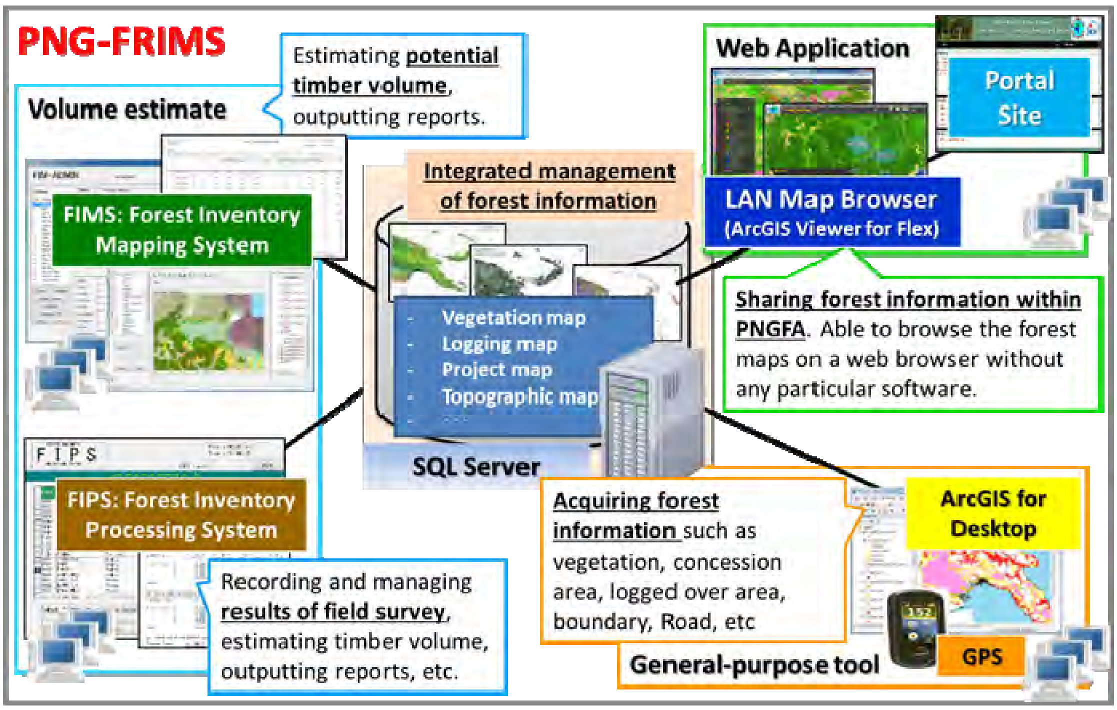
Contents

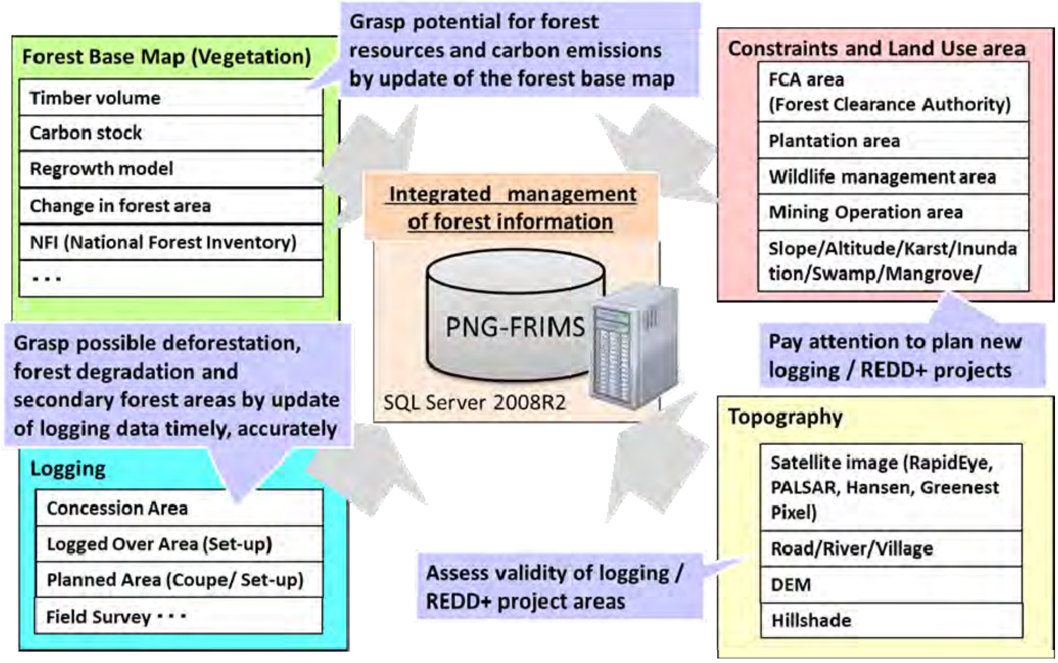
0 Introduction

0-1 Overview of the PNG-FRIMS Concept



0-2 Basic Design Applications of PNG-FRIMS





0-3 Flow of Environment Construction

1. ArcGIS License Manager 10.2.2 Installation

↓

2. ArcGIS for DesktopMap 10.2.2 Installation

↓

3. ArcGIS for Server10.2.2 Installation

↓

4. SQL Server2008R2 Installtion

↓

5. FIMS Installtion

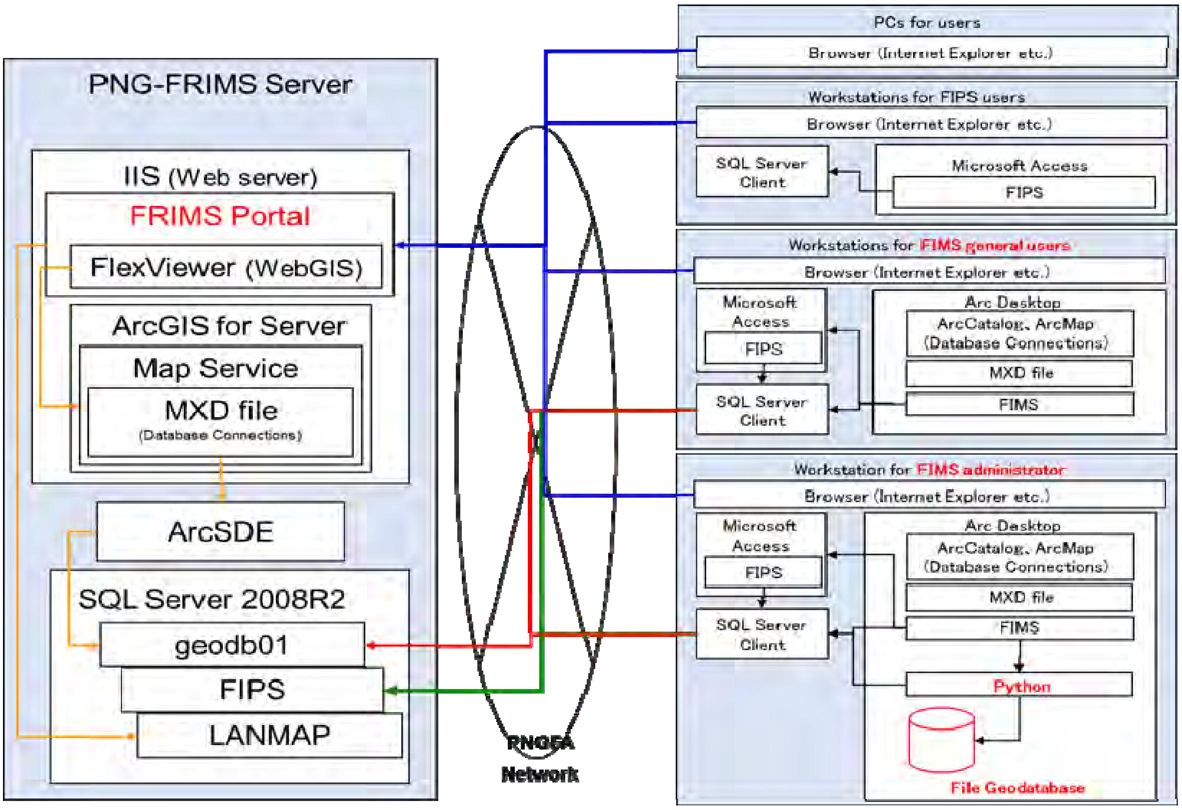
↓

6. FIPS Installtion

↓

7. LAN Map Browser Installtion

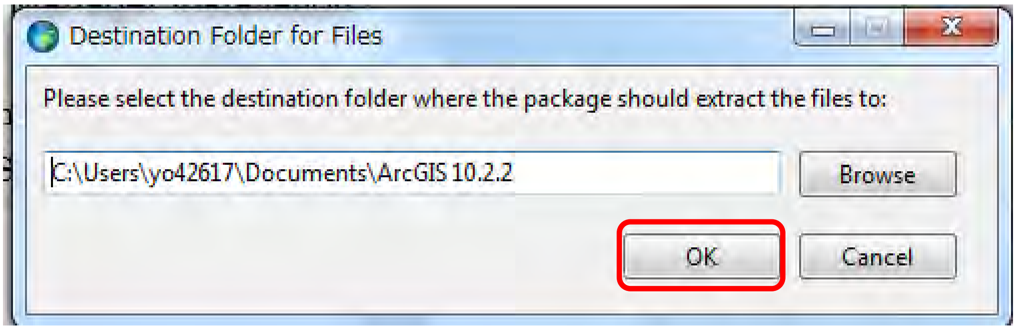
0-4 PNG-FRIMS system structure

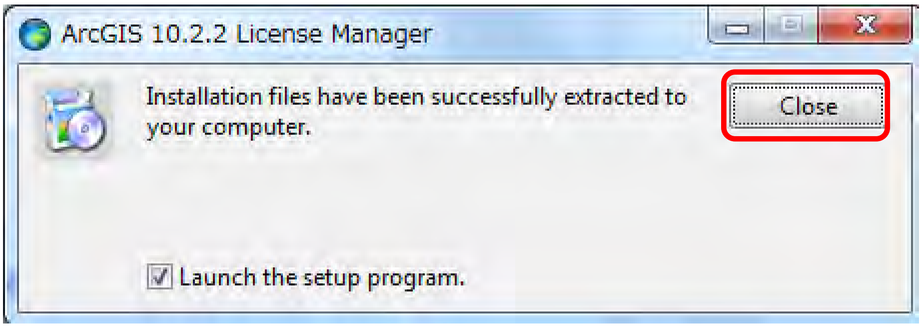


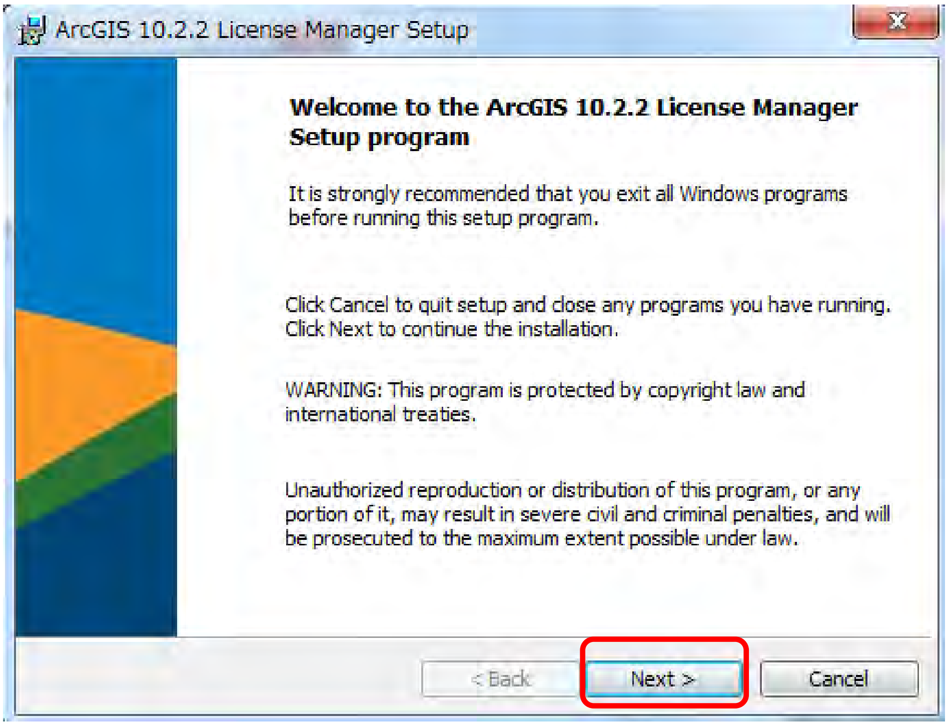
1 License Manager Installation

Step1: Log in as a user with administrative privileges. Close all applications on your computer. Run the ArcGIS License Manager setup.exe installation program.

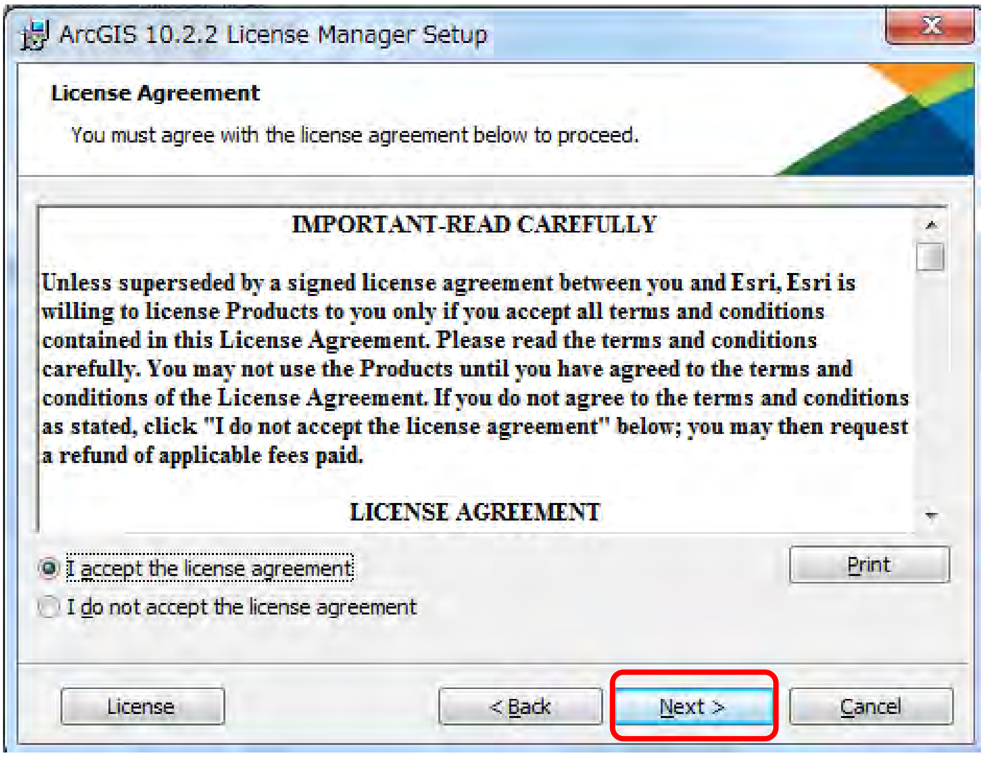
ArcGIS_License_Manager_Windows_1022_140454.exe



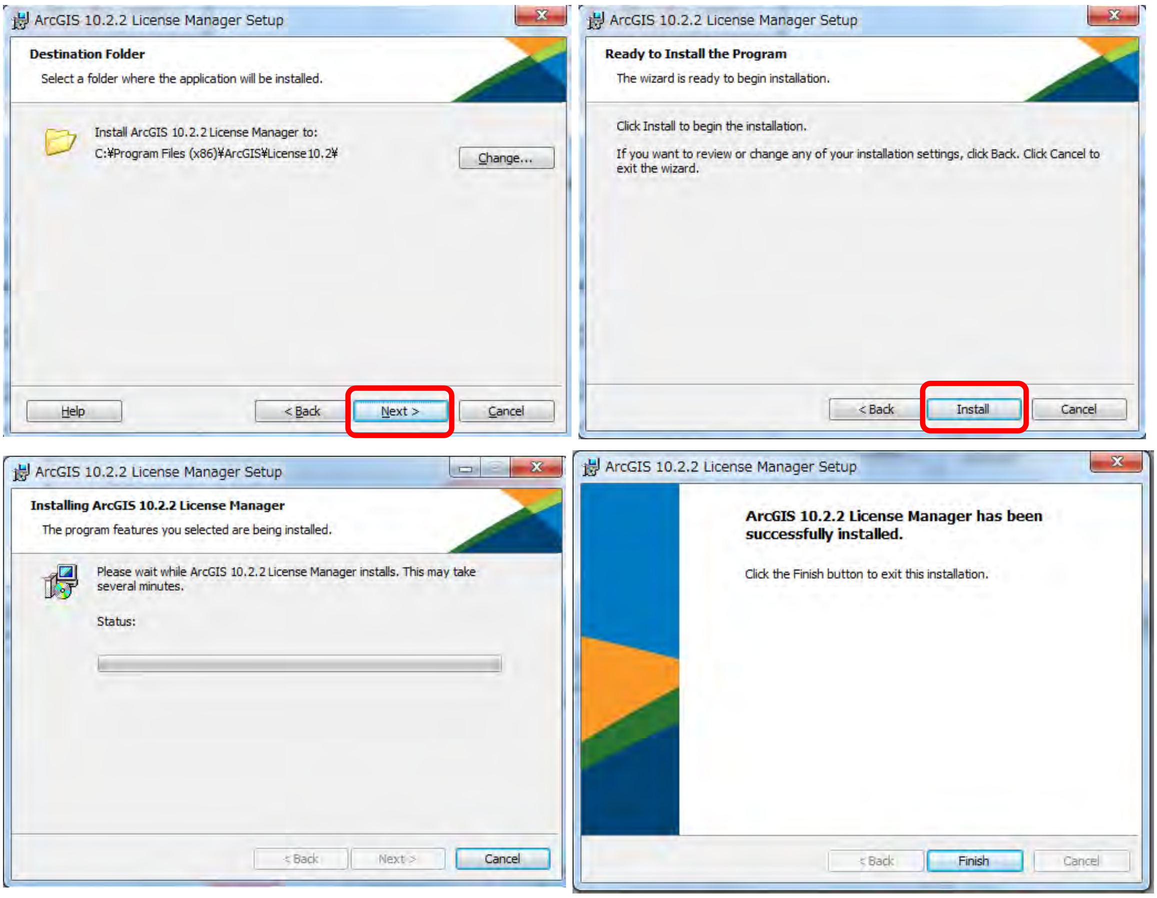




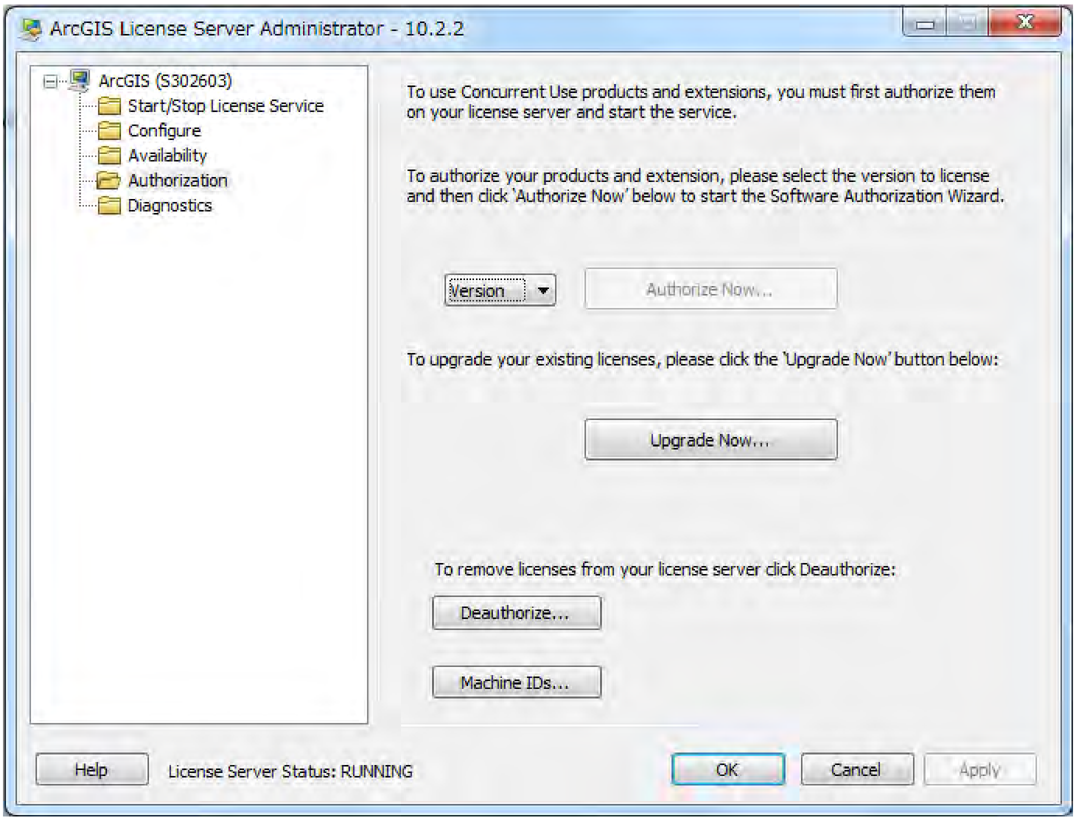
Step2: Check "I accept the licence agreement", and click on "Next".



Step3: You can use the default destination folder, Click on “Install”.



Step4: At the end of the installation, ArcGIS License Server Administrator appears.



Step5A: If the workstation hosting license manager have access to the internet,

Step5: In case of Authorizing licenses offline (for PNGFA case)

Prepare the “License Confirmation”.

Esri製品 ライセンスコンファメーション

発行：2015年2月24日

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本通知は以下記載のライセンスの「保守内容証明書」となりますので大切に保管してください。

No.	ライセンス名	Ver	ライセンス数	認証番号	保守期日
1	ArcGIS for Server Enterprise Standard	10.2.2	1	ECP500266604	2015/3/31
2	ArcGIS for Desktop Basic CU	10.2.2	2	EFL065302098	2015/3/31
3	ArcGIS for Desktop Standard CU	10.2.2	2	EFL830861134	2015/3/31
4	ArcGIS for Desktop Advanced CU	10.2.2	2	EFL410508988	2015/3/31
5	ArcGIS Spatial Analyst for Desktop CU	10.2.2	4	EFL677378864	2015/3/31
6	ArcGIS 3D Analyst for Desktop CU	10.2.2	4	EFL772532392	2015/3/31
7					
8					
9					
10					
11					
12					

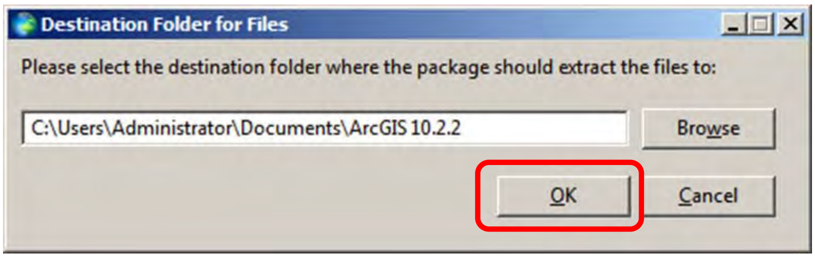
http://resources.arcgis.com/en/help/install-guides/license-manager/10.2/#/na/007900000005000000/

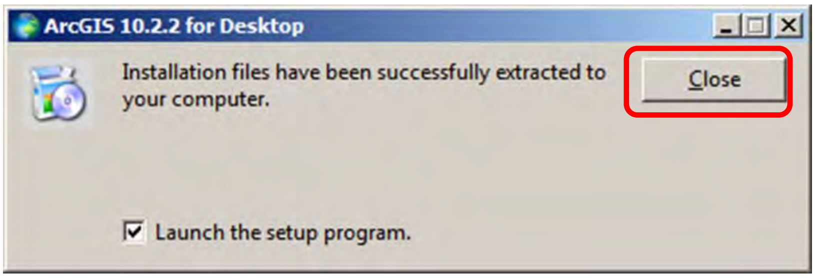
http://resources.arcgis.com/en/help/install-guides/arcgis-desktop/10.2/#/Installing_the_license_manager/00870000000q000000/

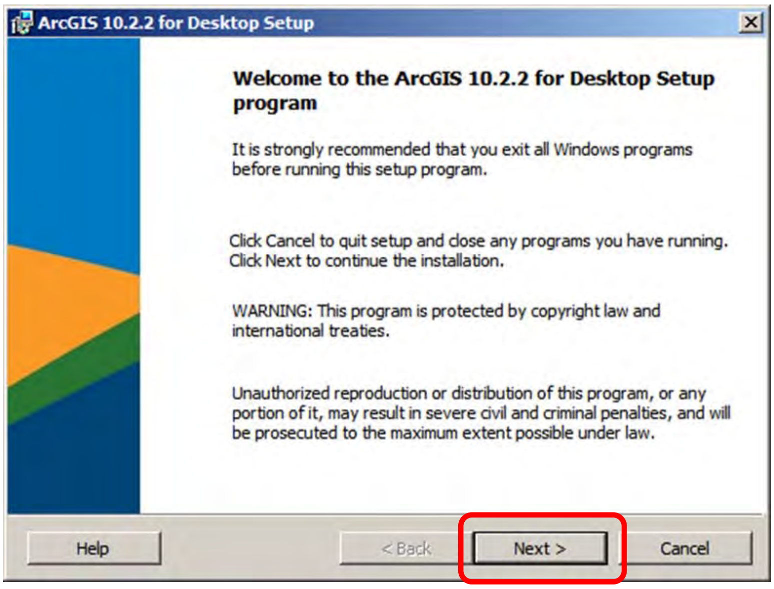
2 Installing ArcGIS for Desktop

Step1: Run the ArcGIS for Desktop setup.exe installation program.

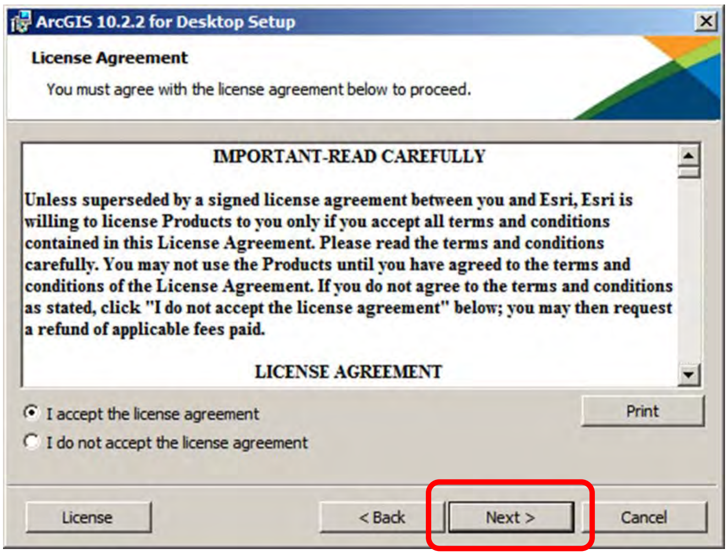
“ArcGIS_Desktop_1022_140415.exe”

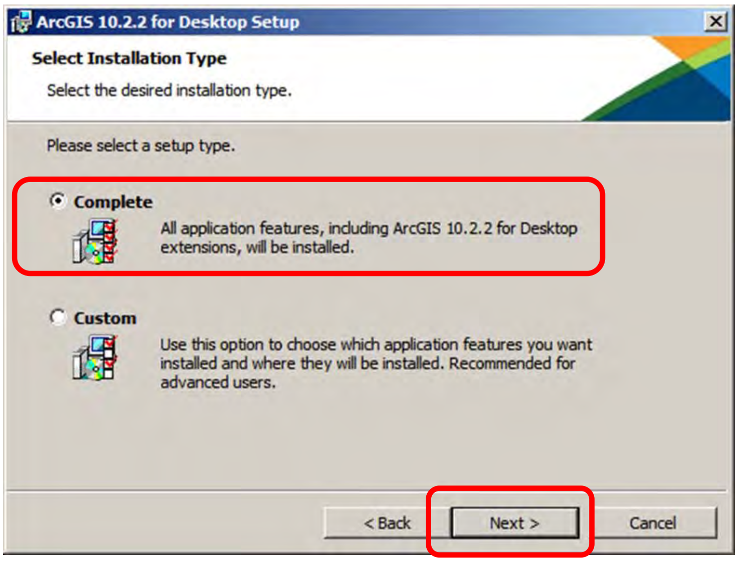




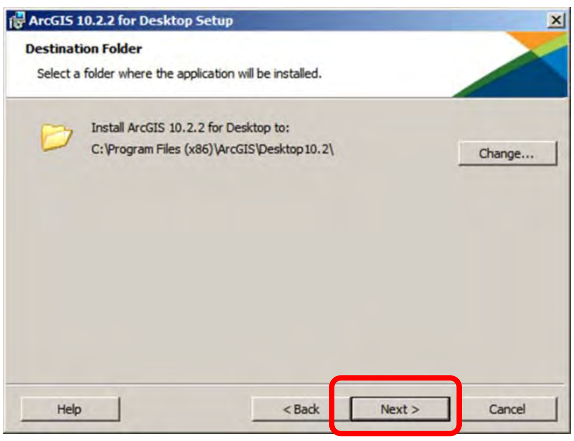


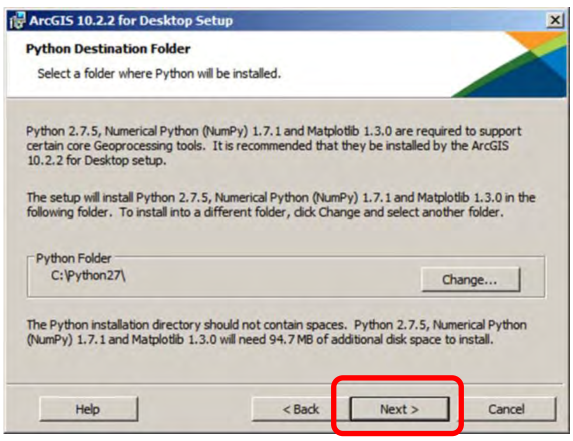
Step2: Check “I accept the licence agreement”, and then choose “Complete”.



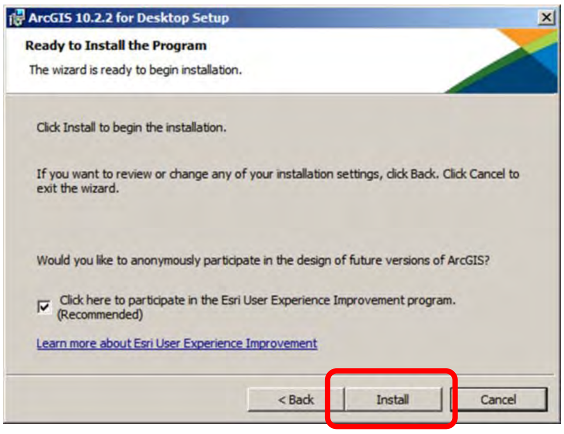


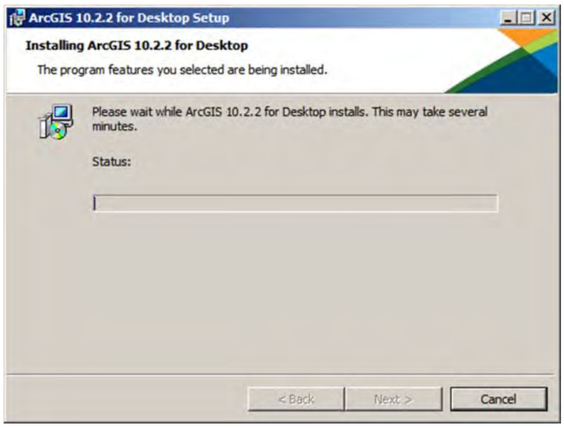
Step3: You can use the default destination folder.



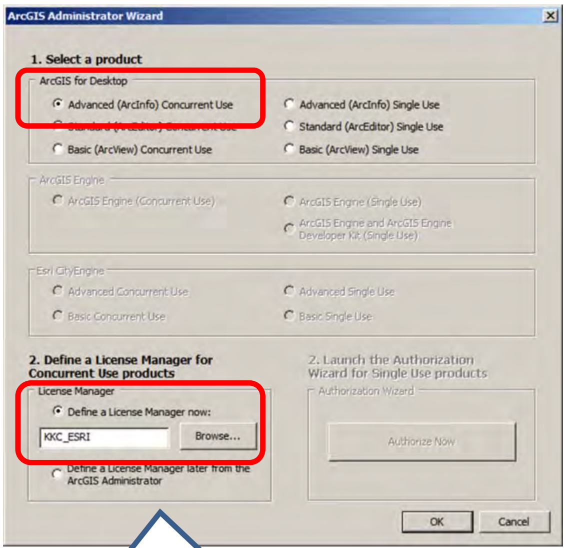


Step4: Click on “Install” and then start the installation process.

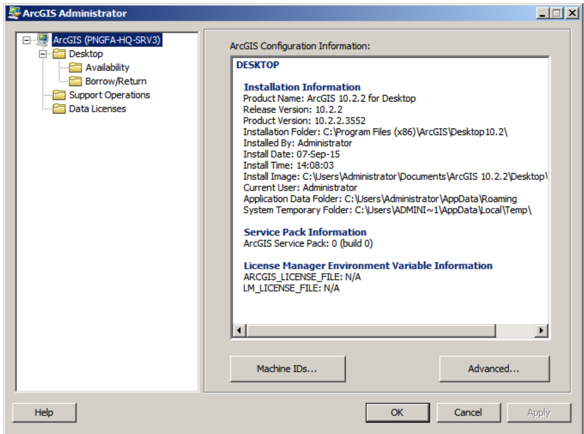


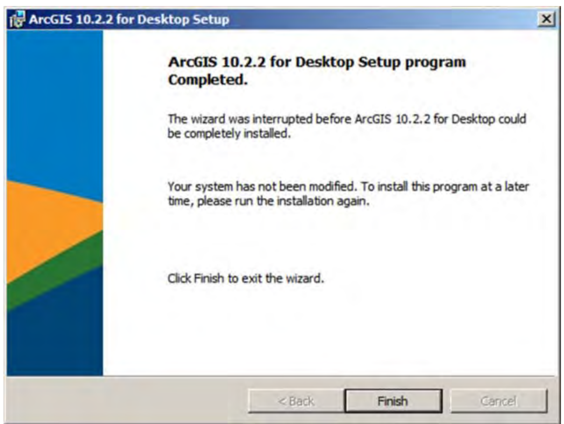


Step5: When the setup is complete the ArcGIS Administrator Wizard is displayed. You can select “Advanced (ArcInfo) Concurrent Use” and define the license manager as “KKC_ESRI”. When you set up ArcGIS for Desktop at PNGFA-HQ, you need to define the license manager as “GIS_PC_01”



“KKC_ESRI” is the license manager for this training. “GIS_PC_01” is the license manager for PNGFA-HQ.





Refer to the following URL:

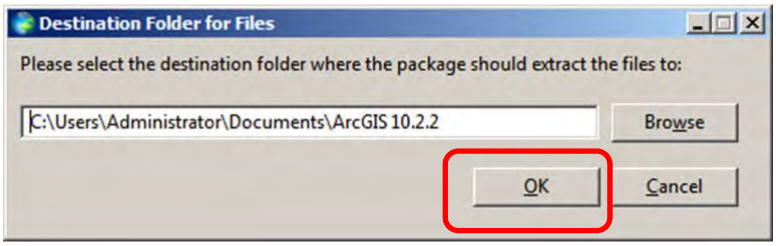
http://resources.arcgis.com/en/help/install-guides/arcgis-desktop/10.2/#/Installing_ArcGIS_Desktop_on_your_computer/00870000000s000000/

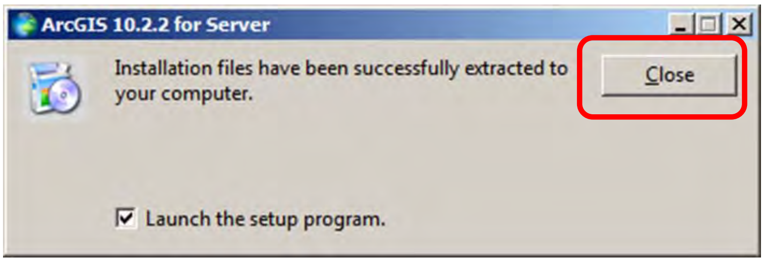
3 Installing ArcGIS for Server

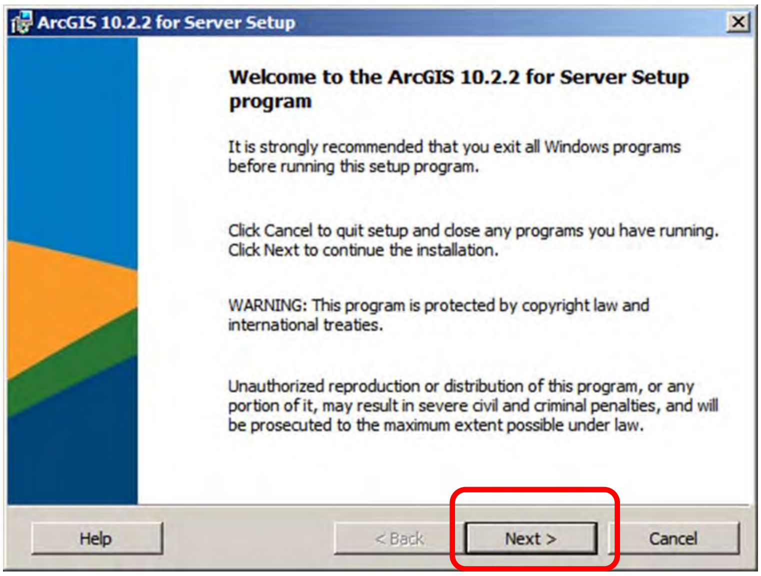
3-1 Installing ArcGIS for Server on one machine

Step1: Run the ArcGIS for Desktop setup.exe installation program.

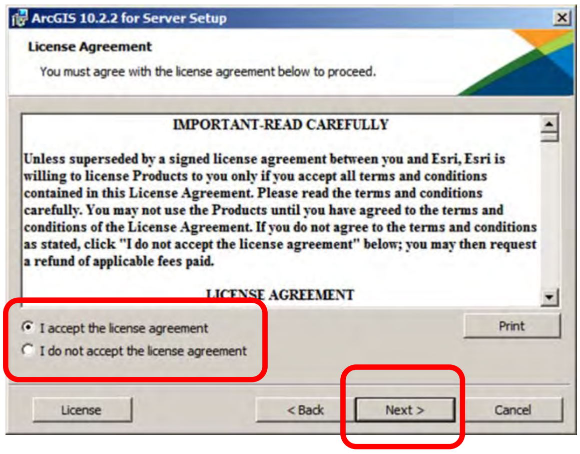
"ArcGIS_Server_Windows_1022_140520.exe"

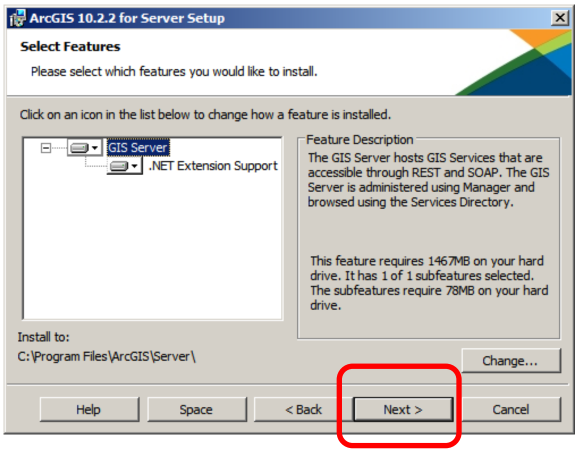


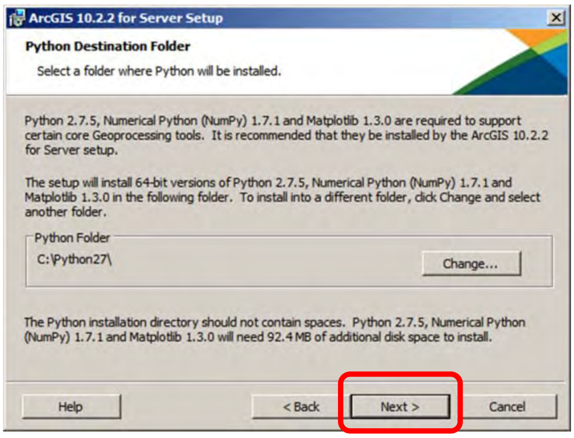




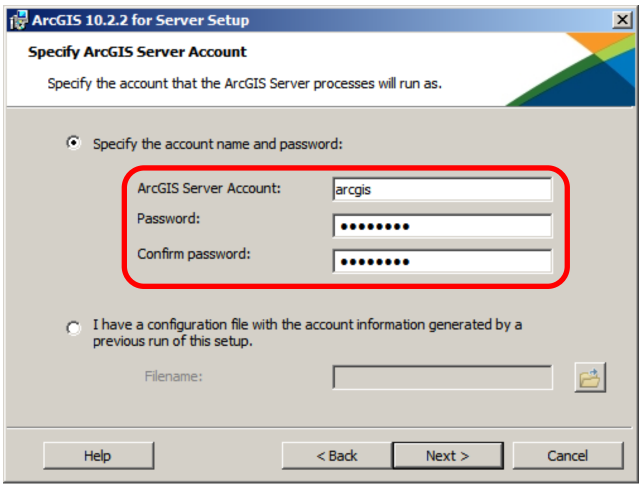
Step2: Check "I accept the licence agreement", and then the ArcGIS for Server setup program displays the features that will be installed. You can use the default setting.



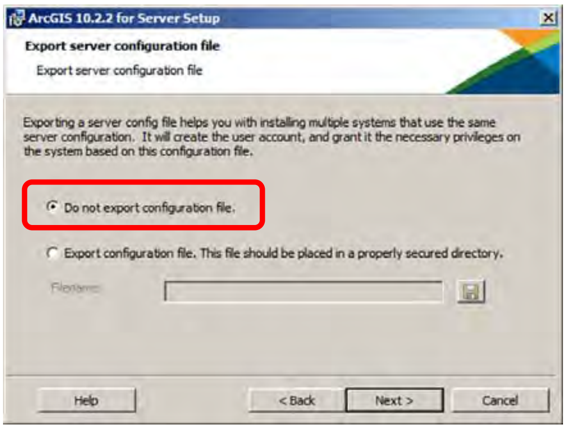


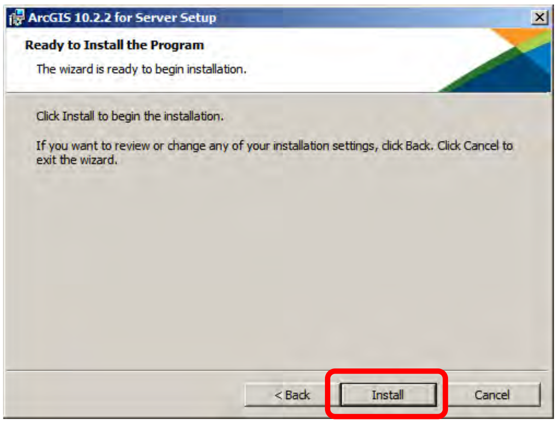


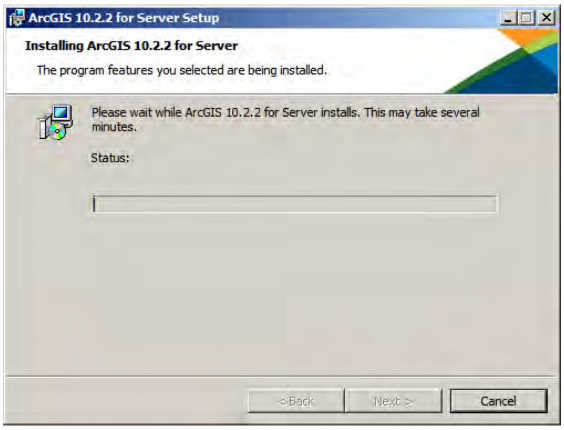
Step3: Specify the account to be used by ArcGIS for Server. You can use the default ArcGIS Server Account "arcgis". Then you need to define the password.

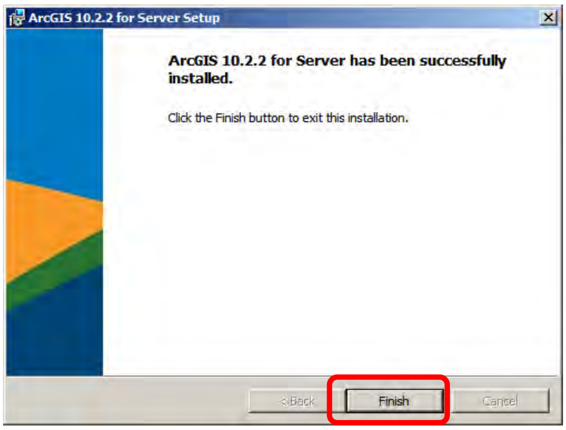


Step4: You can select "Do not export configuration file". Click on "Install" and then start the installation process.

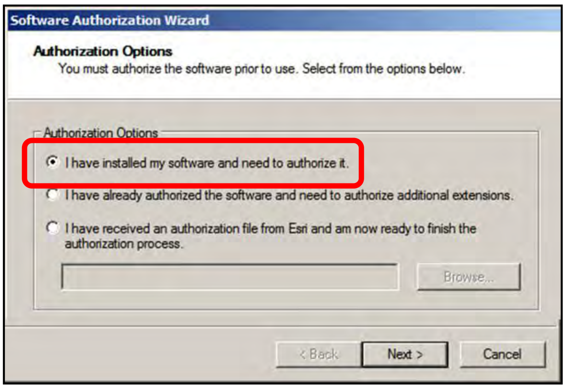


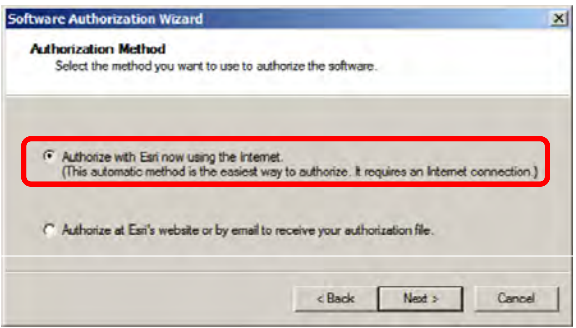


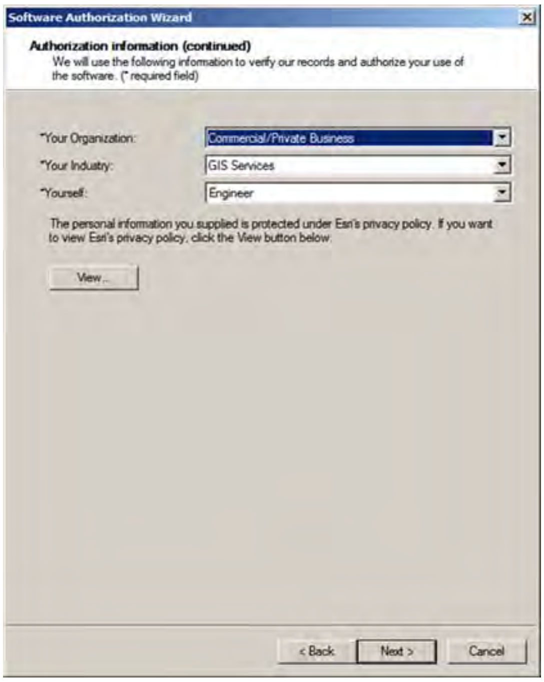




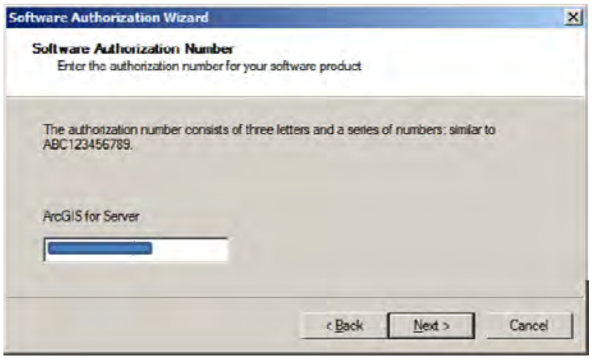
Step5: After the installation completes, the Software Authorization Wizard will open. You can select "I have installed my software and need to authorize it". Then you need to fill in the Authorization Information. At this training, we will enter the profile of KKC.

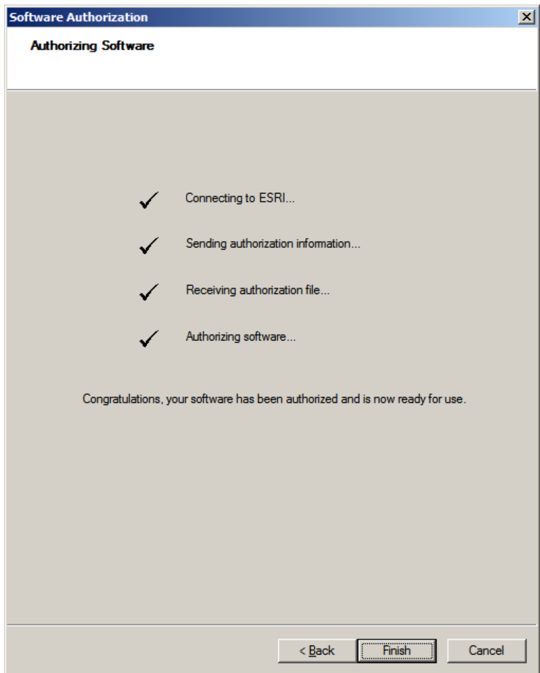






Step6: Enter the authorization number of the software product. You can use the authorization number of KKC this training. PNGFA also has the authorization number. You do not need to auhorize any extensions.





Refer to the following URL:

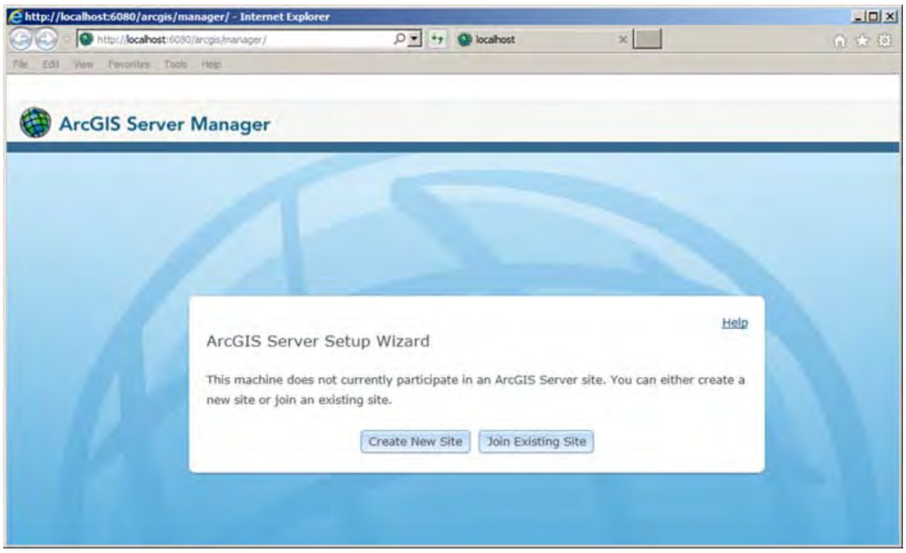
http://resources.arcgis.com/en/help/install-guides/arcgis-server/10.2/index.html#/Installing_ArcGIS_for_Server_on_one_machine/01nm00000005000000/

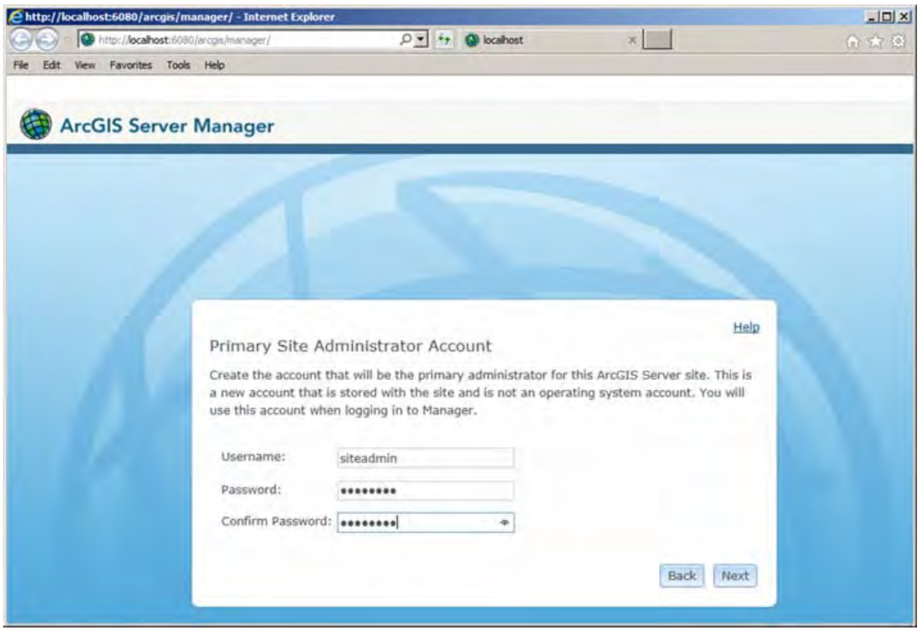
3-2 Creating a new ArcGIS Server site

Step1: After the installation completes, ArcGIS Server Manager Window will open. Click on Create New Site and then create a new account and PW.

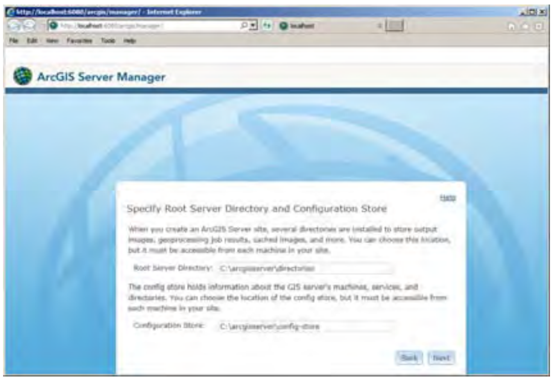
Account: siteadmin

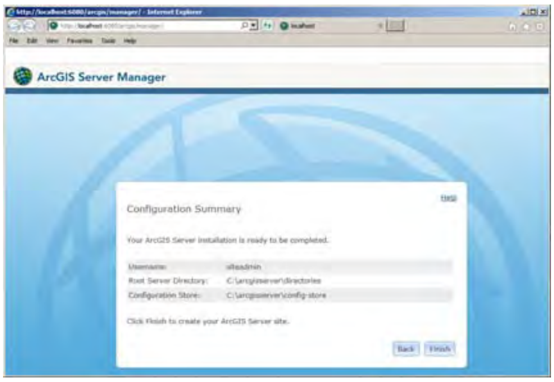
PW: pngf@123

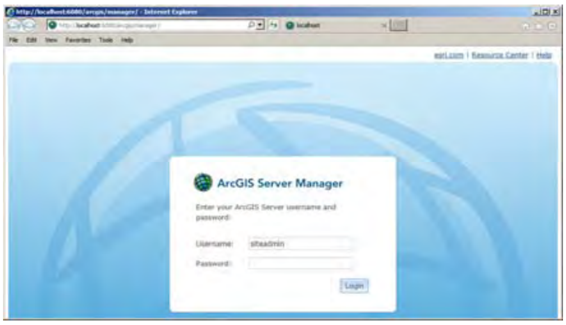




Step2: You can log on to ArcGIS Server Manager.


ArcGIS Server Manager
Specify Root Server Directory and Configuration Store

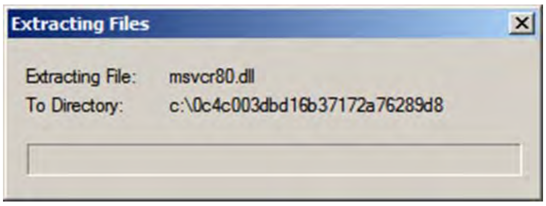

ArcGIS Server Manager
Configuration Summary


ArcGIS Server Manager

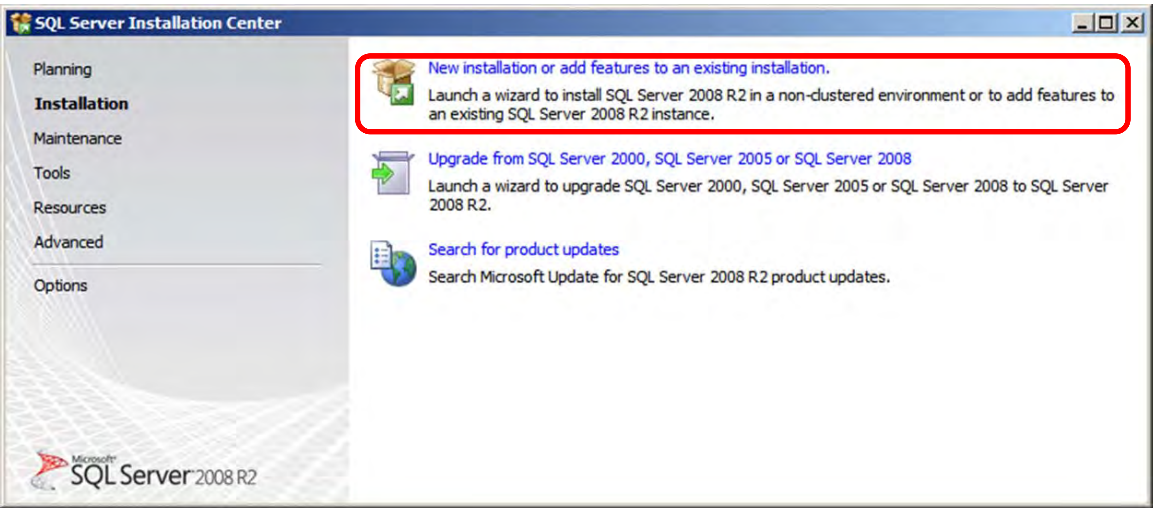

ArcGIS Server Manager
Services
Site
Security
Logs

4 Installing SQL Server 2008R2

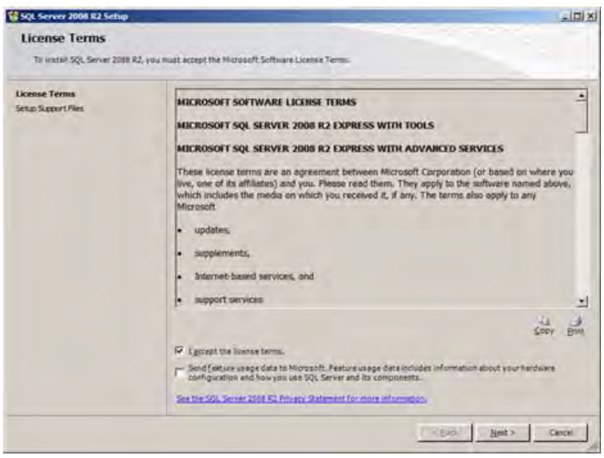
Step1: Run the SQL Server 2008R2 (express) setup.exe “ “SQLEXPRADV_x64_ENU.exe””, you will then see the contents extracted to a temporary location.



Step2: The Installation Center will open. Click on “New installation or add feature to an existing installation” to start the Installation Wizard.

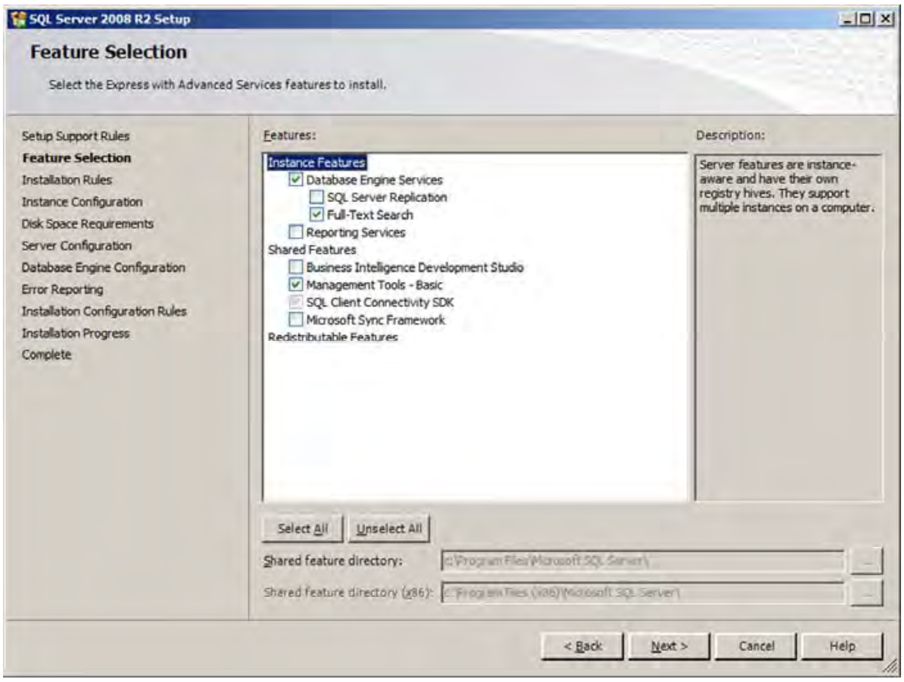


Step3: Accept the license terms.



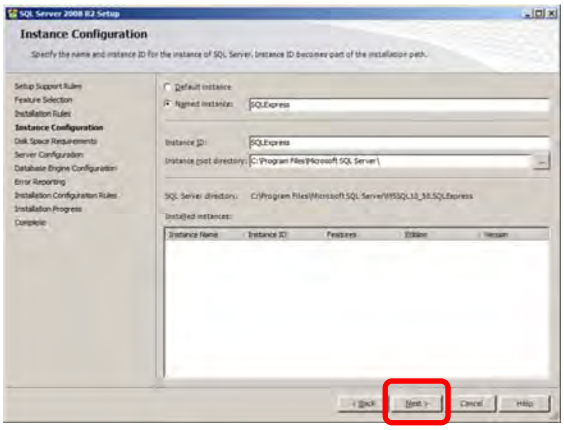
Step4: You have to check the following features.

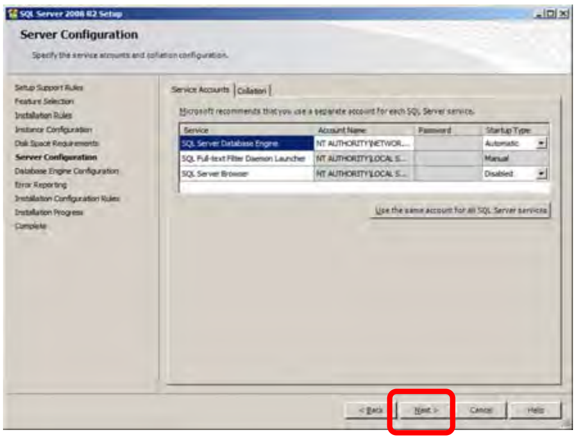
- Database Engine Services
- Full-Text Search
- Management Tools - Basic



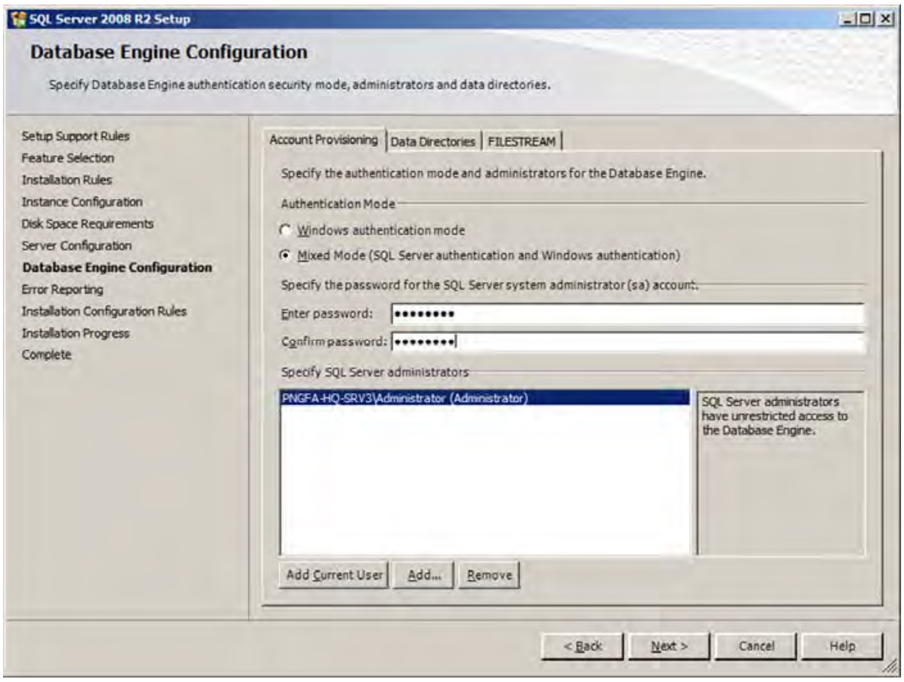
Step5: Review the Instance Name and change if necessary. We can use the default settings.

Click on “Next”.

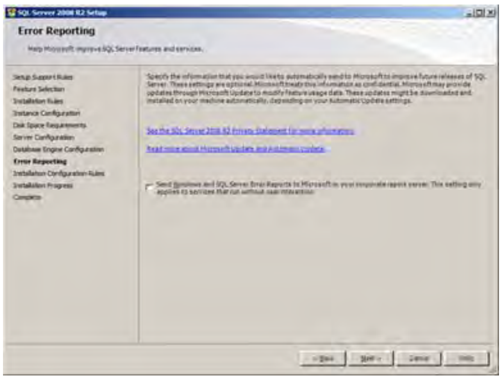


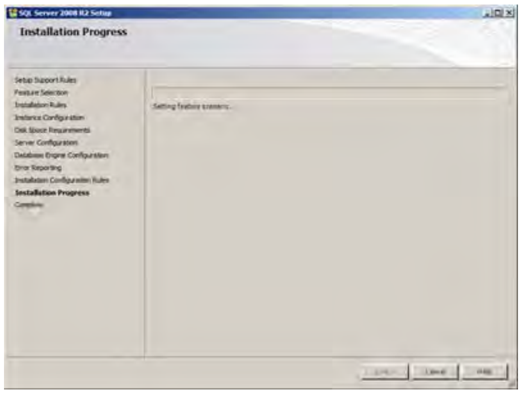


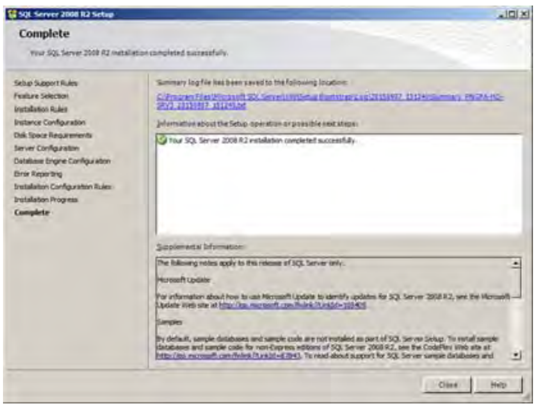
Step6: We will select Mixed Mode. We will be able to use Windows authentification and SQLSever authentification.



Step7: We can use the default setting of Error Reporting and then installation will start.







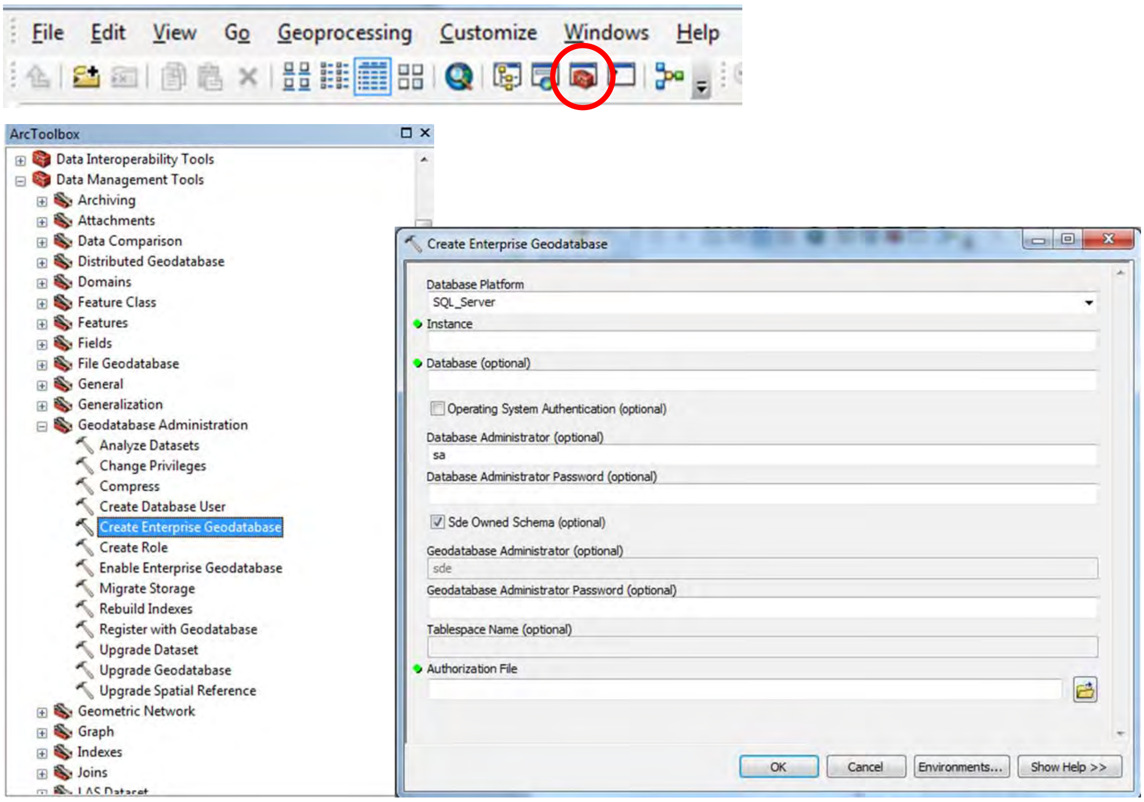
5 FIMS Installation

5-1 Create Geodatabase in a SQL Server 2008R2

You need to create a geodatabase in a Microsoft SQL Server to store forest information used by FIMS.

Step1: Start ArcCatlog or ArcMap.

Step2: Open the **Create Enterprise Geodatabase** geoprocession tool. Either search for the tool in the Search window, or open the tool's dialog box directly from the Geodatabase Administration toolset of the Database Management toolbox.



Step3: Choose **SQL Server** from the **Database Platform** drop-down list.

Step4: Type the name of the SQL Server instance to which you will connect in the Instance text box. You can confirm the name of the SQL Server instance on the Microsoft SQL Server Management.

Instance name = "PNGFA-HQ-SRV3"

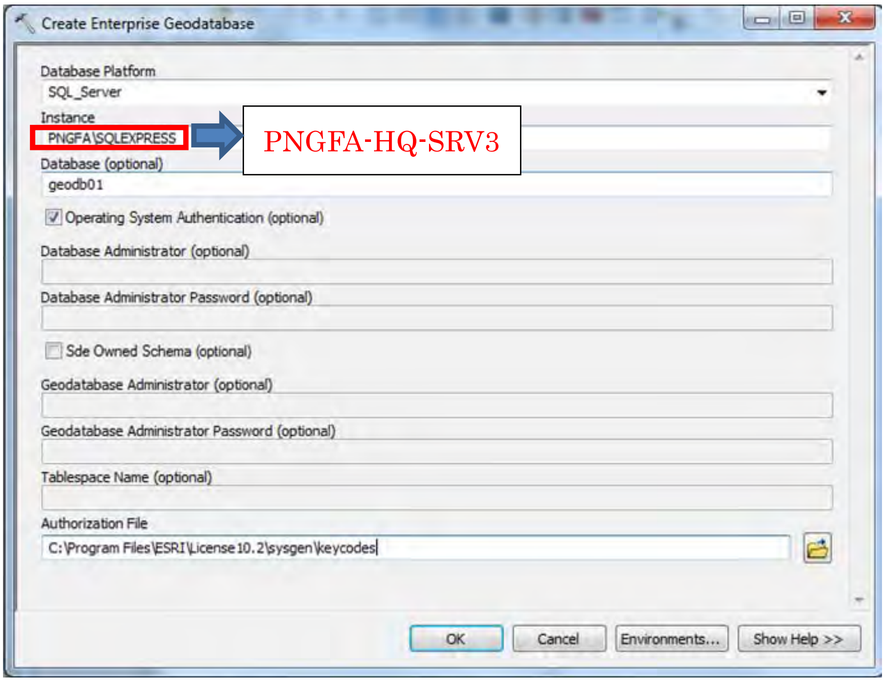
Step5: In the Database text box, type a name for the database where you want to store the geodatabase. New FIMS will use "**geodb01**".

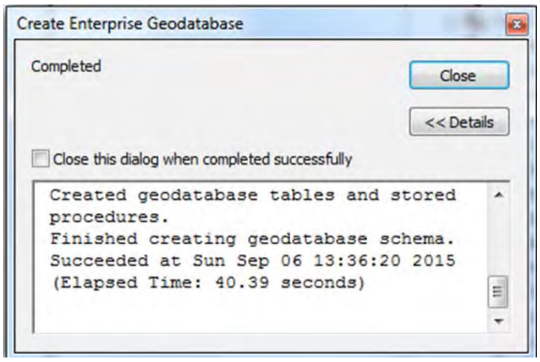
Step6: Connect to SQL Server as a system administrator. To log in with a sysadmin operating system-authenticated login, check **Operating System Authentication** this training.

Step7: **Uncheck** Sde Owned Schema. We will use the dbo user to be the geodatabase administrator and the geodatabase to be stored in the dbo schema. “dbo” is a default schema name and new FIMS have to use it.

Step8: To specify an Authorization File, navigate to and choose the keycodes file that was created when you authorized ArcGIS for Server Enterprise. The keycodes file is written to the ” C:¥Program Files¥ESRI¥License10.2¥sysgen¥keycodes ”.

Step9: Click OK to run the tool.





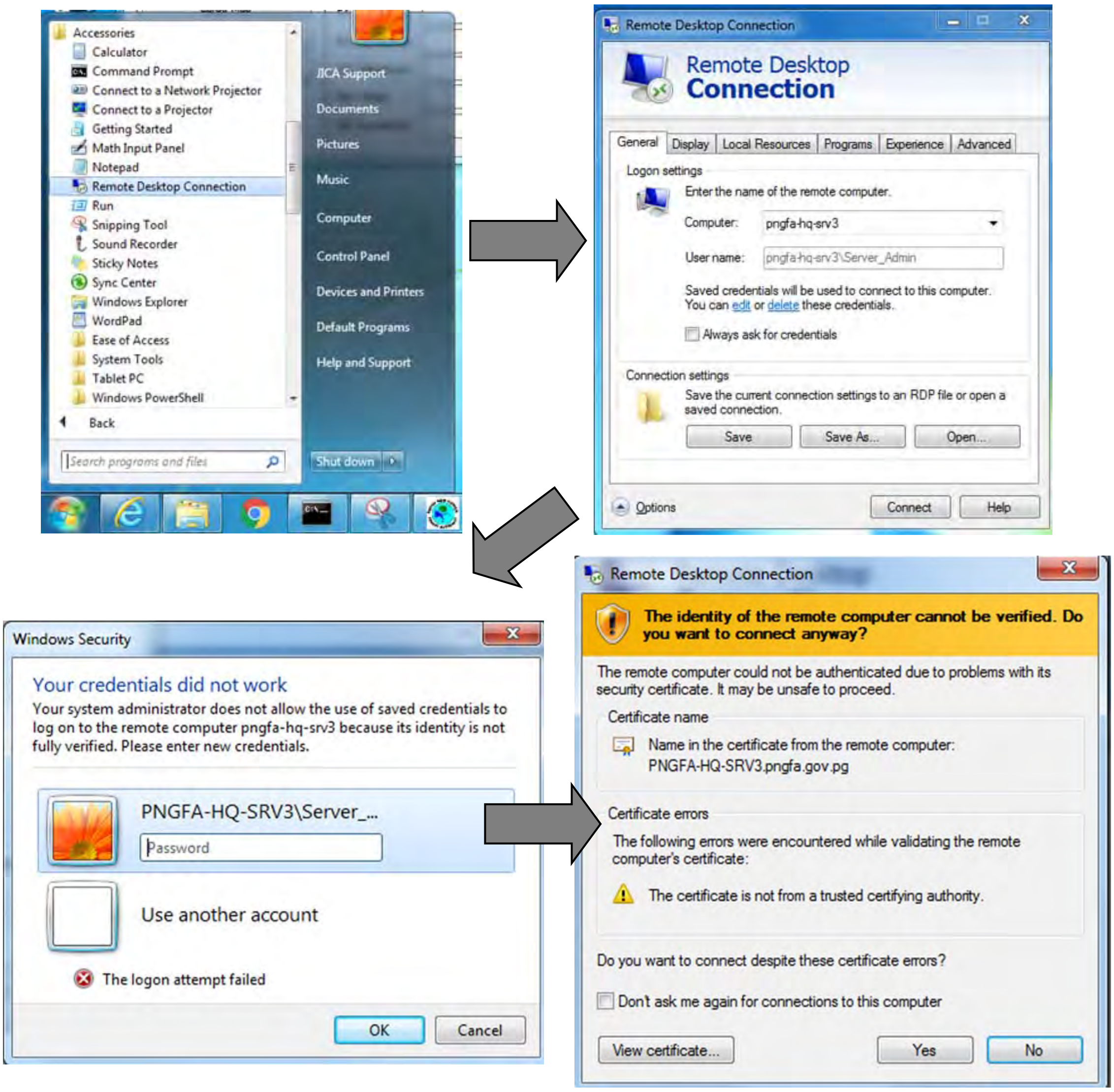
5-2 Restore the FIMS Database Backup file “geodb01.bak” to JICA server (server machine)

The “geodb01.bak” is a backup file of SQL Server 2008 R2. This backup file includes all of data which is necessary for FIMS installation. If there are several backup files, you should confirm when the backup file was generated from Microsoft SQL Server Management Studio of the JICA server.

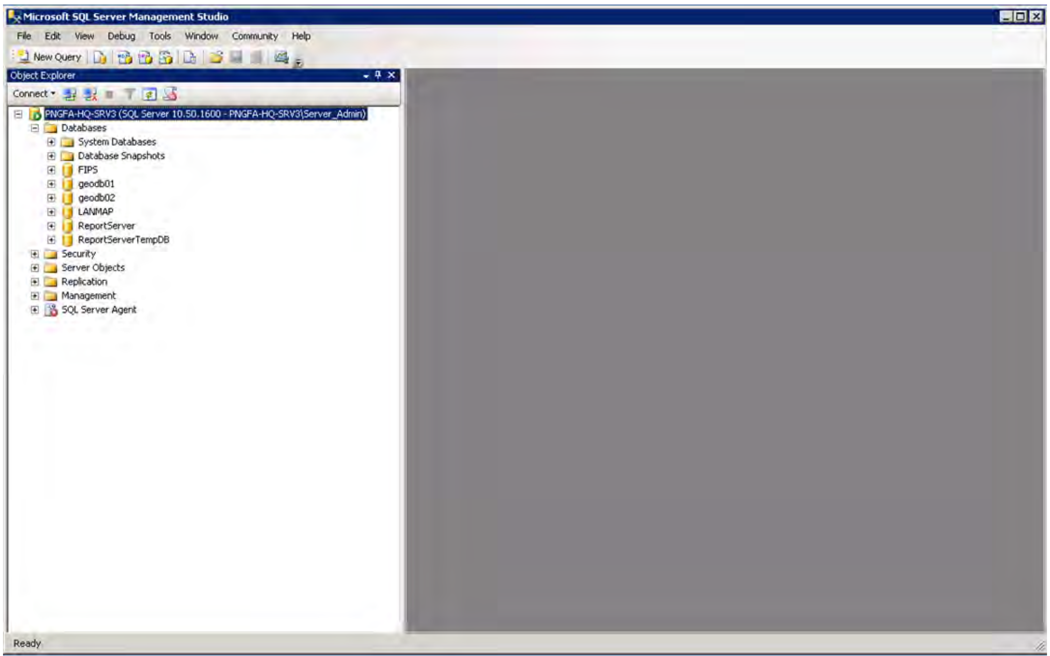
JICA server name is “pngfa-hq-srv3” and its IP address is “**172.20.7.10**”.

FIMS database backup file should be exported regularly from the JICA server using Microsoft SQL Server Management Studio in order to save latest state.

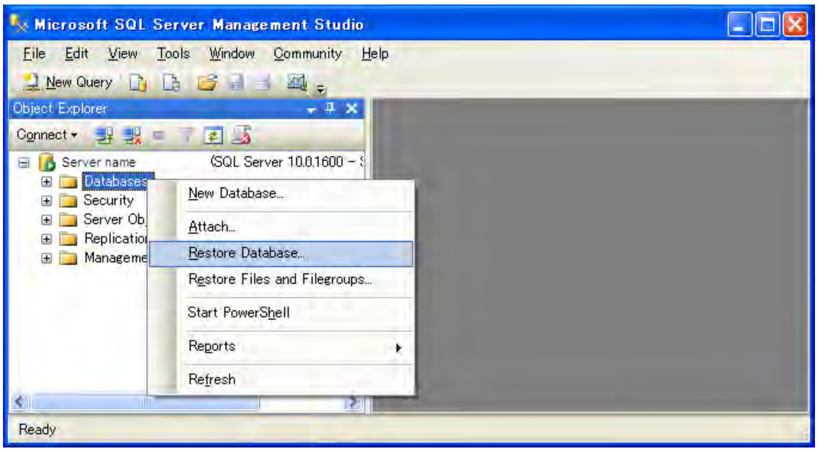
Step1: Connect “pngfa-hq-srv3” of JICA server by Remote Desktop of a JICA workstation (POM-MAP-GIS01 to GIS06).

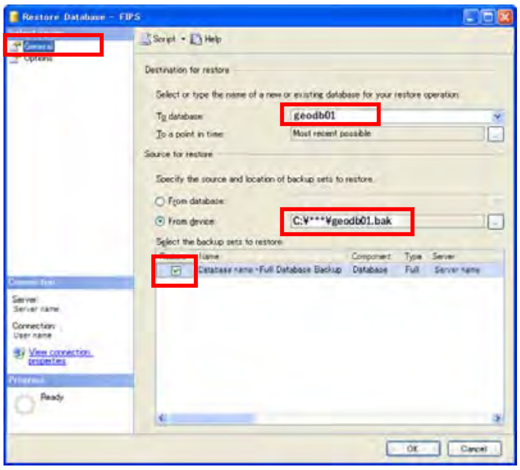


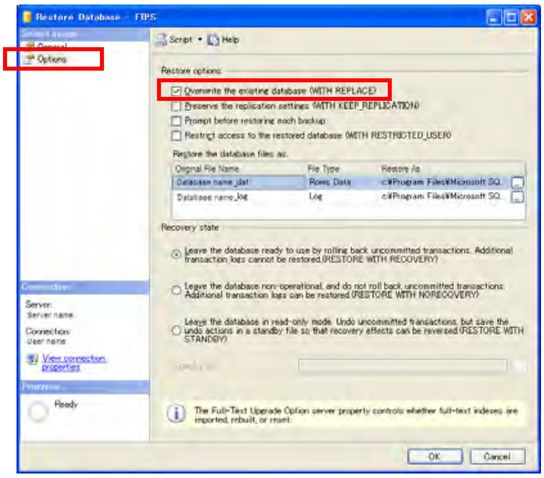
Step2: Start up “Microsoft SQL Server Management Studio” of the JICA server “pngfa-hq-srv3” .



Step3: After connecting to the server, right click “Databases” in the tree menu and select “Restore Database…”. Then, select the restore destination database and choose the backup file. After entering the necessary items, press the OK button to execute the restore. If the “completed successfully” window is displayed, Environment Construction has been completed.







5-3 Allocate executable files of FIMS to the JICA workstations (client machine)

The latest FIMS has to distinguish between the administrator workstation for FIMS (POM-MAP-GIS06, as of June-2019) and the viewer workstations. Because the data size of Forest Base Map 2012 (FBM2012) is too large to handle on the network between the JICA server and workstations, it was decided to put the replicas of FBM2012 into POM-MAP-GIS06. In order to exclude duplication of management of the replicas, only POM-MAP-GIS06 stores the replicas and necessary data for FIMS processing.

Therefore, there are difference of the executable files placed between POM-MAP-GIS06 and other workstations.

The necessary folders placed into workstations are as bellow. The FIMS viewer does not process using FBM2012, therefore “fims_python” and “appendix25” folders are not created under workstations of FIMS viewer.

Folder created for FIMS	Workstation for FIMS Administrator	Workstations for FIMS Viewer
C:¥fims¥exe	✔	✔
C:¥fims¥mxd	✔	✔

Folder created for FIMS	Workstation for FIMS Administrator	Workstations for FIMS Viewer
C:¥fims¥fims_python	✔	(no need to create)
C:¥fims¥appendix25	✔	(no need to create)

FIMS function			User privilege	
NO	Large category	Small category	Administrator	Viewer
1	Login		v	v
2	Main Screen（Province）	List of Provinces and Printing reports	v	v
3	Updating Timber Volumes	for Zone	v	-
4		for FMU	v	-
5	Reports	Print	v	V
6		Preview	v	v
7		Export	v	v
8	Main Screen （Concession data）	List of concession areas by province and Printing reports	v	v
9		File UP & Download	v	-
10	Large Map	Viewer	v	v
11		Editor	v	-
12		FMU Calculation	v	-
13		Import	v	-
14		Copy	v	v
15		Preview	v	v
16	Assessment by FIPS	List of concession areas by province	v	v
17	Administrator	Layer Management	v	-
18		User Management	v	-
19		FIPS Data Import	v	-
20		Appendix2 and 5 Calculation	v	-

The executable files of each folder are as bellow.

Folder	Executable files placed
C:¥fims¥exe	Connection to pngfa-hq-srv3.sde
	FIMS.exe
	FIMS.exe.config
	FIMS.vshost.exe
	FIMS.vshost.exe.manifest
	GISLibrary.dll
	GISLibrary.pdb
	Interop.ADODB.dll
	Interop.DAO.dll
	log4net.dll
	MASTER_PLAN_ID_201806.csv
	MASTER_PLAN_ID_201806_operationalConcession.csv
	report.dsn

Folder	Executable files placed
	ReportingTool_forNew.accdb
	ReportingTool_forNew_ConcessionArea.accdb
	ReportingTool_forOld.accdb
	ReportingTool_forOld_ConcessionArea.accdb
	Report_FIMS_forNew.accdb
	Report_FIMS_forOld.accdb
C:¥fims¥mxd	PNG.mxd
	minimap.mxd
	template.mxd
C:¥fims¥fims_python	fims_work.gdb
	FIMS_LAST_NEW_E.py
	FIMS_LAST_OLD_E.py
	FIMS_MAIN_NEW_E.py
	FIMS_MAIN_NEW_SDE_COPY_E.py
	FIMS_MAIN_OLD_E.py
	FIMS_Preparation_COMMON_E.py
	FIMS_Preparation_OLD_E.py
C:¥fims¥appendix25	01_Western.gdb
	02_Gulf.gdb
	03_Central.gdb
	04_MilneBay.gdb
	05_ORO.gdb
	06_SHP.gdb
	07_EHP.gdb
	08_Simbu.gdb
	09_WHP.gdb
	10_WSP.gdb
	11_ESP.gdb
	12_Madang.gdb
	13_Morobe.gdb
	14_WNB.gdb
	15_ENB.gdb
	16_NIP.gdb
	17_ABG.gdb
	18_Manus.gdb
	19_Enga.gdb

Folder	Executable files placed
	20_NCD.gdb
	21_Hela.gdb
	22_Jiwaka.gdb
	work.gdb
	NEW_Appendix2_and_Appendix5_ConcessionArea_E.py
	NEW_Appendix2_and_Appendix5_E.py
	OLD_Appendix2_and_Appendix5_ConcessionArea_E.py
	OLD_Appendix2_and_Appendix5_E.py
	Preparation_E.py

5-4 Registration of DLL

Execute the following command on the command prompt line with the Administrator authority level.

C:¥Windows¥Microsoft.NET¥Framework¥v2.0.50727¥RegAsm.exe C:¥fims¥exe¥GISLibrary.dll

6 FIPS Installation

6-1 Restore the FIPS Database Backup file “FIPS.bak” to JICA server

The restoration procedure is as same as the restoration of FIMS database backup file. Refer to the chapter 5-2.

FIPS database backup file should be exported regularly from the JICA server using Microsoft SQL Server Management Studio in order to save latest state.

6-2 Allocate executable files of FIPS to the JICA workstations (client machine)

The necessary components of FIPS are placed into “C:¥fips” under JICA workstations.

The executable files of each folder are as bellow.

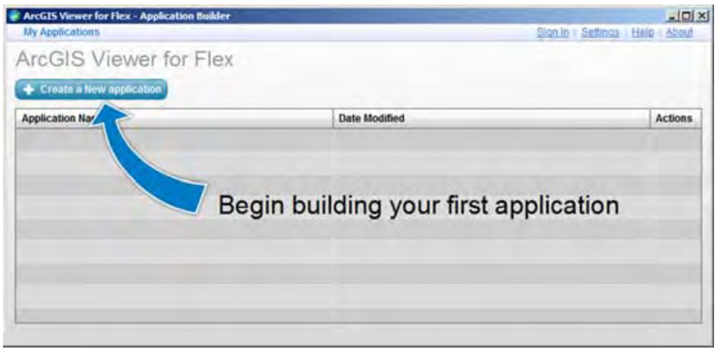
Folder	Executable files placed
C:¥fips	FIPS.mdb
	FIPS_ODBC.dsn
C:¥fips¥macro	FIPS_ImportDataCreator.xls

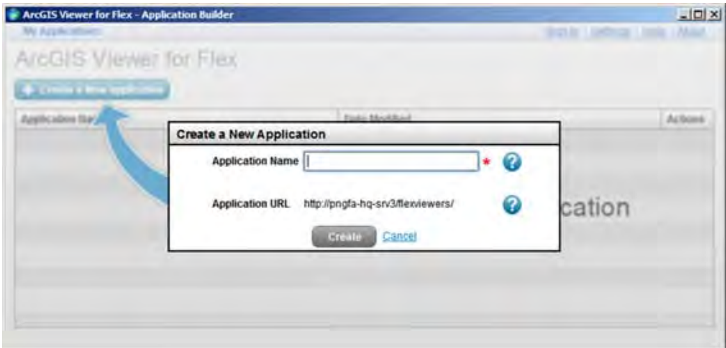
7 LAN Map Browser Installation

7-1 Installation of “ArcGIS Viewer for Flex Builder”.

Step1: Run the AppBuilder-3.7.air.

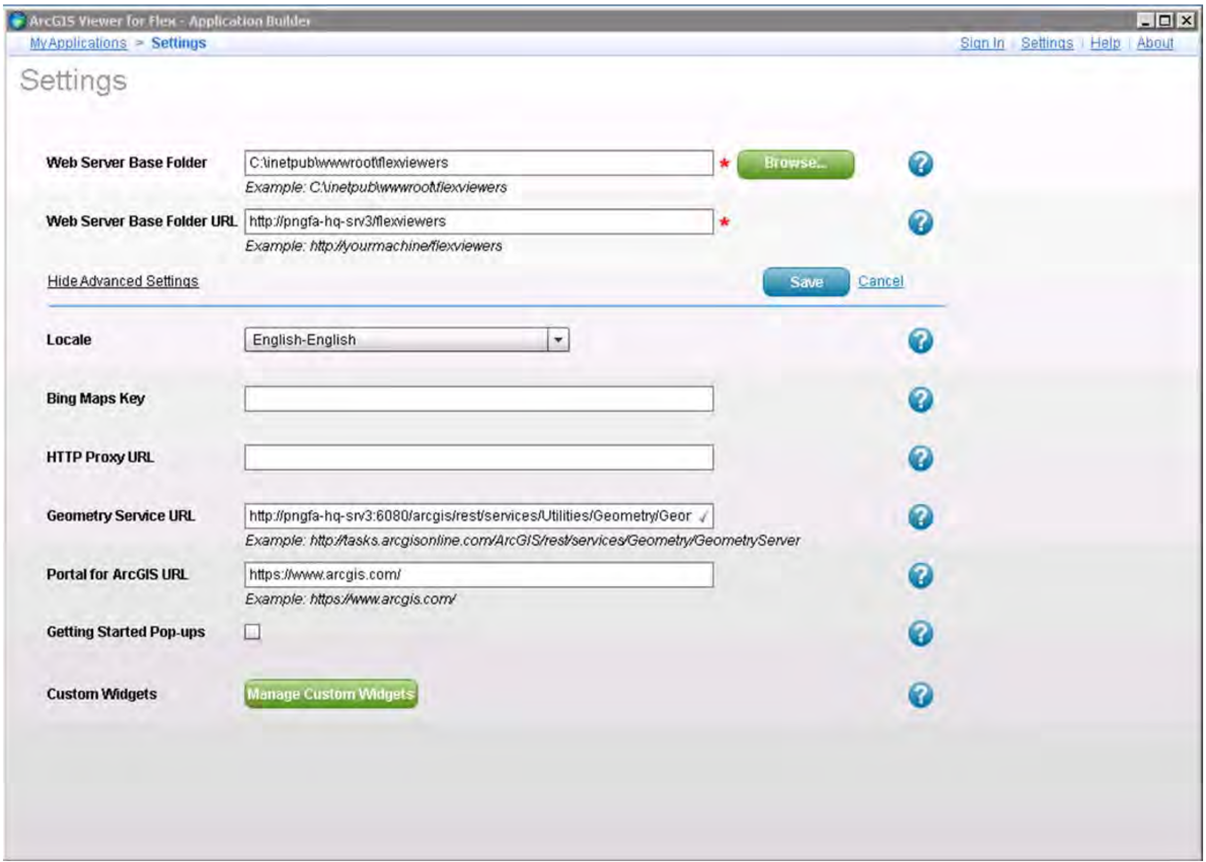
Step2: After the installation completes, You can use ArcGIS Viewer for Flex Builder.





Step3: Set up the environment of LAN-Map

・ Web Server Base Folder: C:¥inetpub¥wwwroot¥flexviewers
・ Web Server Base Folder URL: http://pngfa-hq-srv3/flexviewers
・ Geometry Service URL:
http://pngfa-hq-srv3:6080/arcgis/rest/services/Utilities/Geometry/GeometryServer



FIMS - Forest Inventory and Mapping System User Guide

July 2019

Papua New Guinea Forest Authority (PNGFA)

Japan International Cooperation Agency (JICA)

FIMS – Forest Inventory and Mapping System

User Guide

Forest Inventory and Mapping System User Guide

27/12/2013 Ver. 1.0
30/6/2019 Ver. 2.0

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Contents

1. FIM – ADMIN (Forest Administration)

FIM – ADMIN is a computer program written in Visual Studio .NET, Python and SQL Server which manages the FIM data to provide display, update, report and map view and print functions at the national, provincial, concession or proposed concession level.

1.1. Technical Details

FIM – ADMIN is installed on the dedicated workstation “**POM-MAP-GIS06**” with Windows 7 system. (as of June 2019).

FIM – ADMIN has to be run on the POM-MAP-GIS06 because a unique replica of Forest Base Map 2012 (FBM2012) is allocated in only POM-MAP-GIS06. By doing this, it always ensures that the replica is the latest one. Although it has been updated through carring out FMU calculation.

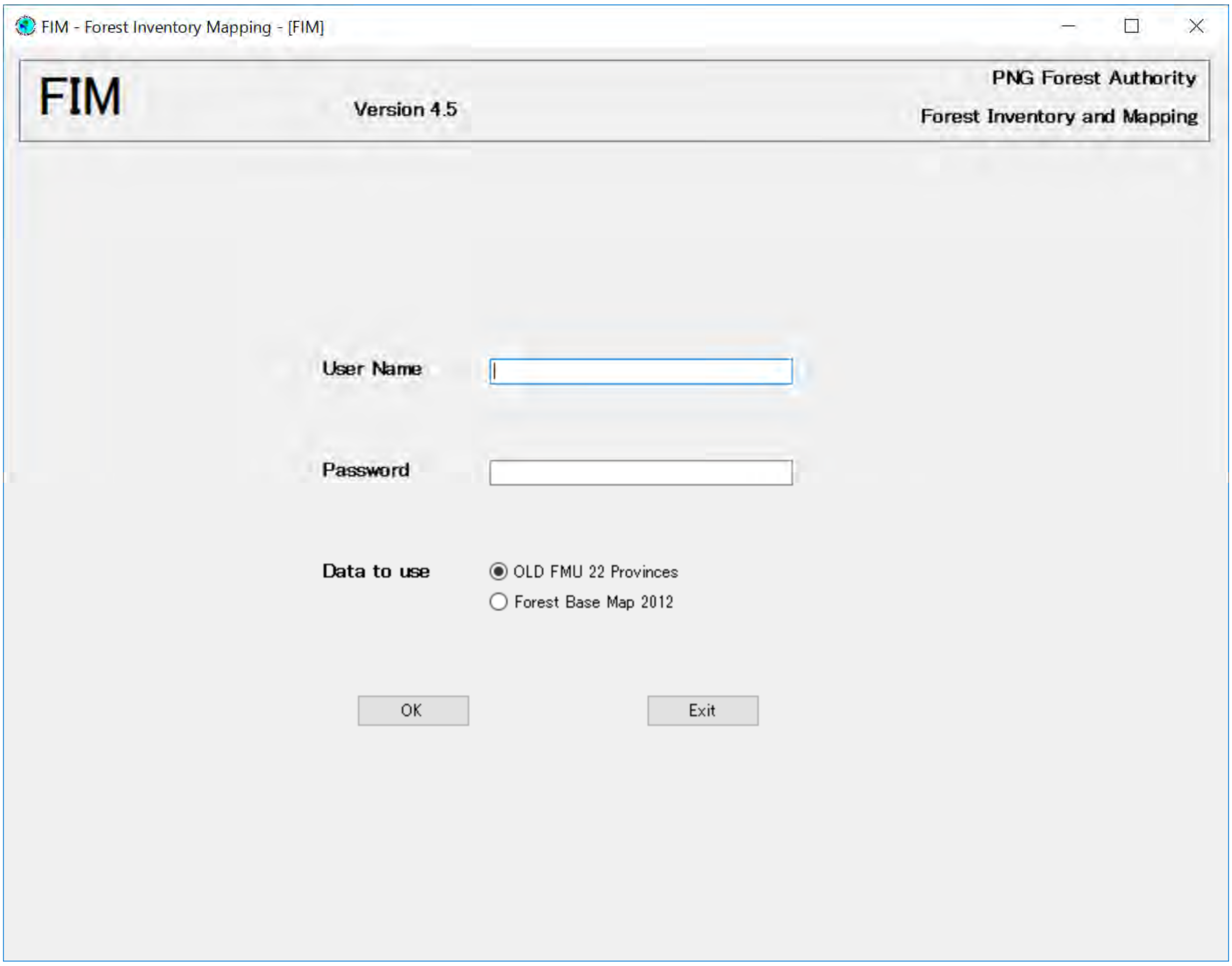
It consists of the following files:

Folder	Executable files placed
C:¥fims¥exe	Connection to pngfa-hq-srv3.sde
	FIMS.exe
	FIMS.exe.config
	FIMS.vshost.exe
	FIMS.vshost.exe.manifest
	GISLibrary.dll
	GISLibrary.pdb
	Interop.ADODB.dll
	Interop.DAO.dll
	log4net.dll
	MASTER_PLAN_ID_201806.csv
	MASTER_PLAN_ID_201806_operationalConcession.csv
	report.dsn
	ReportingTool_forNew.accdb
	ReportingTool_forNew_ConcessionArea.accdb
	ReportingTool_forOld.accdb
	ReportingTool_forOld_ConcessionArea.accdb
	Report_FIMS_forNew.accdb
	Report_FIMS_forOld.accdb
C:¥fims¥mxd	PNG.mxd
	minimap.mxd
	template.mxd
C:¥fims¥fims_python	fims_work.gdb
	FIMS_LAST_NEW_E.py
	FIMS_LAST_OLD_E.py
	FIMS_MAIN_NEW_E.py
	FIMS_MAIN_NEW_SDE_COPY_E.py
	FIMS_MAIN_OLD_E.py
	FIMS_Preparation_COMMON_E.py
	FIMS_Preparation_OLD_E.py
C:¥fims¥appendix25	01_Western.gdb

Folder	Executable files placed
	02_Gulf.gdb
	03_Central.gdb
	04_MilneBay.gdb
	05_ORO.gdb
	06_SHP.gdb
	07_EHP.gdb
	08_Simbu.gdb
	09_WHP.gdb
	10_WSP.gdb
	11_ESP.gdb
	12_Madang.gdb
	13_Morobe.gdb
	14_WNB.gdb
	15_ENB.gdb
	16_NIP.gdb
	17_ABG.gdb
	18_Manus.gdb
	19_Enga.gdb
	20_NCD.gdb
	21_Hela.gdb
	22_Jiwaka.gdb
	work.gdb
	NEW_Appendix2_and_Appendix5_ConcessionArea_E.py
	NEW_Appendix2_and_Appendix5_E.py
	OLD_Appendix2_and_Appendix5_ConcessionArea_E.py
	OLD_Appendix2_and_Appendix5_E.py
	Preparation_E.py

1.2. Login

This is the login window.

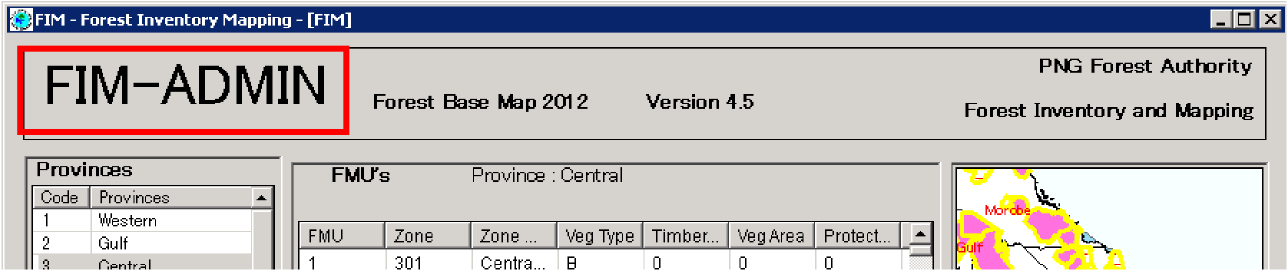


・Enter the user name and password.

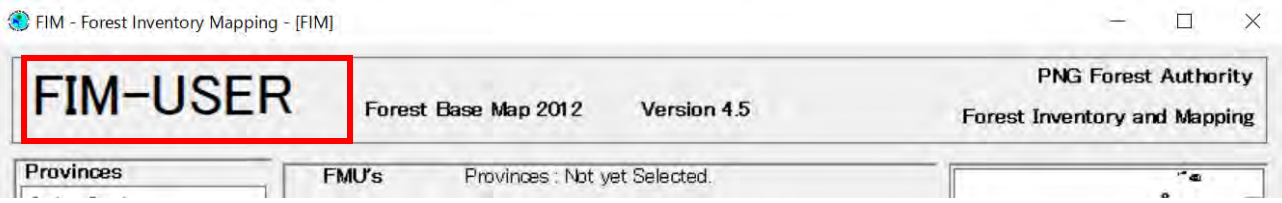
・Choose OLD FMU or Forest Base Map 2012 for calculation of volume estimate.

When logged in as the admin user, FIM-ADMIN appears at the top of the screen, and when logged in as a guest user, FIM-USER appears.

Admin User



Guest User



This chapter explains the FIM-ADMIN functions.

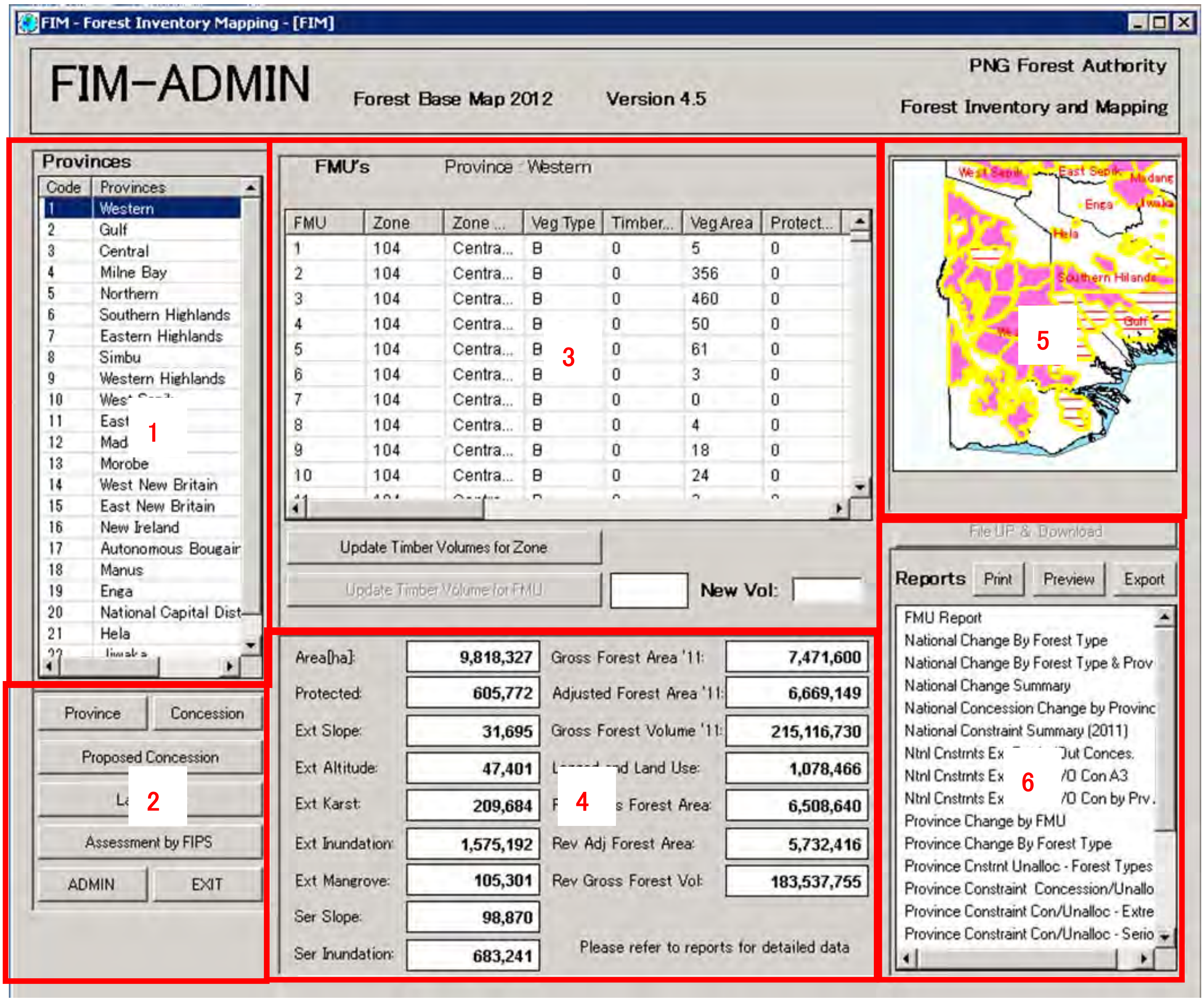
For details of the FIM-USER functions, refer to **3 FIM-USER**.

1.3. Main Screen（Province）

This is the FIM – ADMIN main screen displayed upon launching FIM from Windows 7.

The following operations can be performed in this screen.

- You can check the details of the province FMUs.
- You can check the total values for the province.
- You can print out the province reports.
- You can update the province timber volumes.



1. Provinces: Displays the list of province codes and names.
   When you select a province from the list, areas 3, 4 and 5 are updated.

2. **Province**: Click to display the list of Provinces.
   Concession: Click to display the list of Concession Area codes and names.
   Proposed Concession: Click to display the list of Proposed Concession Area codes and names.
   Assesment by FIPS: Click to display the Concession (FIPS) screen of the selected province.
   Large Map: Click to display the Large Map screen.
   ADMIN: Click to jump to the ADMIN screen.
   EXIT: Click to exit the system.

3. Displays the list of FMUs in the selected province.

   Update Timber Volumes for Zone: Click to jump to the Update Timber Volumes screen.
   Update Timber Volume for FMU: Updates the timber volume of the selected FMU using the value entered in New Vol.

4. Displays the totals for the selected province.

5. Displays the map.

6. Displays the list of available reports (ledgers).
   For details of ledgers, refer to the Ledger Design Document.

   Print: Click to print the selected report in A4 or A3 format.

   For paper sizes, refer to Report Printing Sizes below.

   The "last update" displayed when printing a ledger is controlled in province or concession units.

   Preview: A preview of the selected ledger is displayed when pressed.

   Export: The selected ledger is output in rtf or xls format when pressed.

   * The Access standard function is used to output the ledger.

   For rtf format, output is in the ledger format.

   For xls format, output is in the format of a table with 1 record on 1 line. Basically, the ledger column name is used as the table column name, but for ledgers in special format, such as FMU Reports, the form is ledger column name, ledger row name.

*The width of areas 5 and 6 and areas 3 and 4 can be changed.

・Report Printing Sizes

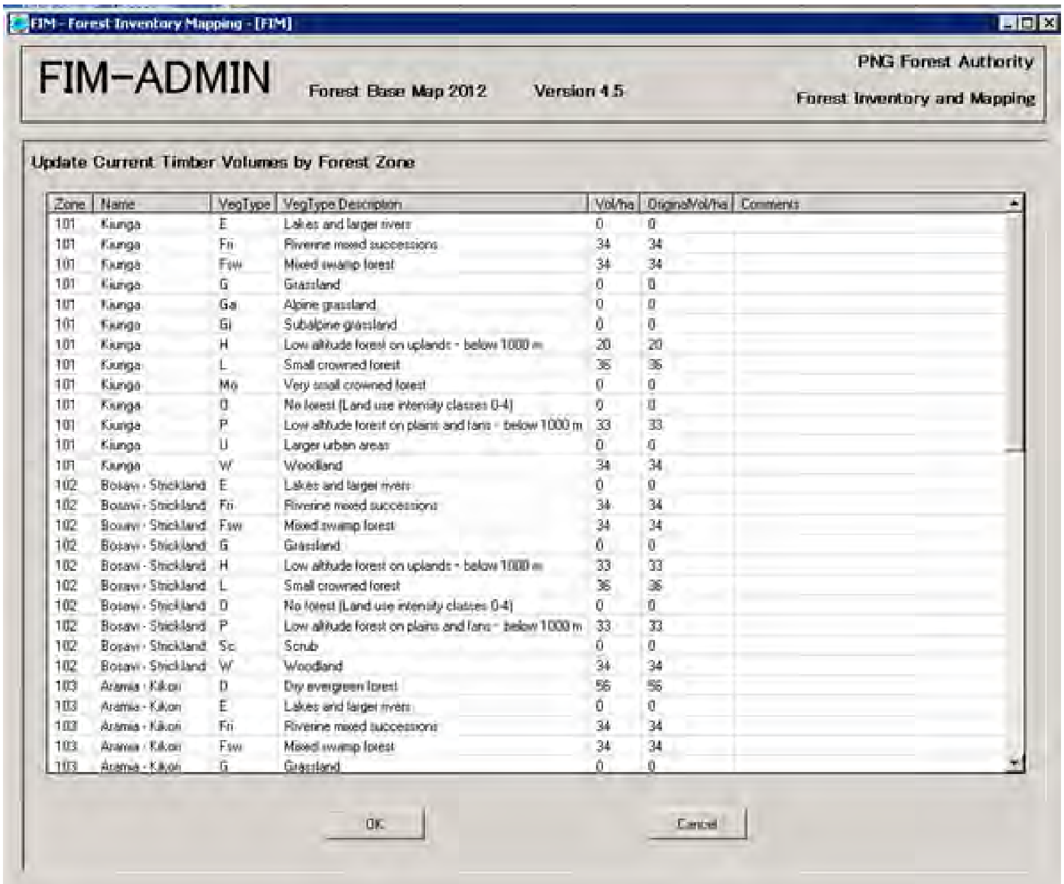
Report Name	Paper Size
FMU Report(Province)	A4
National Change By Forest Type	A4
National Change By Forest Type & Prov	A4
National Change Summary	A4
National Concession Change by Province	A4
National Constraint Summary (1975)	A4
Ntnl Cnstrnts Ext Frst In/Out Conces.	A3
Ntnl Cnstrnts Ext N/Frst I/O Con A3	A3
Ntnl Cnstrnts Ext N/Frst I/O Con by Prv A3	A3
Province Change by FMU	A4
Province Change By Forest Type	A4
Province Cnstrnt Unalloc – Forest Types	A4
Province Constraint Concession/Unalloc	A4
Province Constraint Con/Unalloc - Extreme	A4
Province Constraint Con/Unalloc - Serious	A4
Province Resource by FMU - 1975	A4
Province Resource by FMU - Current	A4
Province Species Distribution	A4
Province Timber Volumes	A4
Province Unallocated – Non-Forest Types	A4
Vegetation Types - All	A4
Vegetation Types - Grouped	A4

1.4. Updating Timber Volumes

After selecting the relevant province, timber volumes can be updated for a Vegetation Type within a Forest Zone within a Province, or for an individual FMU. Note that this function can only be performed by the Planning Manager.

1.4.1. Updating a Timber Volume for a Vegetation Type within a Forest Zone

Simply click on the button 'Update Timber Volume for Zone.' You will then be presented with the following screen which displays all the Forest Zones for the particular Province:



Zone	Name	VegType	VegType Description	Vol/ha	OriginalVol/ha	Comments
101	Kiunga	E	Lakes and larger rivers	0	0	
101	Kiunga	Fri	Riverine mixed successions	34	34	
101	Kiunga	Fsw	Mixed swamp forest	34	34	
101	Kiunga	G	Grassland	0	0	
101	Kiunga	Ga	Alpine grassland	0	0	
101	Kiunga	Gi	Subalpine grassland	0	0	
101	Kiunga	H	Low altitude forest on uplands - below 1000 m	20	20	
101	Kiunga	L	Small crowned forest	36	36	
101	Kiunga	Mo	Very small crowned forest	0	0	
101	Kiunga	O	No forest (Land use intensity classes 0-4)	0	0	
101	Kiunga	P	Low altitude forest on plains and fans - below 1000 m	33	33	
101	Kiunga	U	Larger urban areas	0	0	
101	Kiunga	W	Woodland	34	34	
102	Bosavi - Strickland	E	Lakes and larger rivers	0	0	
102	Bosavi - Strickland	Fri	Riverine mixed successions	34	34	
102	Bosavi - Strickland	Fsw	Mixed swamp forest	34	34	
102	Bosavi - Strickland	G	Grassland	0	0	
102	Bosavi - Strickland	H	Low altitude forest on uplands - below 1000 m	33	33	
102	Bosavi - Strickland	L	Small crowned forest	36	36	
102	Bosavi - Strickland	O	No forest (Land use intensity classes 0-4)	0	0	
102	Bosavi - Strickland	P	Low altitude forest on plains and fans - below 1000 m	33	33	
102	Bosavi - Strickland	Sc	Scrub	0	0	
102	Bosavi - Strickland	W	Woodland	34	34	
103	Aramia - Kikori	D	Dry evergreen forest	56	56	
103	Aramia - Kikori	E	Lakes and larger rivers	0	0	
103	Aramia - Kikori	Fri	Riverine mixed successions	34	34	
103	Aramia - Kikori	Fsw	Mixed swamp forest	34	34	
103	Aramia - Kikori	G	Grassland	0	0	

Simply update the figure in the column 'Current Vol/ha'. Notice that there is a column 'Orig Vol/ha'. This column contains all the original timber volumes used in the initial FIM system, as detailed in the publication by E.T. Hammermaster and J.C. Saunders "Forest Resources and Vegetation Mapping of Papua New Guinea".

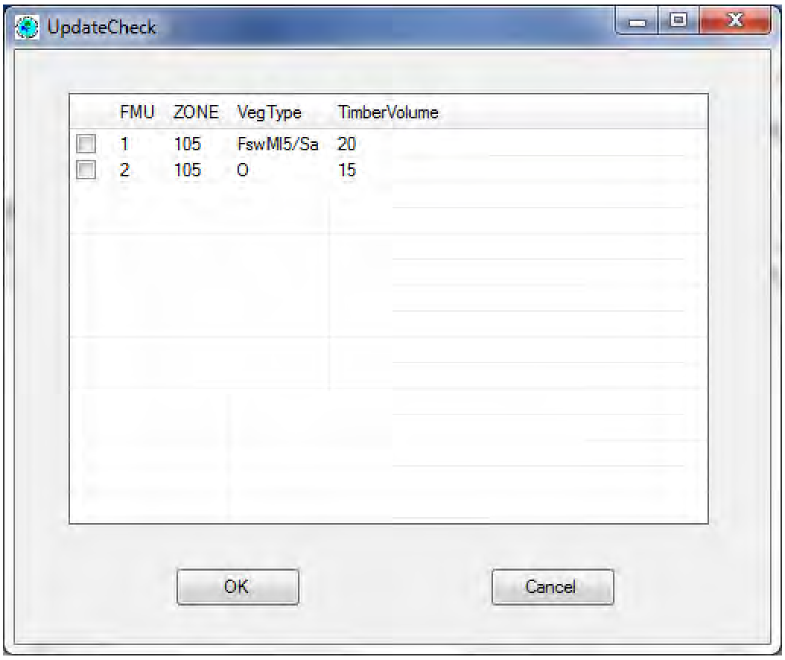
To cancel updating, click the Cancel button. To update, click the OK button.

Clicking the OK button after you have clicked the Update Timber Volumes for FMU button and updated the data will display the subwindow. However, if you exit the application after clicking the Update Timber Volumes for FMU button and updating the data, or if you click the OK button after the subwindow is displayed, the subwindow will not be displayed from the next time onwards.

If the data has not been updated with the Update Timber Volumes for FMU button, it will be updated without the subwindow being displayed.

Only the Vol/ha column can be edited. Click the cell to display the dialogue for entering a new value.

Subwindow



・The list of updated FMUs using Update Timber Volumes for FMU is displayed.

・Only the FMUs with selected check boxes are updated when the OK button is clicked.
・If no Zone and VegType with selected check box exists in the list on the FMU Update for Zone screen, a warning message is displayed. When the message appears, deselect the relevant record and click the OK button.

1.4.2. Updating a Timber Volume for an individual FMU

Choose the FMU you wish to update from the FMU display (click on the relevant row). The chosen FMU number will appear next to the button 'Update Timber Volume for FMU'. In the example above, FMU 37 has been chosen.

Enter the revised timber volume figure in the box next to 'New Timber Volume (cu m ha). In the example above, we are updating the timber volume for FMU 37 from 50 cubic metres per hectare to 45 cubic metres per hectare.

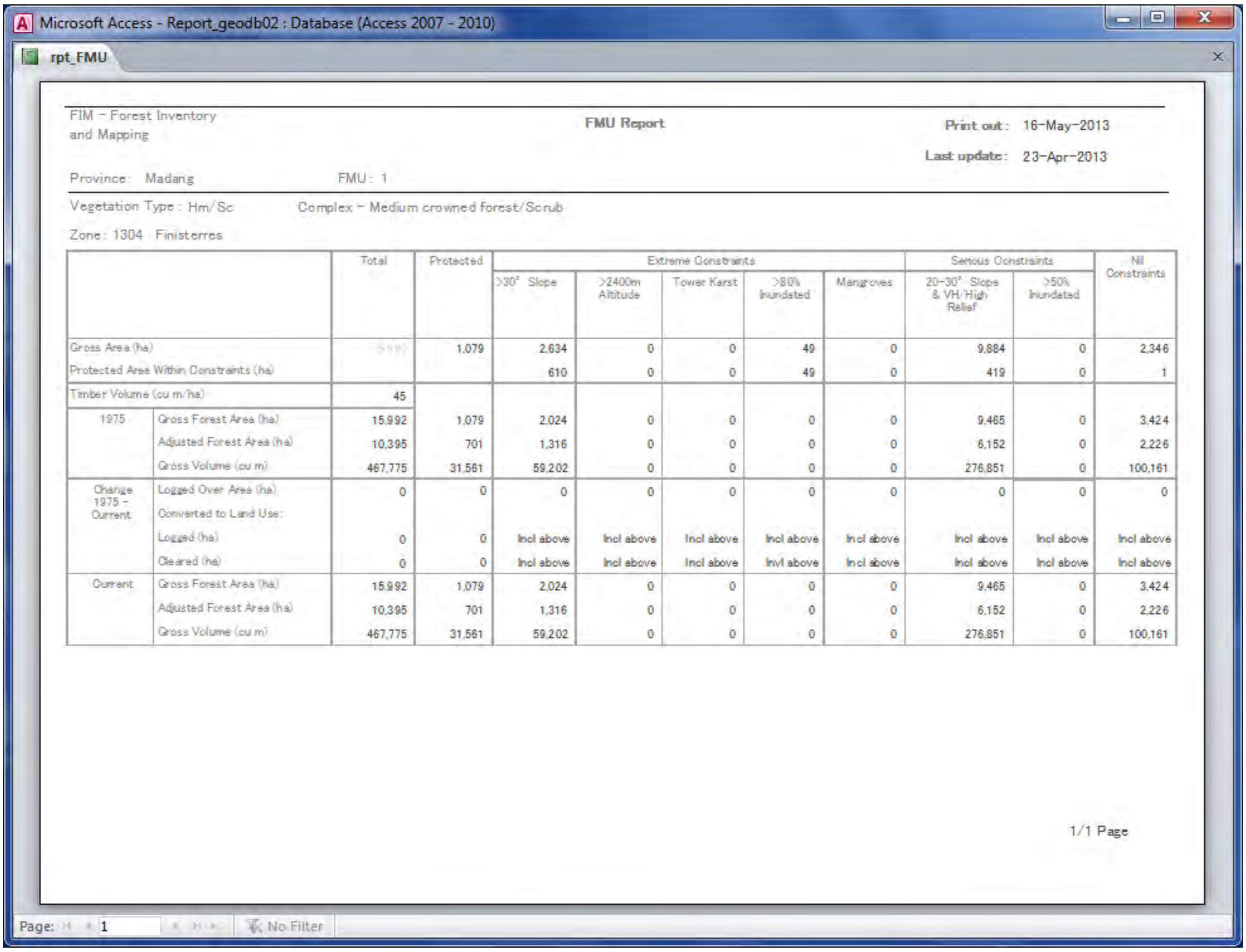
Then click on the button 'Update Timber Volume for FMU'.

If you are certain of your selection, choose Yes to the question "Are you sure you wish to update the Timber Volume for chosen FMU?" If not, choose No and no change will be made.

After choosing Yes, the Timber Volume for the Vegetation Type in the individual FMU will be updated, and all volume calculations for the FMU, and for any concessions that the FMU is in, will be automatically performed.

1.5. Preview Window(Report)

You can display the print image by selecting a report from the Report list on the main screen and clicking the Preview button.



FIM – Forest Inventory and Mapping

FMU Report

Print out: 16–May–2013

Last update: 23–Apr–2013

Province: Madang FMU: 1

Vegetation Type: Hm/Sc Complex – Medium crowned forest/Scrub

Zone: 1304 Finisterres

		Total	Protected	Extreme Constraints					Serious Constraints		Nil Constraints
				>30° Slope	>2400m Altitude	Tower Karst	>80% Inundated	Mangroves	20–30° Slope & VH/High Relief	>50% Inundated	
Gross Area (ha)		[illegible]	1,079	2,634	0	0	49	0	9,884	0	2,346
Protected Area Within Constraints (ha)				610	0	0	49	0	419	0	1
Timber Volume (cu m/ha)		45									
1975	Gross Forest Area (ha)	15,992	1,079	2,024	0	0	0	0	9,465	0	3,424
	Adjusted Forest Area (ha)	10,395	701	1,316	0	0	0	0	6,152	0	2,226
	Gross Volume (cu m)	467,775	31,561	59,202	0	0	0	0	276,851	0	100,161
Change 1975 – Current	Logged Over Area (ha)	0	0	0	0	0	0	0	0	0	0
	Converted to Land Use:										
	Logged (ha)	0	0	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above
	Cleared (ha)	0	0	Incl above	Incl above	Incl above	Invl above	Incl above	Incl above	Incl above	Incl above
Current	Gross Forest Area (ha)	15,992	1,079	2,024	0	0	0	0	9,465	0	3,424
	Adjusted Forest Area (ha)	10,395	701	1,316	0	0	0	0	6,152	0	2,226
	Gross Volume (cu m)	467,775	31,561	59,202	0	0	0	0	276,851	0	100,161

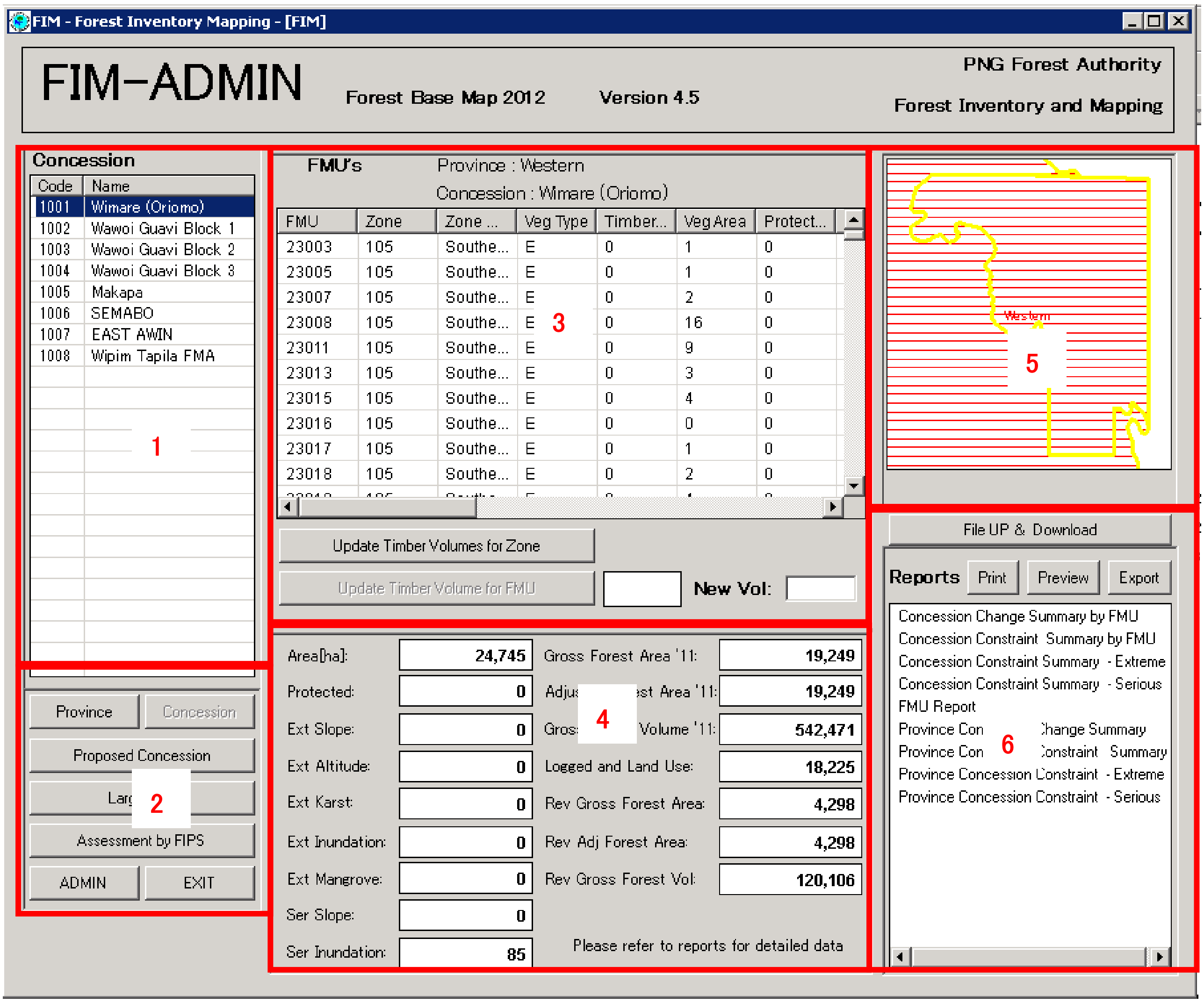
1/1 Page

1.6. Main Screen（Concession data）

When you select a province and click the Concession button or Proposed Concession button, the following screen is displayed.

The following operations can be performed in this screen.

- You can check the details of the concession FMUs.
- You can check the total values for the concession.
- You can print out the concession reports.
- You can update the concession timber volumes.
- You can upload and download files.



1. Concession： Displays the list of Concession Area codes and names.
   Proposed Concession： Displays the list of Proposed Concession Area codes and names.
   When you select a Concession Area or Proposed Concession Area from the list, areas 3, 4 and 5 are updated.

2. **Province**： Click to display the list of Provinces.
   Concession： Click to display the list of Concession Area codes and names.
   Proposed Concession： Click to display the list of Proposed Concession Area codes and names.
   Assesment by FIPS： Click to display the selected province Concession (FIPS) screen.
   Large Map： Click to jump to the Large Map screen.

ADMIN: Click to jump to the ADMIN screen.
EXIT: Click to exit the system.

3. Displays the list of FMUs in the selected concession area.

   Update Timber Volumes for Zone: Click to jump to the Update Timber Volumes screen.

   Update Timber Volume for FMU: Updates the timber volume of the selected FMU using the value entered in New Vol.

4. Displays the totals for the selected concession area.

5. Displays the map.

6. Displays the list of available reports (ledgers).
   For details of ledgers, refer to the Ledger Design Document.

   Print: Click to print the selected report in A4 or A3 format.

   For paper sizes, refer to Report Printing Sizes below.

   The "last update" displayed when printing a ledger is controlled in province or concession units.

   Preview: A preview of the selected ledger is displayed when pressed.

   Export: The selected ledger is output in rtf or xls format when pressed.

   * The standard Access function is used for outputting ledgers.

   For rtf format, output is in the ledger format.

   For xls format, output is in the format of a table with 1 record on 1 line. Basically the ledger column name is used as the table column name, but for ledgers in special format, such as FMU Reports, the form is ledger column name, ledger row name.

   File Up & Download: The FileUpDownload Dialog box is displayed when pressed.

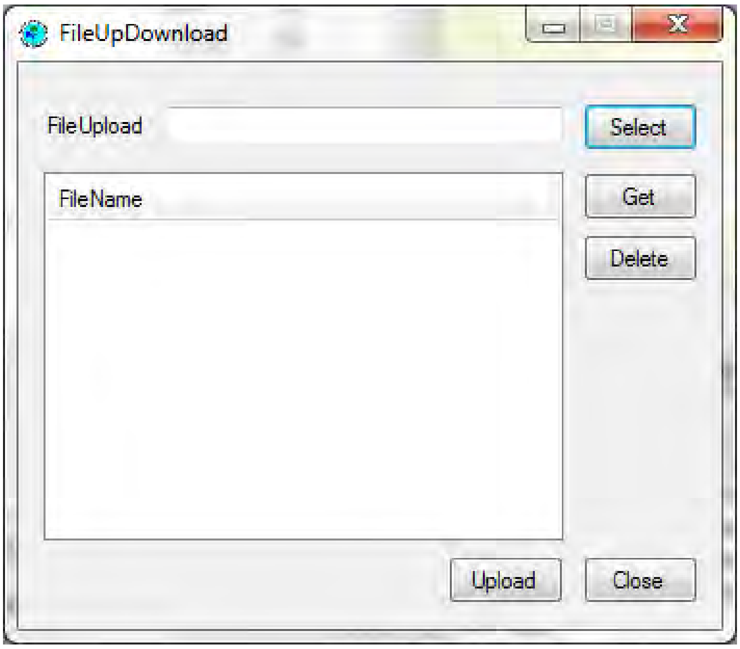
   *The width of areas 5 and 6 and areas 3 and 4 can be changed.

・Report Printing Sizes

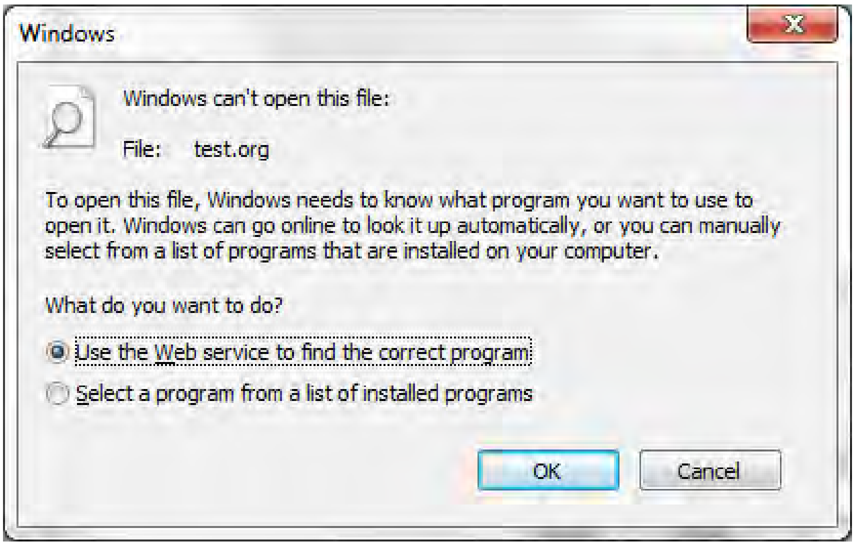
Report Name	Paper Size
Concession Change Summary by FMU	A4
Concession Constraint Summary by FMU	A4
Concession Constraint Summary - Extreme	A4
Concession Constraint Summary - Serious	A4
FMU Report(Concession)	A4
Province Concession Change Summary	A4
Province Concession Constraint Summary	A4
Province Concession Constraint – Extreme	A4
Province Concession Constraint - Serious	A4

・**FileUpDownload Dialog box**

Files can be uploaded and selected files can be downloaded using this dialog box.



- **Select**: Select the file to be uploaded.
- **Upload**: Upload the selected file to FIMS.
  Any file can be uploaded except files with extensions .exe and .bat.
- **Get**: When pressed after selecting a file displayed in the list, the selected file is obtained and opened.
  * If the extension of a file obtained is associated with an application, the file is opened with that application. If the extension is not associated with an application, a dialog box (Windows standard) to specify the application to open the file is displayed.



- **Delete**: When pressed after selecting a file displayed in the list, the selected file is deleted.

* Files uploaded here are tied to the ConcessionArea by the plan_id key, and if the ConcessionArea is deleted from the LargeMap screen, it is not possible to get the tied files.
Therefore, if ConcessionArea is to be deleted, delete it after getting and deleting the files uploaded from this screen.

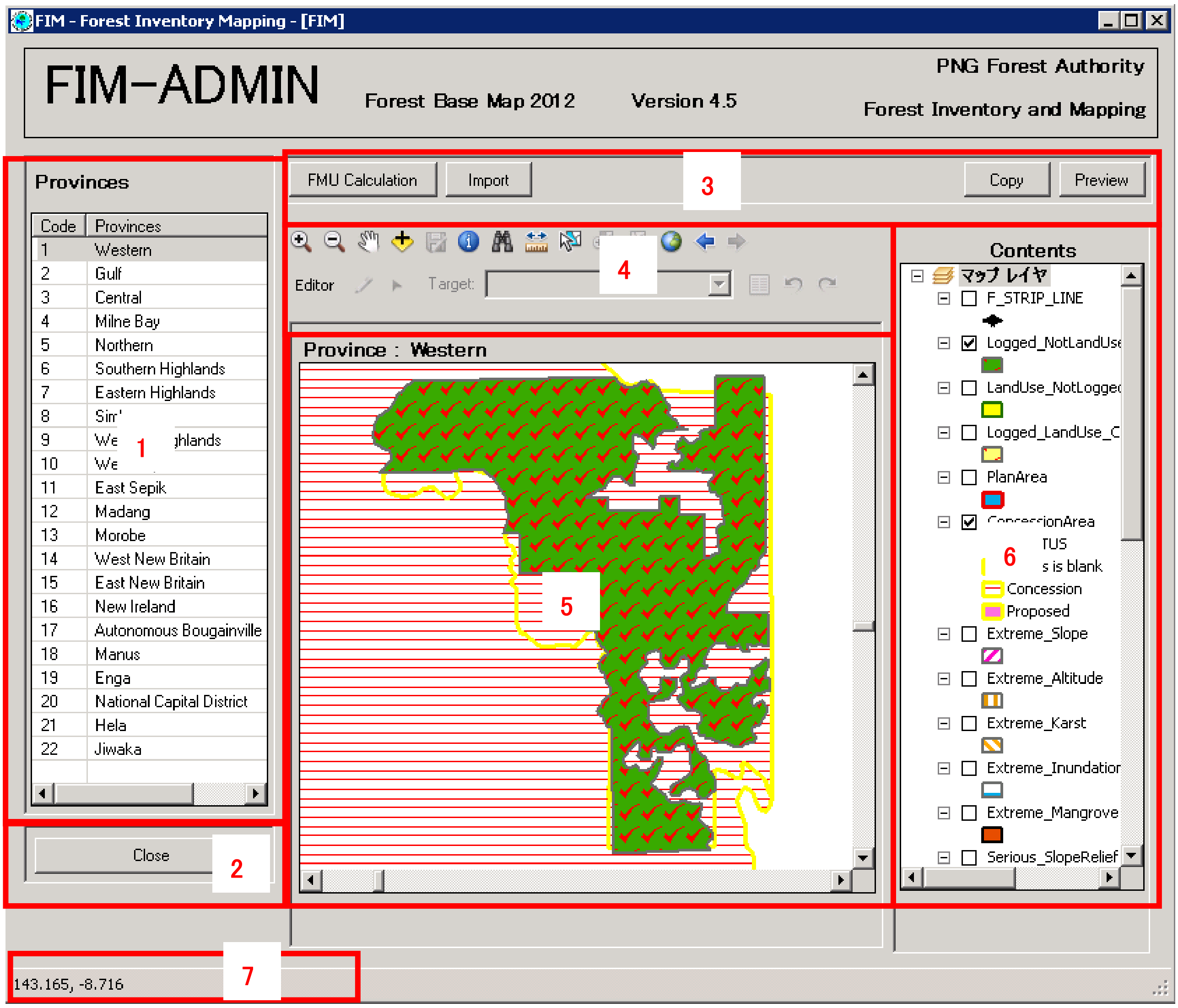
1.7. Large Map

Click the Large Map button on the main screen to jump to the following screen.

To change the style of a map, right click the layer with the mouse and select Property.

The following operations can be performed in this window.

- You can draw or edit a Concession Area, Protected Area, LandUse_NotLogged_Current, Logged_LandUse_Current, Logged_NotLandUse_Current or PlanArea, search for features and add or replace data.
- You can recalculate (update) FMUs and Concession FMUs.
  (After adding, replacing, drawing or editing data, perform recalculation.)
- You can print the map.



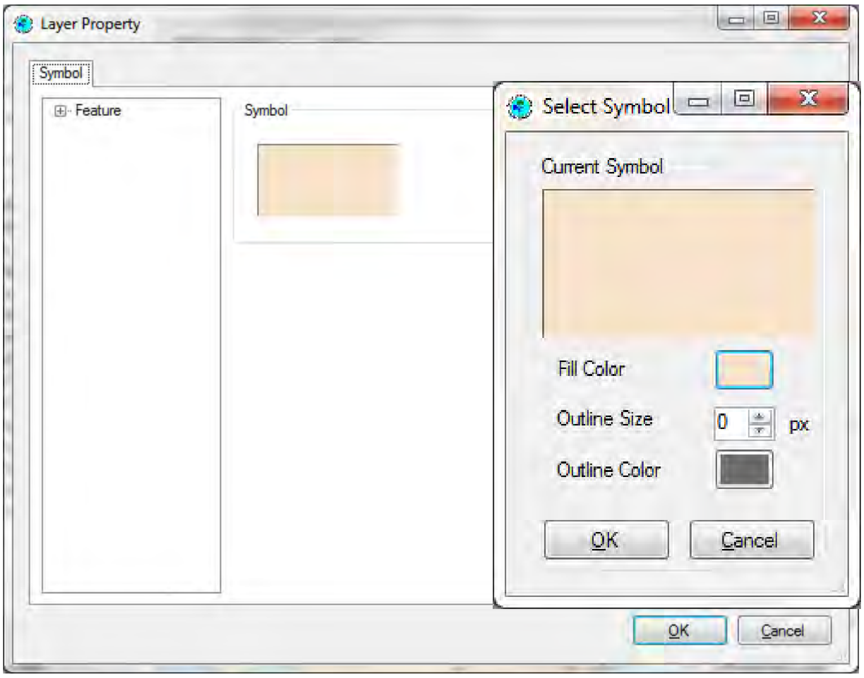
1. Displays the list of province codes and names.
2. **Close**: Click to close the LargeMap screen.
3. **FMU Calculation**: The details are described later.

   Import: The details are described later.

Copy： Click to copy the currently displayed map to the clipboard.

4. **Preview**： Click to display the preview screen for the currently displayed map.
5. **Tool Bar**: The details are described later.
6. Displays the map.
   If a .shp file is Dragged & Dropped into this area, a layer can be added to the map.
7. Control the sequence of displaying layers or change the legend, etc.
   The sequence of displaying a layer can be changed by Dragging & Dropping the layer.
   The legend can be changed by right clicking a layer with the mouse, and selecting Property.
   Layers added to the map by Drag&Drop can be deleted by right clicking with the mouse and selecting Remove Layer.
8. The coordinates of the position indicated by the mouse pointer are displayed in the BL.
9. *The width of area 6 and areas 4 and 5 can be changed with the mouse.

・Property



The Layer Property screen is displayed by right clicking the layer with the mouse and selecting Property.

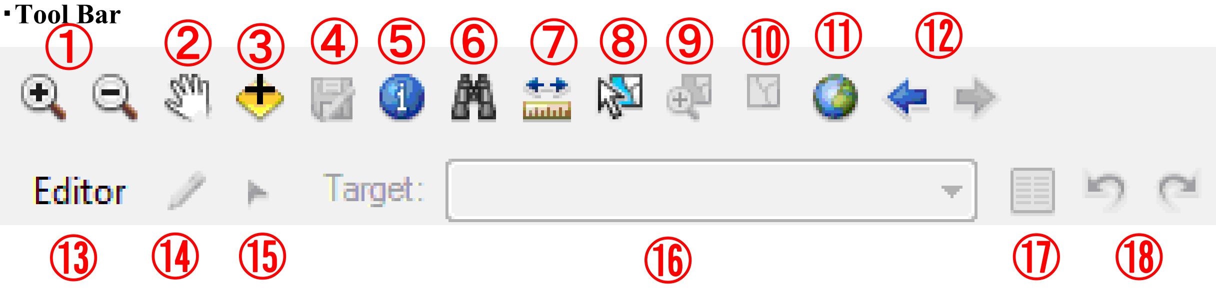
By selecting Symbol there, the Select Symbol screen is displayed.

The legend of the selected Layer can be changed by specifying the color, etc., here, and pressing the OK button to finish.

To perform special Symbol settings such as transparent, etc., open the PNG.mxd file in ArcMap and edit it. For details refer to the official manual or website.

http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

・Tool Bar



① **Zoom In/Out**: Enlarges and reduces the map.

② **Pan**: Moves the map.

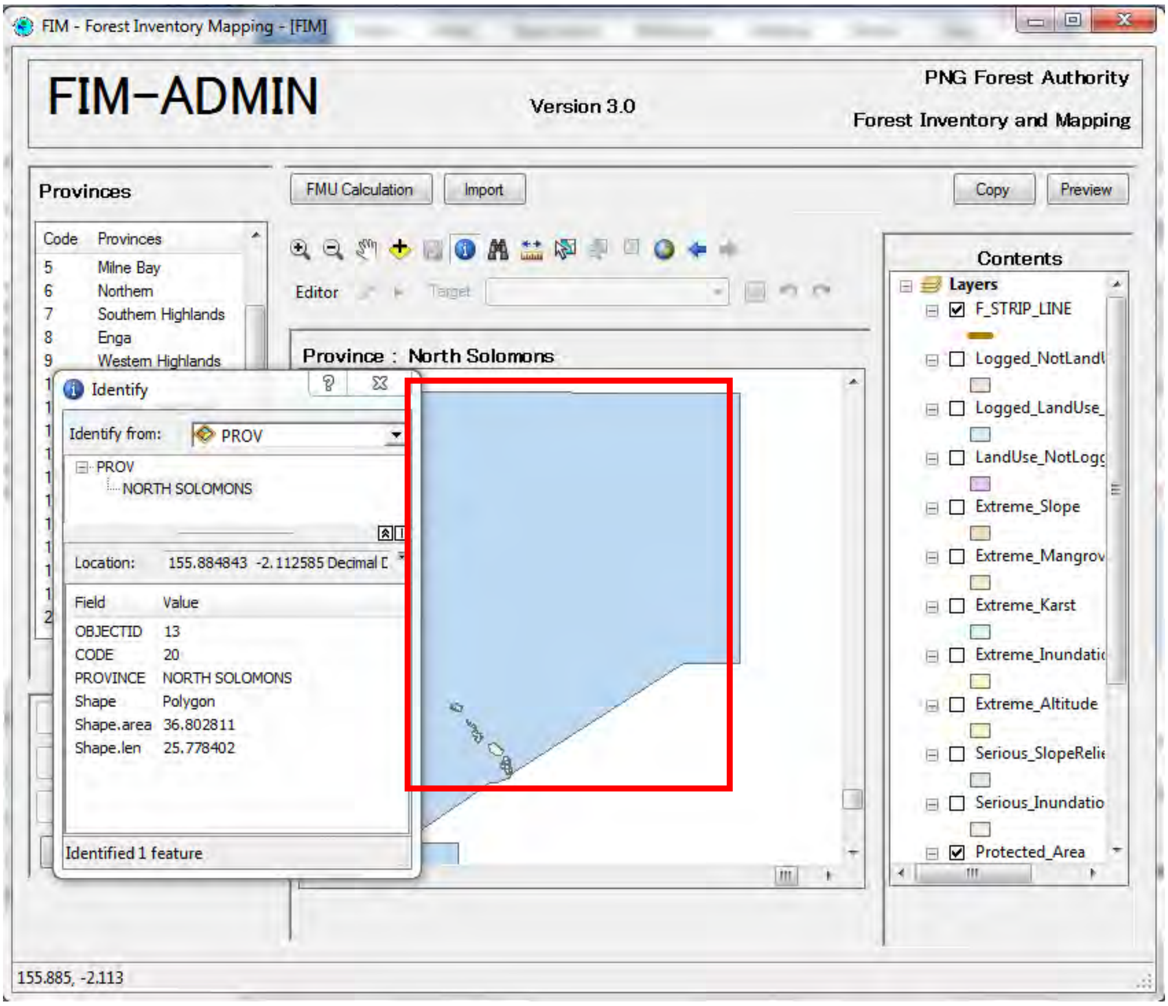
③ **Add Layer**: Adds a displayable layer（.shp file or .tif file）on the screen.

This function is for displaying local data on the map; it is not for sharing (with another client computer). If you wish to share, use the function in 2.2 Layer Management

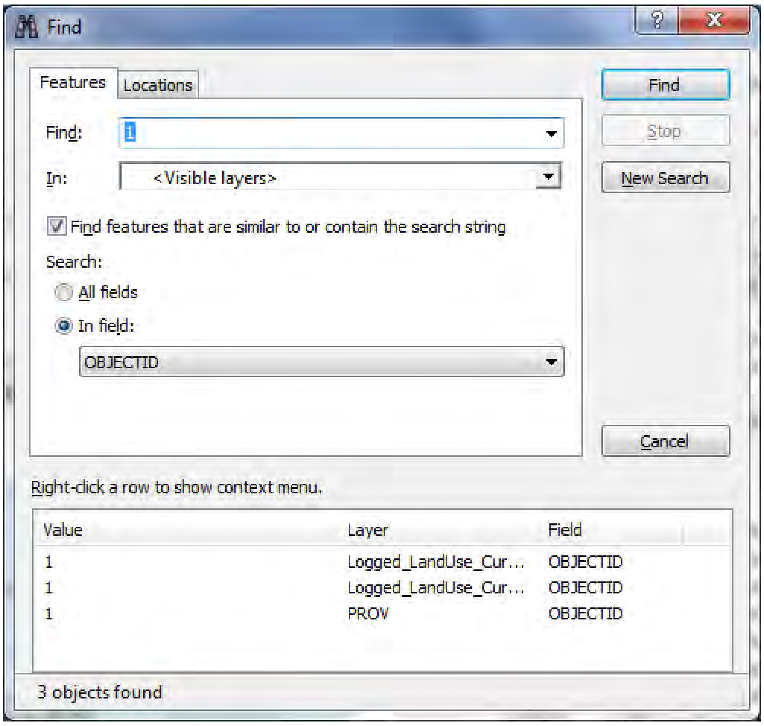
To delete an added layer, select the layer that has been added from the Contents tree by right clicking with the mouse, and selecting Remove Layer (a layer that has been registered in the mxd file from the start cannot be deleted).

④ **Save Edits**: Saves the edited content.
Edit using functions ⑬-⑰. For details, check ⑬-⑰.

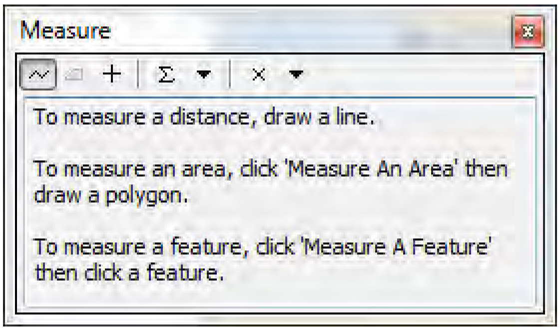
⑤ **Identify**: Displays information on the selected location. (Red frame: Selected location)



⑥ **Find**: Enter the conditions and search for features.



⑦ **Measure:** Measures distances and areas. Besides drawing and measuring lines or planes, it is possible to select a linear feature or a planar feature and measure the distance or area.



⑧ **Select Feature**: Selects a feature. You can only select a layer that is registered in the version-compliant layers.
Version-compliant layers are Concession Area, Protected Area, LandUse_NotLogged_Current, Logged_LandUse_Current, Logged_NotLandUse_Current and PlanArea.

*To select a layer other than the above

・Select a feature in the individual attributes window, right-click on the feature name and click Select.
・Right-click on the search results and click Select.

When you select a feature, function ⑨ is activated.

To cancel the selection, use function ⑩.

⑨ **Zoom Selected Feature**: Displays the selected feature in maximum size.

⑩ **Cancel Select**: Cancels selection of a feature.

⑪ **Full Extent**: Displays the entire map.

⑫ **Go Back To Previous Extent/Go to Next Extent**: Goes to previous or next map display range.

⑬ **Editor**: Click to display the following items.

・Start Editing: Starts editing.

・Stop Editing: Stops editing.
・Copy: Copies a feature.

・Cut: Cuts out a feature.

・Delete: Deletes a feature.

・Paste: Pastes a feature.

・Save Edits: Saves changes.

・Snapping Settings: Configures the snapping settings.

When you select Start Editing, functions ⑬-⑰ are activated.

This allows you to draw and edit the following five layers.

・ConcessionArea

・LoggedNotLandUse_Current

・LoggedLandUse_Current

・LandUseNotLogged_Current

・ProtectedArea

・PlanArea

It is possible to simultaneously edit from several FIMS.

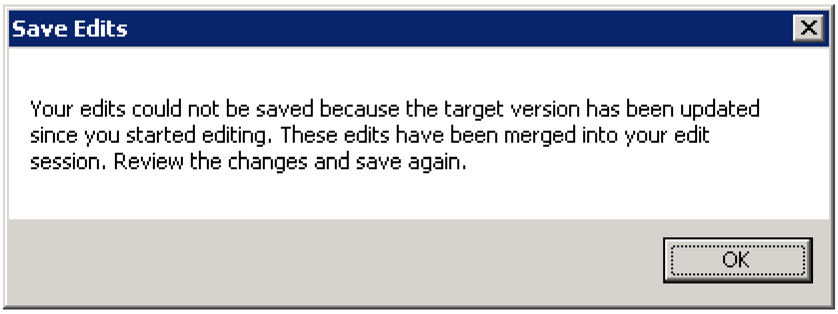
To draw, select the layer you want to draw in ⑮ and create a feature with ⑬.

To edit, select ⑭ and select a feature.

To stop editing, select Save Edits to save changes, and exit editing by clicking Stop Editing.

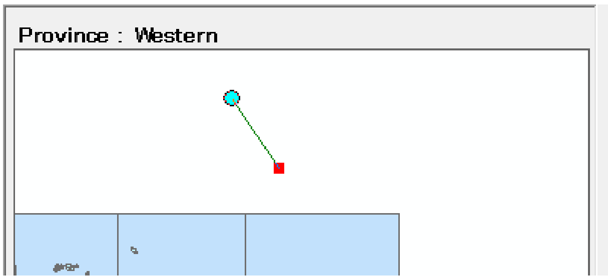
If editing is carried out simultaneously from several FIMS, when the second or subsequent PC selects Save Edits, the following message is displayed and the map screen is redrawn. After that, by selecting Save Edits again, the content of the work is saved*.

* If several FIMS have edited the same feature, the result of editing by the FIMS that is saved last is saved.

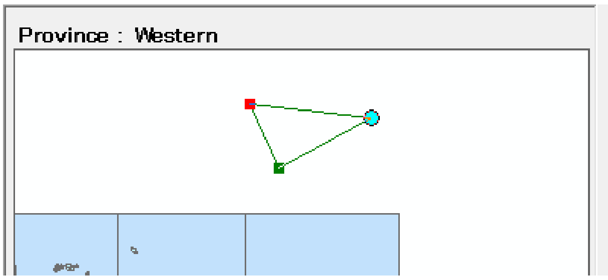


⑭ Creates a feature in the map.

1. Click on the screen to set a vertex.

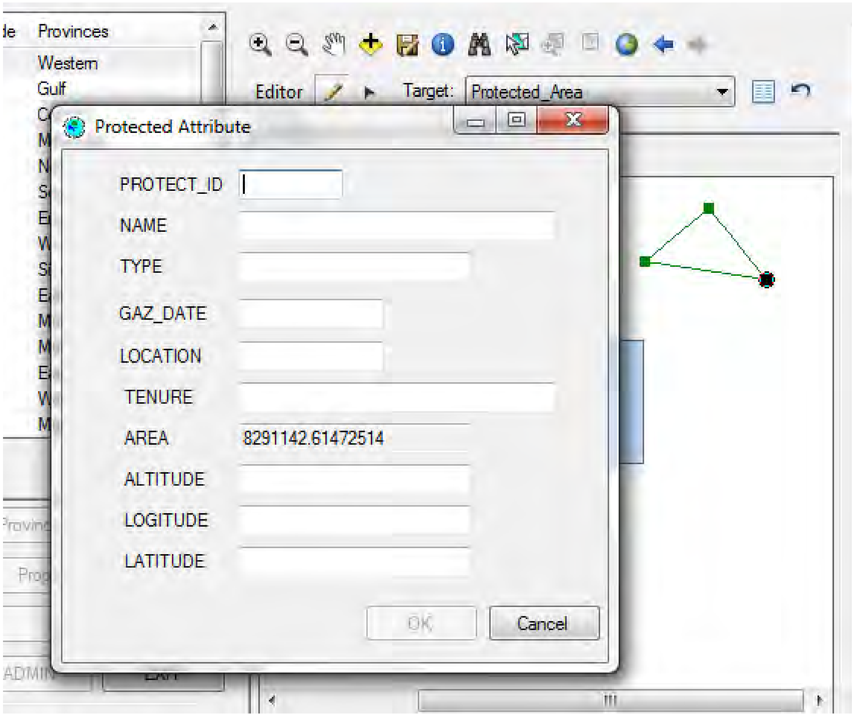


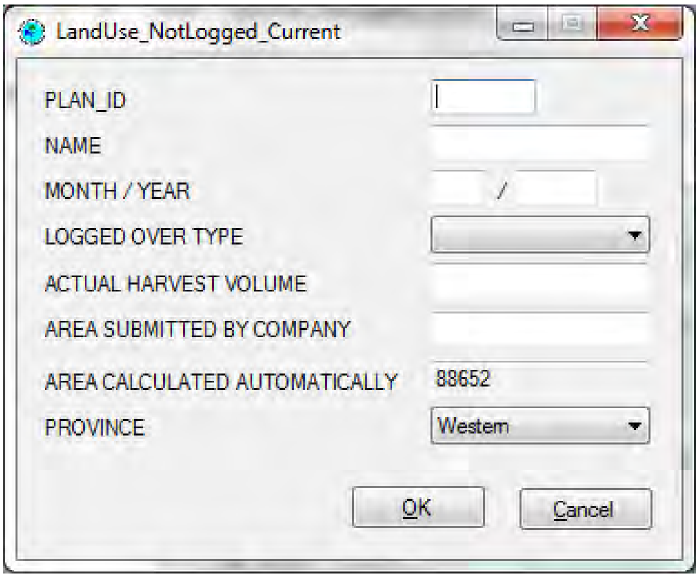
2.Create a feature.



3. Double-click to finalise.

After confirming, the Attribute Window is displayed. The content of the window displayed may vary depending on the type of layer.





*To cancel drawing, press Ctrl + Delete before finalising.

To return to the previous state, press Ctrl + Z.

Concession Area has four important fields.

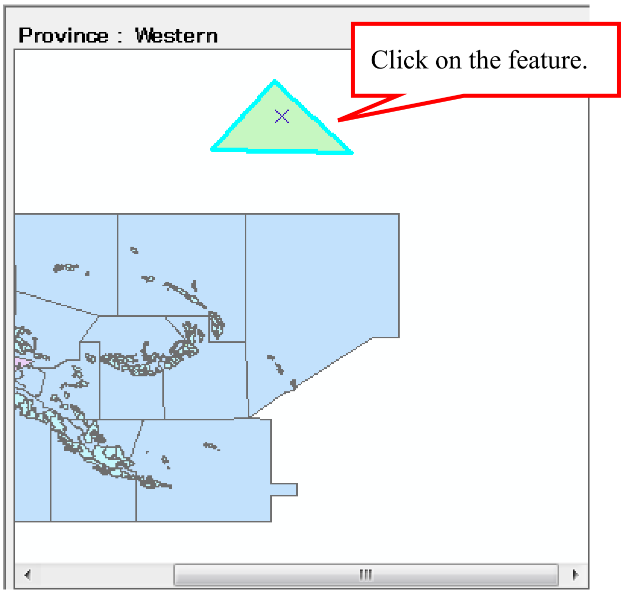
- **plan_id** – enter the next plan id for the Province (these numbers are formally listed in the Plans Listing document held by the Mapping Branch Manager).
- **name** – enter the name of the new concession area.
- **area** – enter the area in hectares of the new concession area. The area can be determined by double-clicking on the polygon.
- **status** – enter the status of a new concession area as 'Proposed'. An existing concession area has the status 'Concession'. So to change a Proposed Concession Area into an official Concession Area, simply change the status from Proposed to Concession. Make sure the spelling is correct.

All Protected areas for Western province are displayed. To modify current Protected Areas, or to create new Protected Areas, make the Protected Area layer editable, and then use the this drawing tools.

Logged Over Area has two important fields.

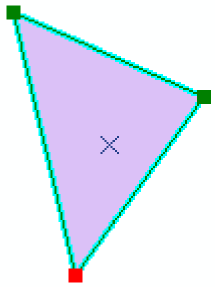
- **plan_id** – Input the plan_id of the ConcessionArea associated with the feature of the Logged Over Area.
- **Actual Harvest Volume** – Input the Actual Harvest Volume of the Logged Over Area. The value input is that used in the Concession (FIPS) screen.

⑮ **Edit Tool**: Selects a feature.

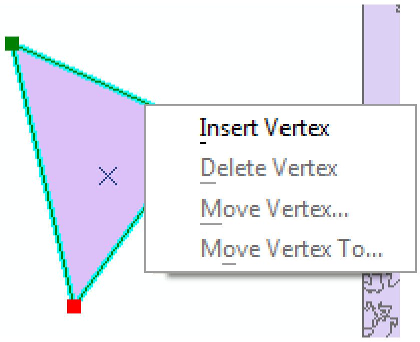


・Adding a Vertex

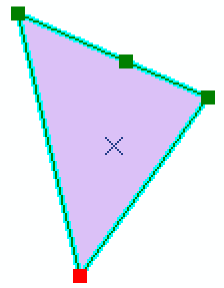
Select a feature and double-click to switch to editing mode.



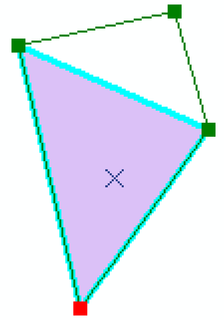
Right-click on one side of the feature to activate the Insert Vertex menu.



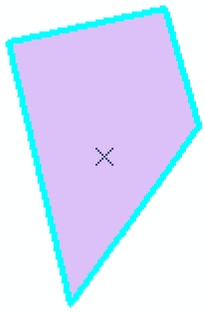
Add a vertex using Insert Vertex.



When the mouse is placed on the vertex, the pointer changes. Drag the vertex to the desired position.



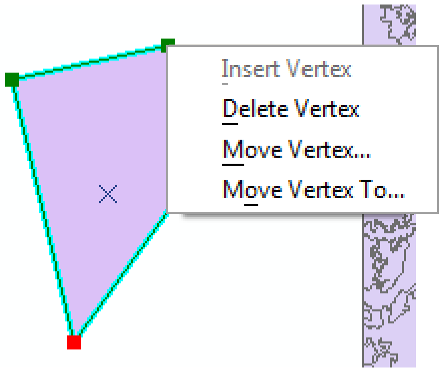
Click outside the feature to finalise the change.



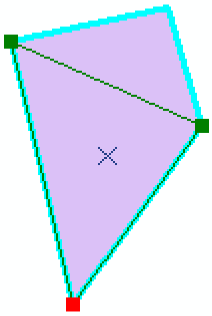
*To return to the state before the vertex was added, press Ctrl + Z.

・Deleting a Vertex

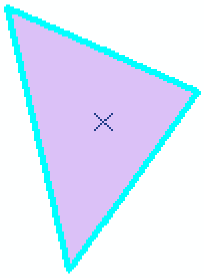
Right-click on a vertex of the feature to activate the Delete Vertex menu.



Click to delete the desired vertex.



Click outside the feature to finalise the change.



*To return to the state before the vertex was deleted, press Ctrl + Z.

・Deleting Features

When the Delete key is pressed when a feature is selected, the feature is deleted.

To delete a feature, select the rearmost feature. To select the frontmost feature, carry out the following operations.
1. Select the feature using the Attribute function of ⑰.
2. Cancel editing of attributes.
3. Select the icon of ⑮.
4. The feature in 1 becomes selected, so press the delete key as it is.

* If a ConcessionArea is deleted, it is not possible to get files tied to the ConcessionArea.

Therefore, to delete a ConcessionArea, first get or delete files uploaded using 1.6. Main Screen（Concession data） screen.

⑯ **Editable Layer**: Selects the layer to be drawn in ⑮.
Only the following layers can be drawn.

・ConcessionArea

・LoggedNotLandUse_Current

・LoggedLandUse_Current

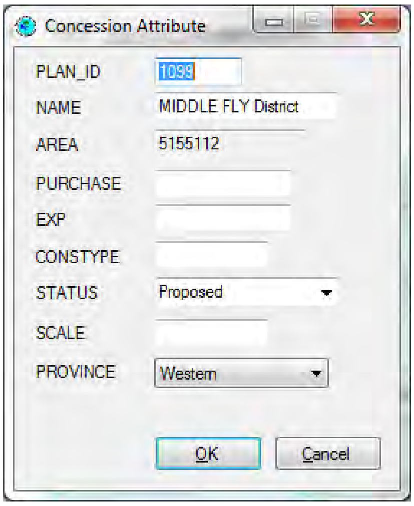
・LandUseNotLogged_Current

・ProtectedArea

・PlanArea

* This specification is used when specifying a layer to prepare a drawing, and it cannot be used when editing attributes, etc.*

⑰ **Attribute**: After selecting the icon, displays the Attribute window when you double-click on a Protected Area, Concession Area, Logged Over Area or PlanArea feature. (When a position with several superimposed features is selected, the uppermost of the editable features is selected)



・You can display or enter the attributes of the drawn layer.

・The area of the drawn graphic is automatically entered in the Attributes.

・When you change the graphic of a selected feature, you can recalculate the area value.

・This window is displayed when you select Editor in the tool bar to draw a layer and click the Attribute button in the Editor tool bar.

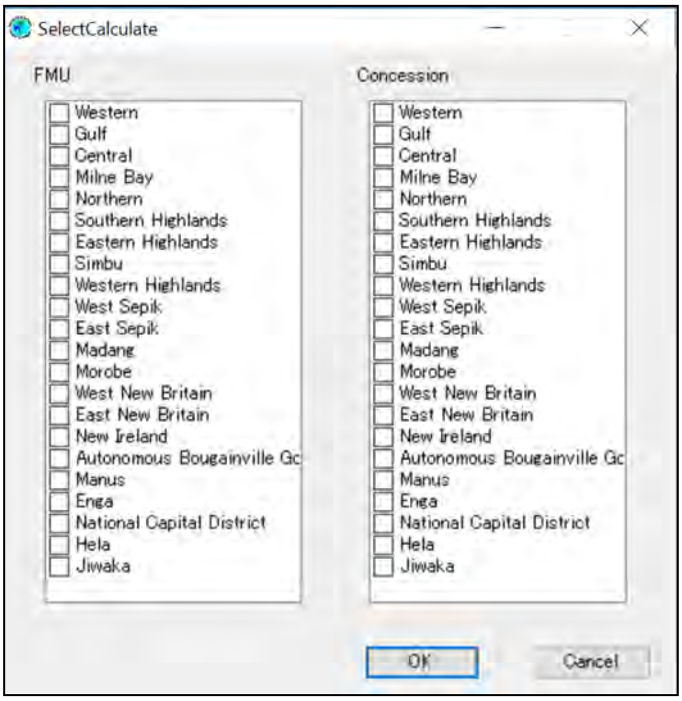
* If a feature whose attributes are to be edited cannot be selected, do not display layers that are higher than the feature, and select the feature when there are no features superimposed on the layer to be edited.

⑱ **Back/Redo**: Returns from the current state to the previous state or proceeds to the next state.

*For an explanation of the commands in the pop-up menu displayed by right-clicking while drawing or editing a feature, refer to the official help section. You can search for a command using the search box at top right.

http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

1.7.1. FMU Calculation



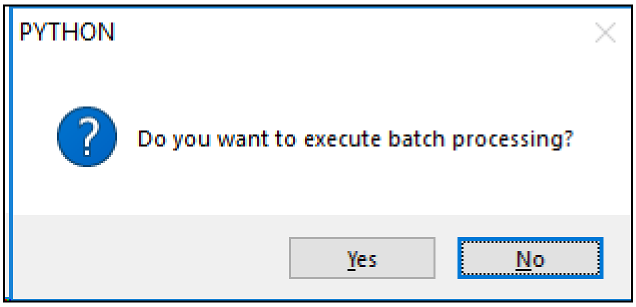
Processing will be carried out using FMU (old FMU or Forest Base Map 2012) and other layers which are edited or updated when the OK button is pressed.

You have to excute the FMU calculation after you update the layers of ConcessionArea, Protected Area, LandUse_NotLogged_Current, Logged_LandUse_Current, Logged_NotLandUse_Current.

・FMU tab: Re-calculation will be carried out using FMUs of the selected provinces and other related layers orvelapping FMUs. Also the timber volume is recalculated. As a result of the re-calculation, the FMU layer is updated.

・Concession tab: Re-calculation will be carried out using concession areas which belong to provinces selected and other related lyaers overlappeing concession areas. As a result of the re-calculation, the FMU_Concession table will be updated. Estimated timber volume inside each concession area is also updated.

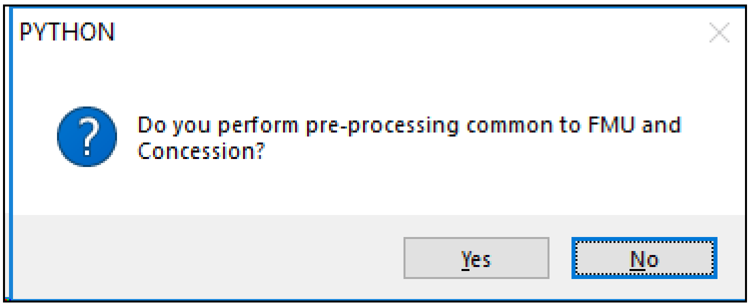
・The following message will appear after clicking the OK button above.



Click on “Yes” when you want to continue processing.

Click on “No” when you stop processing.

・The following message will appear when you click on “Yes” above.



The message is confirming if a common pre-processing for both FMU and concession area will be carried out.

Generally, you can choose “Yes”. If you have executed either FMU tab or Concession tab once, you can choose “No” to skip pre-processing for another tab because the result of the pre-processing is common between FMU tab and Concession tab.

The calculation will be carried out using replicated layers such as concession area and logging history which are transferred from SQL server to the workstation (POM-MAP-GIS06, as of 2019) of FIMS administrator.

・The following command window will be appear after clicking the OK button above.

This is a command prompt for pre-processing which is a common process for FMU and Concession Area.

Command line displayed on the screen is getting increased as process goes.

Next process starts automatically after the pre-processing finished.

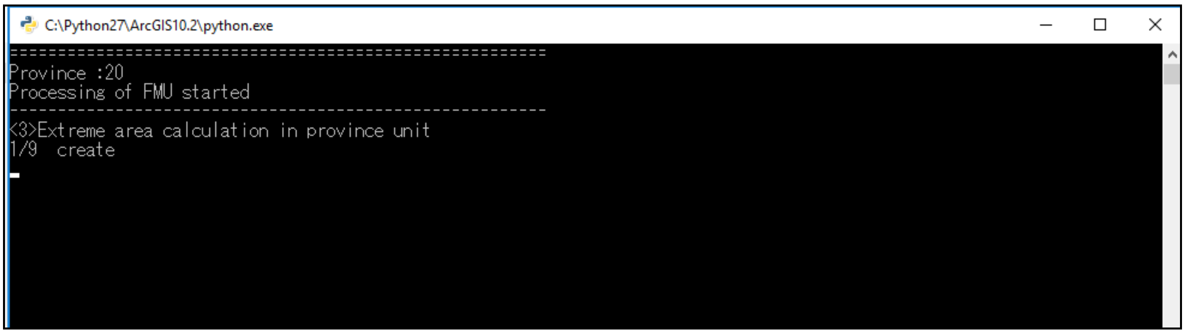
The following command prompt will appear if “Old FMU” was chosen on the login window.

This screen is a command prompt for pre-processing of “Old FMU”.

Command line displayed on the screen is getting increased as process goes.

Next process starts automatically after the pre-processing finished.

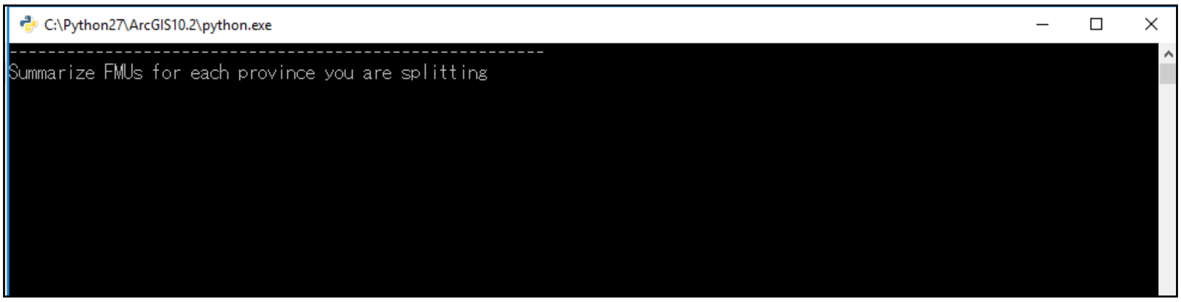
The following command prompt will appear by province selected.



Command line displayed on the screen is getting increased as process goes.

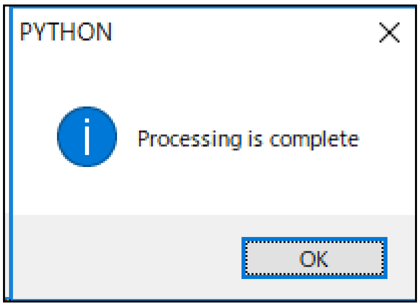
Next process starts automatically after the processing finished.

Then a command prompt for post-processing will appear.



Command line displayed on the screen is getting increased as process goes.

The following message will appear after the post-process finishes.



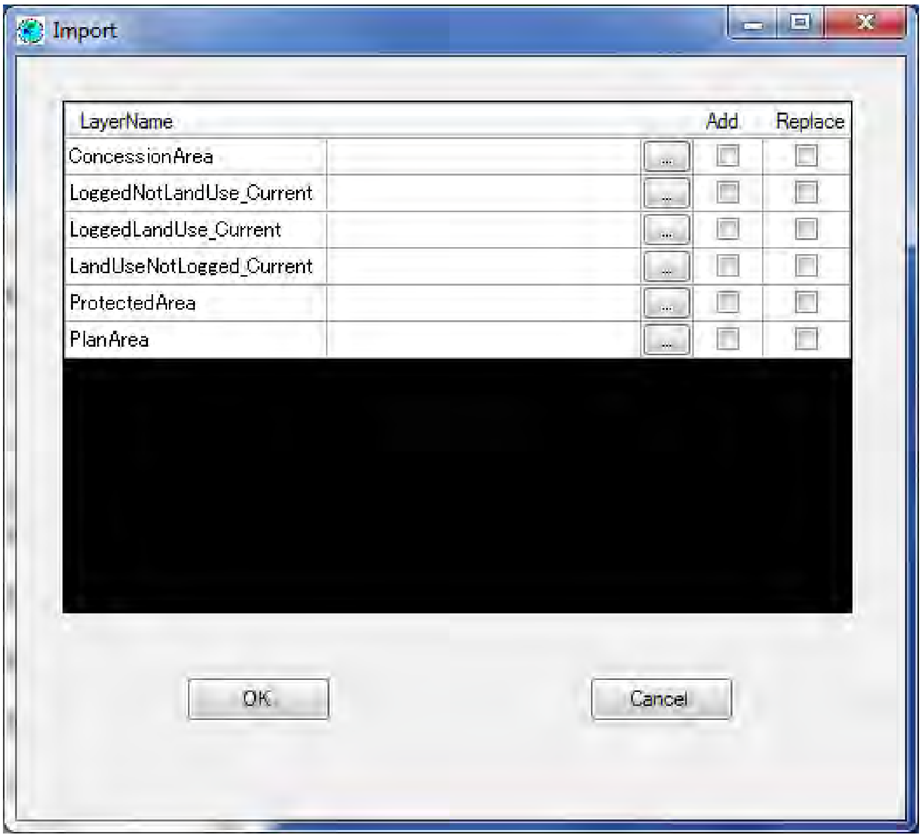
Click on the OK button and close the window.

The processing date and time are recorded by province and concession area. The date and time will appear in the field “last update” of reports.

1.7.2. Import

Select an SHP file and display the import dialogue.

This function is for registering five kinds of layer data that can be edited with the Large Map function.
The importable layers using this function are Nos. 1, 2, 3, 4, 6 and 17 in Table 1-1.



・When you select the Add check box and click the OK button, the data is imported, and when you select the Replace check box, the layers are replaced in a batch.

・After data has been replaced, it can be displayed and edited by other users (client).

・Replaceable layers cannot be added with this function.

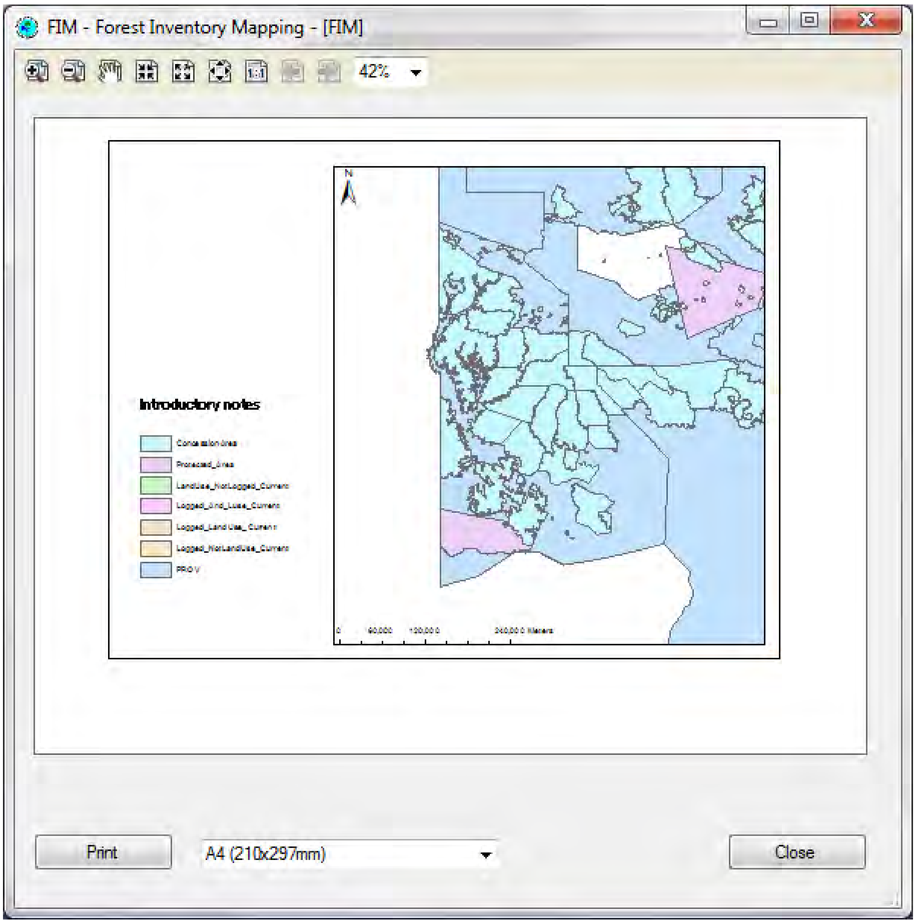
Table 1-1 List of Layers Used on FIMS and Relationships with Screen Functions

No	Layer name	Map screen			Administrator screen				
		Display	Draw Edit	Mass Replace	Management Target	Add	Edit (Mass Replace)	Delete	Remarks
1	Concession Area	○	○	○	-	-	-	-	
2	Logged_NotLandUse	○	○	○	-	-	-	-	
3	Logged_LandUse	○	○	○	-	-	-	-	
4	LandUse_NotLogged	○	○	○	-	-	-	-	
5	Logged_And_Luse	-	-	-	-	-	-	-	
6	Protected Area	○	○	○	-	-	-	-	
7	Forest Mapping Unit (FMU)	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
8	Slope (Extreme)	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
9	Altitude	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
10	Karst	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
11	Inundation (Extreme)	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
12	Mangroves	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
13	Inundation (Serious)	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
14	Slope/Relief	○	-	-	○	-	○	-	After replacement, perform recalculation of FMU and Concession FMU layers.
15	Background image (Satellite image)	○	-	-	○	○	○	○	
16	Background image (Other)	○	-	-	○	○	○	○	
17	PlanArea	◯	◯	◯	-	-	-	-	

1.7.3. Preview Window(Map)

・You can display the print image of the currently displayed map by clicking the Preview button in the Large Map screen.

・Legend and scale are displayed.



・Specify the print paper size from the pull-down list.

・Print: Click to print.

*If you want to change the print image, open and edit the template.mxd file in ArcMap.

For details of how to operate ArcMap, refer to the official manual or website.

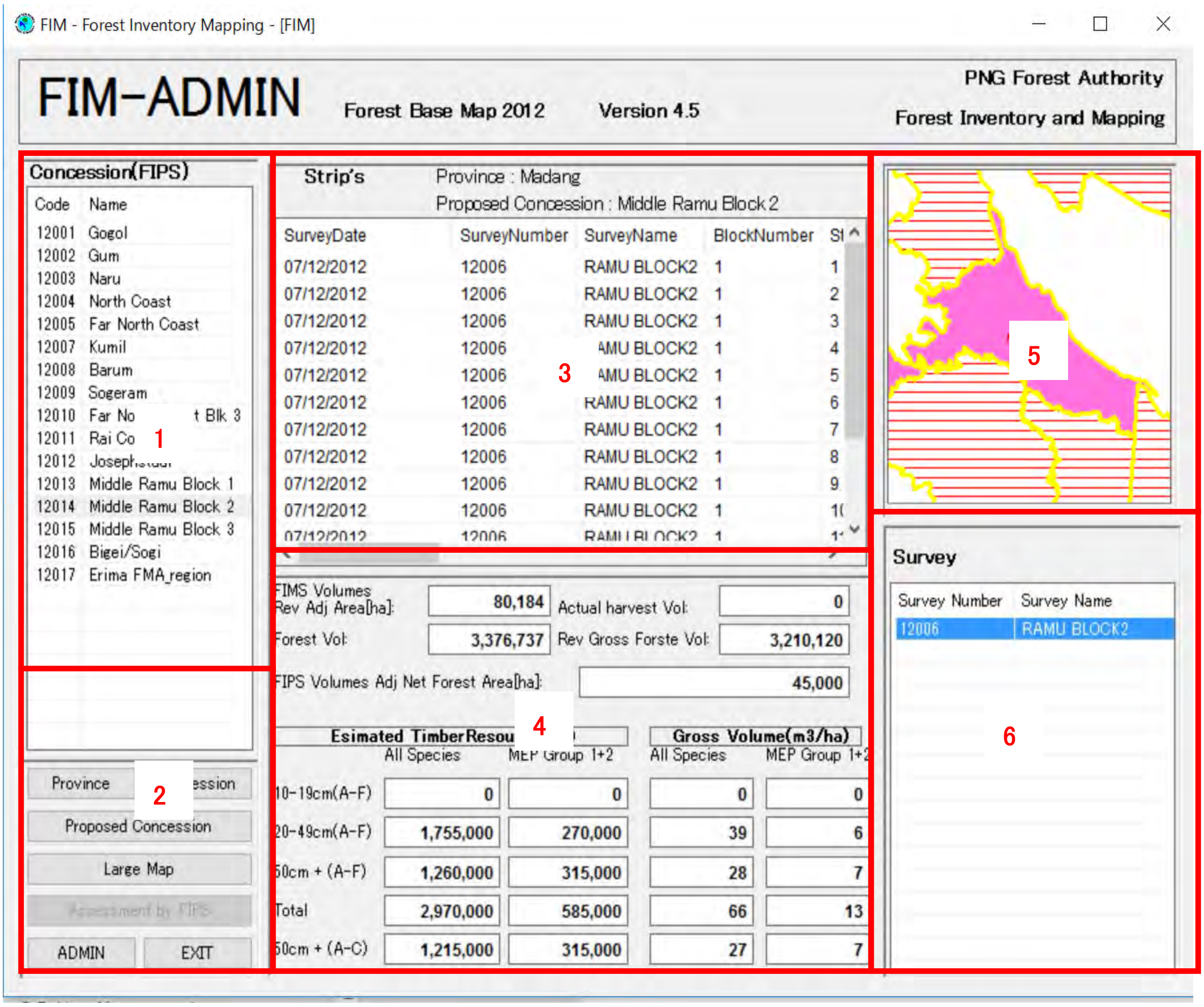
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

1.8. Assesement by FIPS

Select Province in the Main Screen, press the Assesment by FIPS button, and this screen is displayed.

The following operations can be carried out in this screen.

- A detailed StripLine of the Survey of the selected FIPS can be checked.
- The amount of forest in the Concession and the amount of forest in the selected Survey can be compared and checked.



1. A list of codes and names of Concession Areas (including Proposed Concession Areas) is displayed. If a Concession Area is selected from the list, the areas of 5 and 6 are updated.

2. **Province**: A list of provinces is displayed when pressed.
   Concession: A list of codes and names for Concession Areas is displayed when pressed.
   Proposed Concession: A list of codes and names for Proposed Concession Areas is displayed when pressed.
   Large Map: The Large Map screen is displayed when pressed.
   ADMIN: Changes to the ADMIN screen when pressed.
   EXIT: The system terminates when pressed.

3. A list of StripLines of the selected Survey is displayed.

4. The total values for both the selected Concession Area and Survey are displayed.

5. A map is displayed.
6. A list of FIPS Surveys（Survey Number, Survey Name） tied to the selected Concession Area is displayed. If a Survey is selected from the list, the Areas of 3 and 4 are updated.

* The width of areas 5 and 6 and areas 3 and 4 can be changed with the mouse.

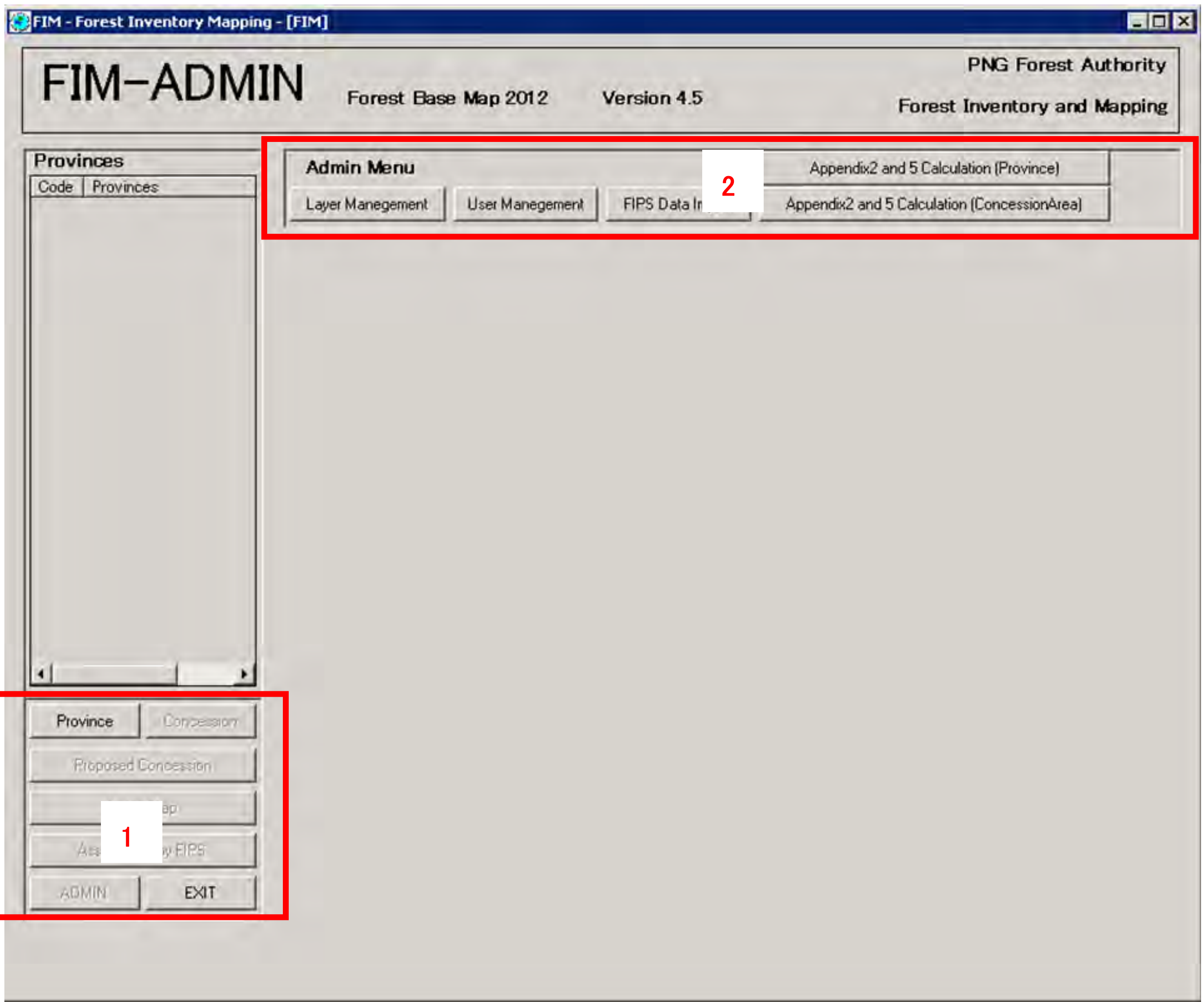
・Details of Items Displayed in 4

No	Item name	Details
1	Rev Adj Area[ha]	Total value of Adjusted_Forest_Area75 of selected Concession（plan_id）
2	Forest Vol	Total value of Gross_Forest_Vol_75 of selected Concession（plan_id）
3	Rev Gross Forest Vol	Total value of Rev_Gross_Forest_Vol of selected Concession(plan_id)
4	Actual_harvest_Vol	Total value of Actual Harvest Volume of Logged Over Area having the same plan_id as the selected Concession
5	Adj_Net Forest_Area[ha]	Value of ADJ_NET_FOREST_AREA of the selected Survey
6	Gross Volume(m3/ha) All Species	Value of, the Gross Volume (m3/ha) of the selected Survey
7	Gross Volume(m3/ha) MEP Group 1+2	Value of, the Gross Volume (m3/ha) of the selected Survey * Limited to MEP Group 1+2 only
8	Esimated TimberResource(m3) All Species	Value of Estimated TimberResource (m3) of selected Survey
9	Esimated TimberResource(m3) MEP Group 1+2	Value of Estimated TimberResource (m3) of selected Survey * Limited to MEP Group 1+2 only

2. FIM – ADMIN (System Administration)

2.1. Admin

The Admin screen is displayed by clicking the Admin button in each screen.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

   EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to the User Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen.

   AAC Calculation: Click to go to the Appendix2 and 5 Calculation

2.2. Layer Management

The Layer Management screen is displayed by clicking the Layer Management button in the Admin screen.

The function of this screen is to replace layer data which cannot be operated with the Import button, and also to manage (register, replace, delete) layers that you want to share (with another client computer).

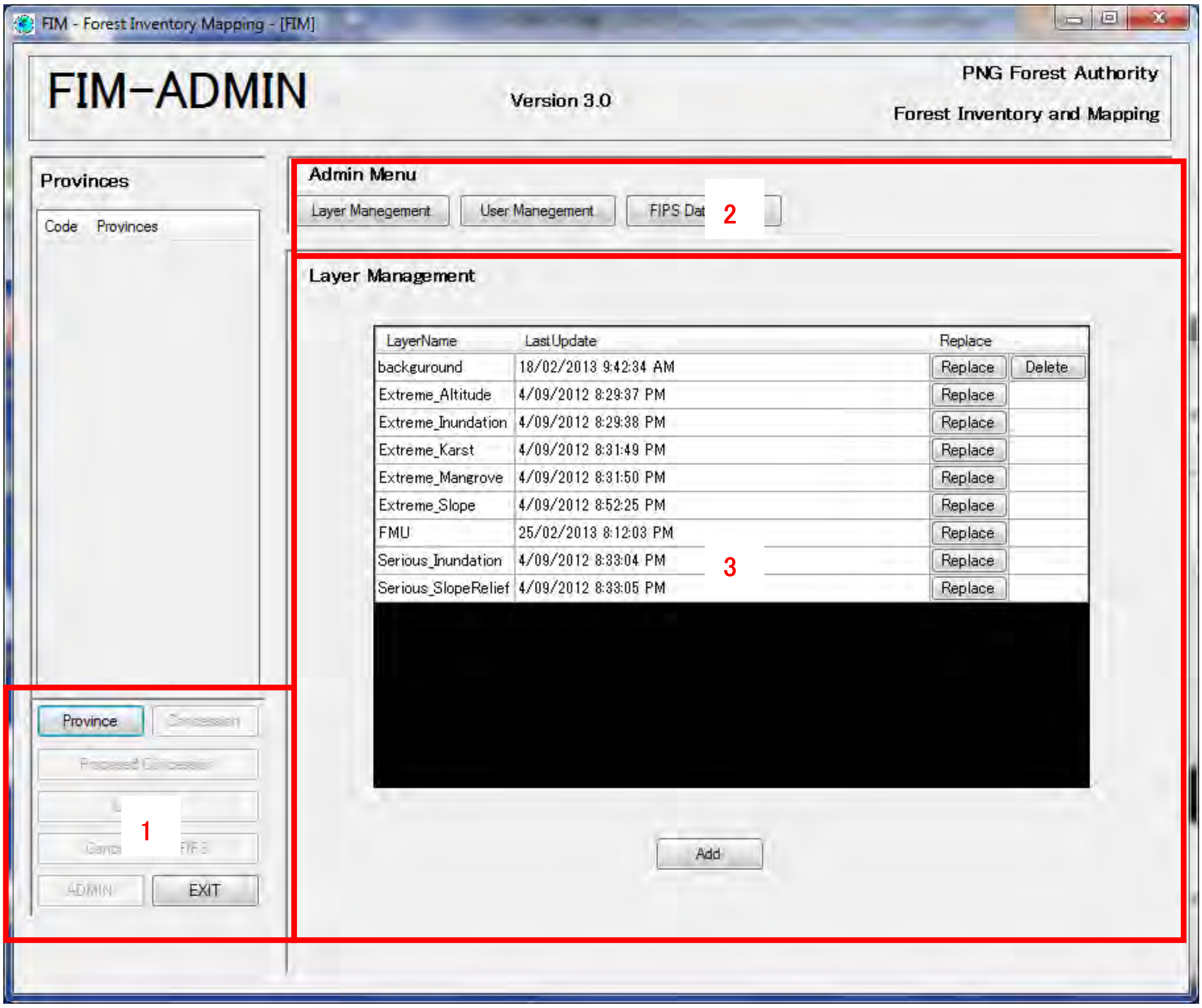
Layers from No.7 onwards in Table 1-1 can be managed with this function.

The figures in replaceable-only layers (7 layers) cannot be changed. (System renovation is required.)

When you add a layer with this function, it is registered in the GeoDatabase. By editing the PNG.mxd file, the data can therefore be viewed by other users (client).

To edit the PNG.mxd file, open ArcMap. For details, refer to the official manual or website.
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

Added layers can be deleted by other users.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to the User Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen.

3. Displays layer information.

   ・**Add**: Click to go to the Add Layer screen.

   ・**Replace**: Click to go to the Replace Layer screen.

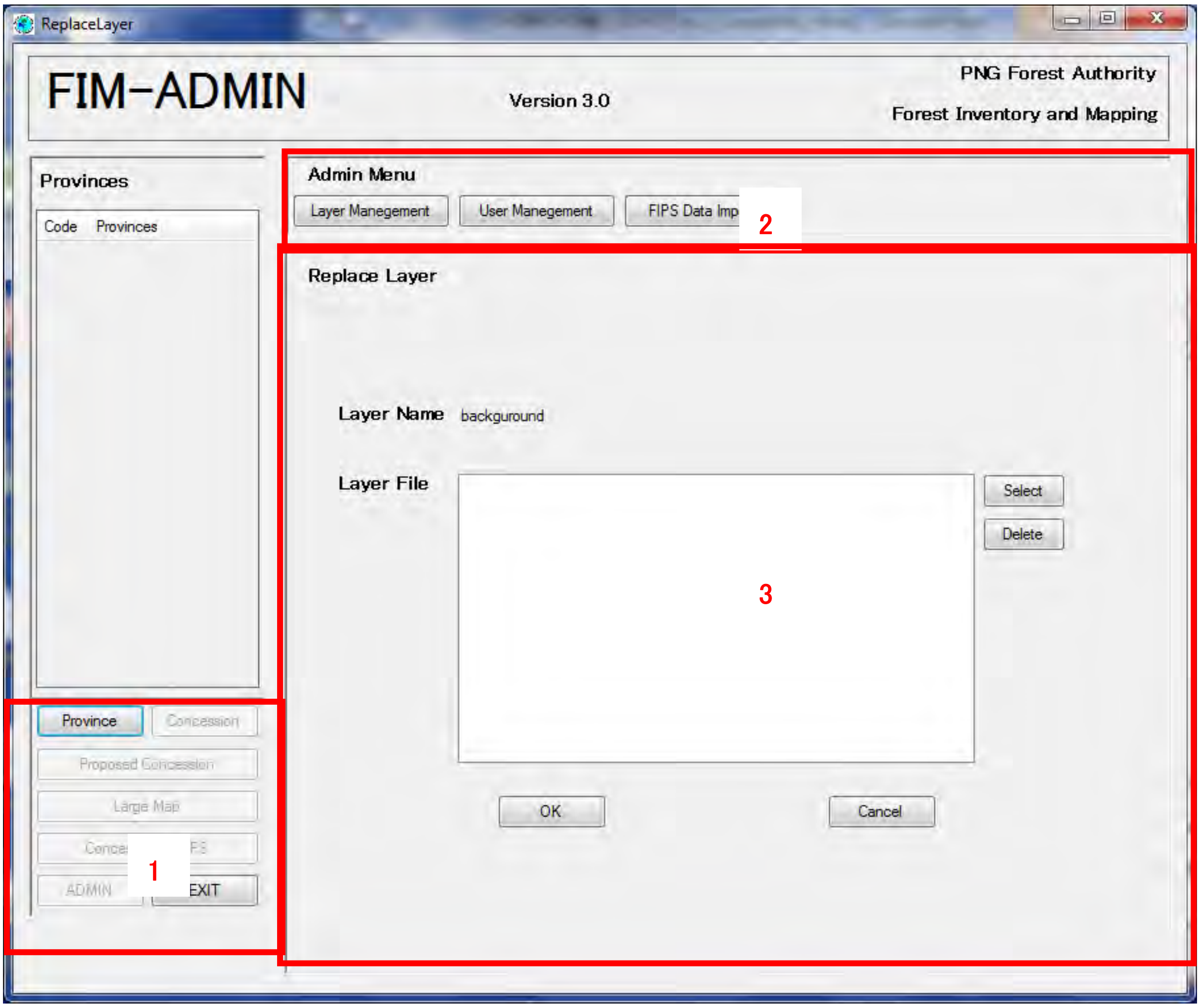
   ・**Delete**: Click to delete data from this screen and the Map screen. Layers No.7 to No.14 in Table 1-1 cannot be deleted.

⇒Function requirements of the administrator screen

- The user can replace a layer (vector type) that has been registered to a server.
- After replacing a layer (vector type), perform recalculation of the FMU and Concession_FMU layers.
- The user cannot add or delete a layer (vector type) that has been registered to the server.
- The user can register a layer (raster type) as a background image to the server.
- The user can replace a layer (raster type) that has been registered to a server.
- The user can delete a layer (raster type) that has been registered to the server.

2.3. Replace Layer

The Replace Layer screen is displayed by clicking the Replace button in the Layer Management screen.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

   EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to the User Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen.

3. The information of the replacement layer is displayed.

   ･**Layer Name**: Displays the layer name.

   ･**Layer File**: Selects the replacement layer.

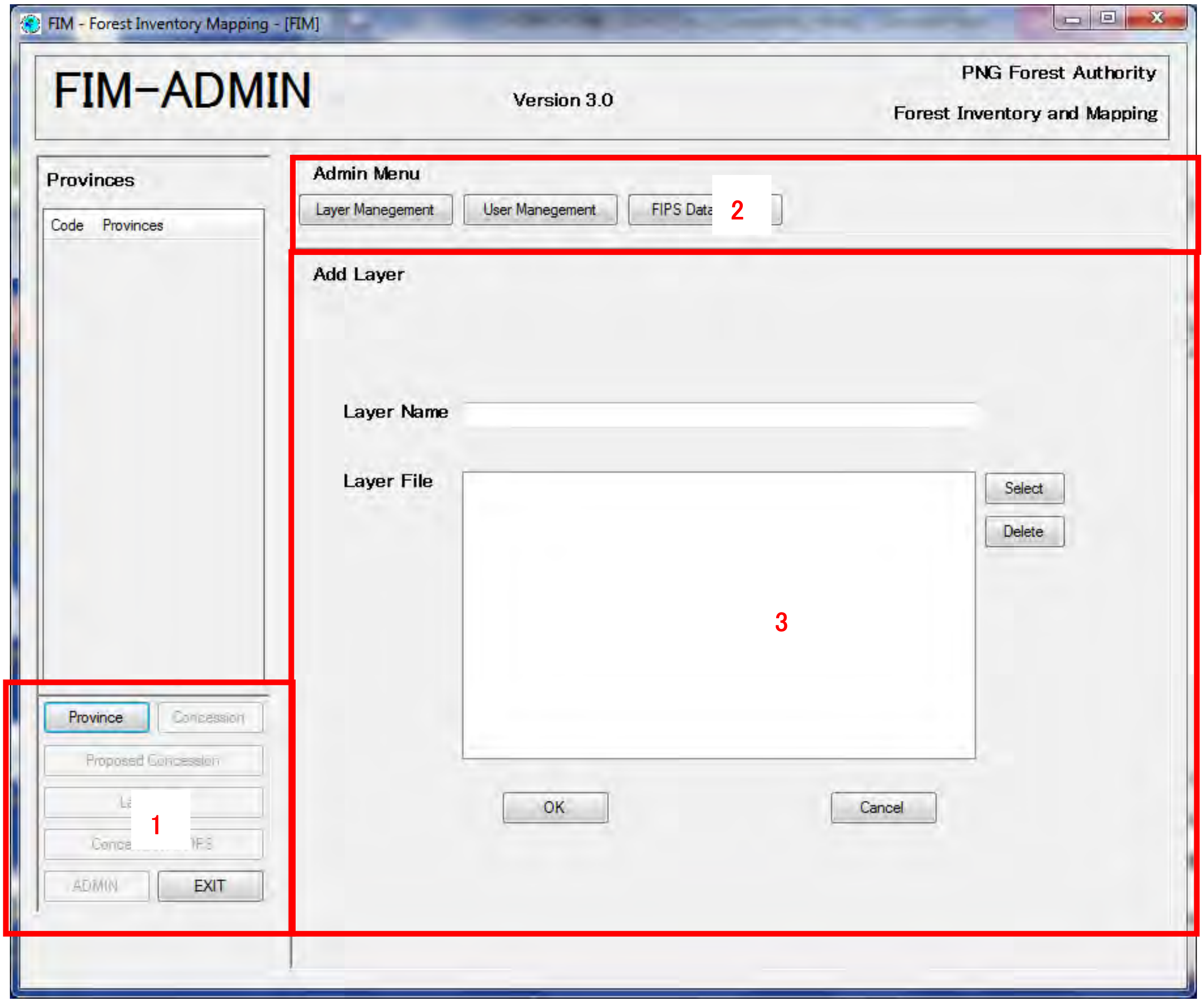
   ･**Delete**: Deletes the selected layer.

   ･**OK**: Click to replace the existing layer, if it is Feature Class, with the selected SHP file. Replacement is also carried out in the case of raster data or mosaic data.

   ･**Cancel**: Click to display the Layer Management screen.

2.4. Add Layer

The Add Layer screen is displayed by clicking the Add button in the Layer Management screen.



1. **Province** : Click to go to the Provinces screen and display the list of provinces.

   EXIT : Click to exit the system.

2. **Layer Management** : Click to go to the Layer Management screen.

   User Management : Click to go to the User Management screen.

   FIPS Data Import : Click to go to the FIPS Data Import screen.

3. **Layer Name** : Enter the layer name.

   ･**Layer File** : Select the replacement layer.

   ･**Delete** : Deletes the selected layer.

   ･**Cancel** : Click to display the Layer Management screen.

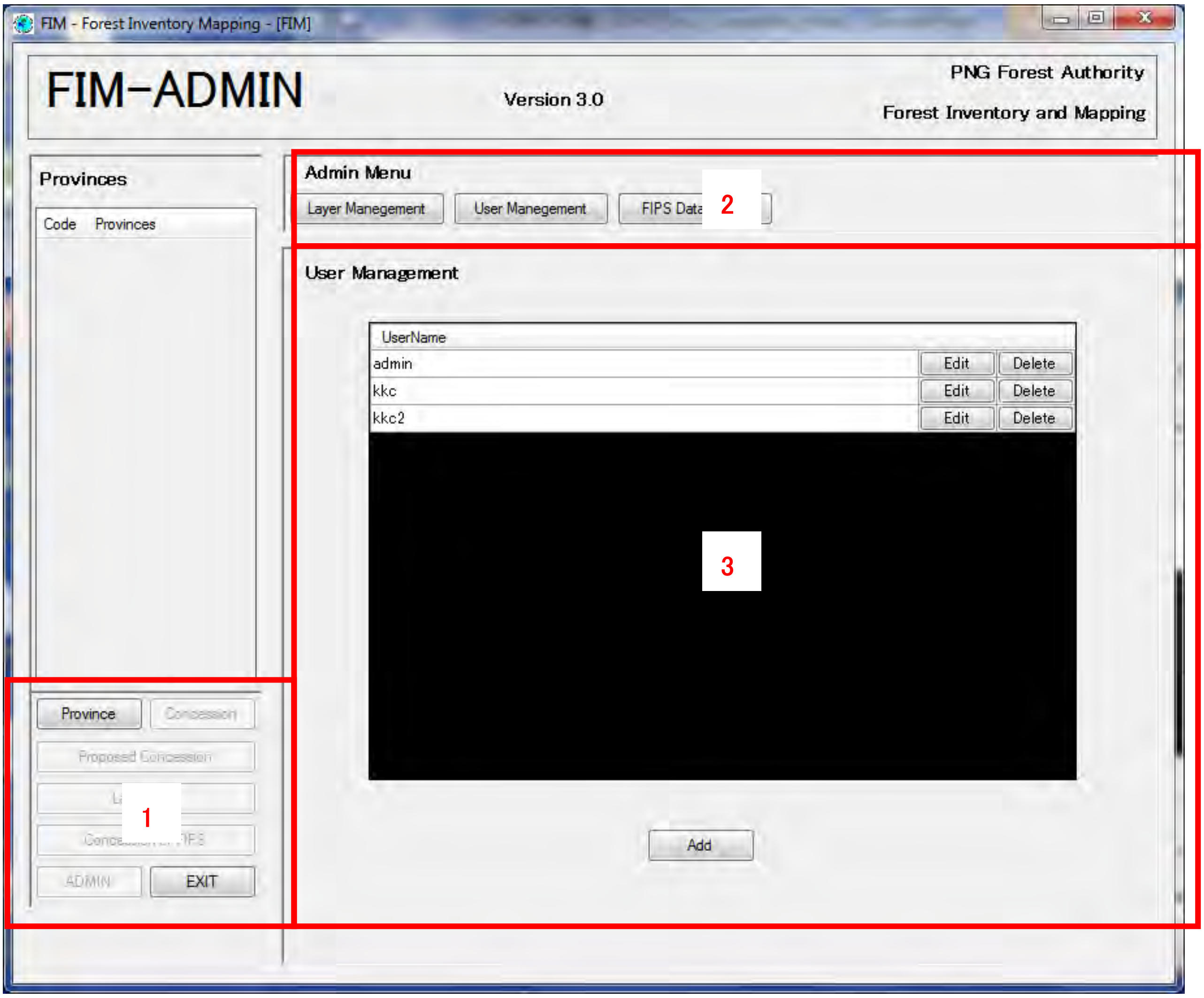
   ･**OK** : Click to add layer, raster datasets or mosaic datasets.

When a layer is newly registered using this function, the layer data is stored on the server, but it is not automatically displayed on LargeMap, etc., of each client PC.

To display the layers registered on the server on each PC on which FIMS is installed, re-create the PNG.mxd file, referring to the Environment Creation Procedures Manual.

2.5. User Management

This screen is displayed by clicking the User Management button in the Admin screen.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

   EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to theUser Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen..

3. Displays user information.

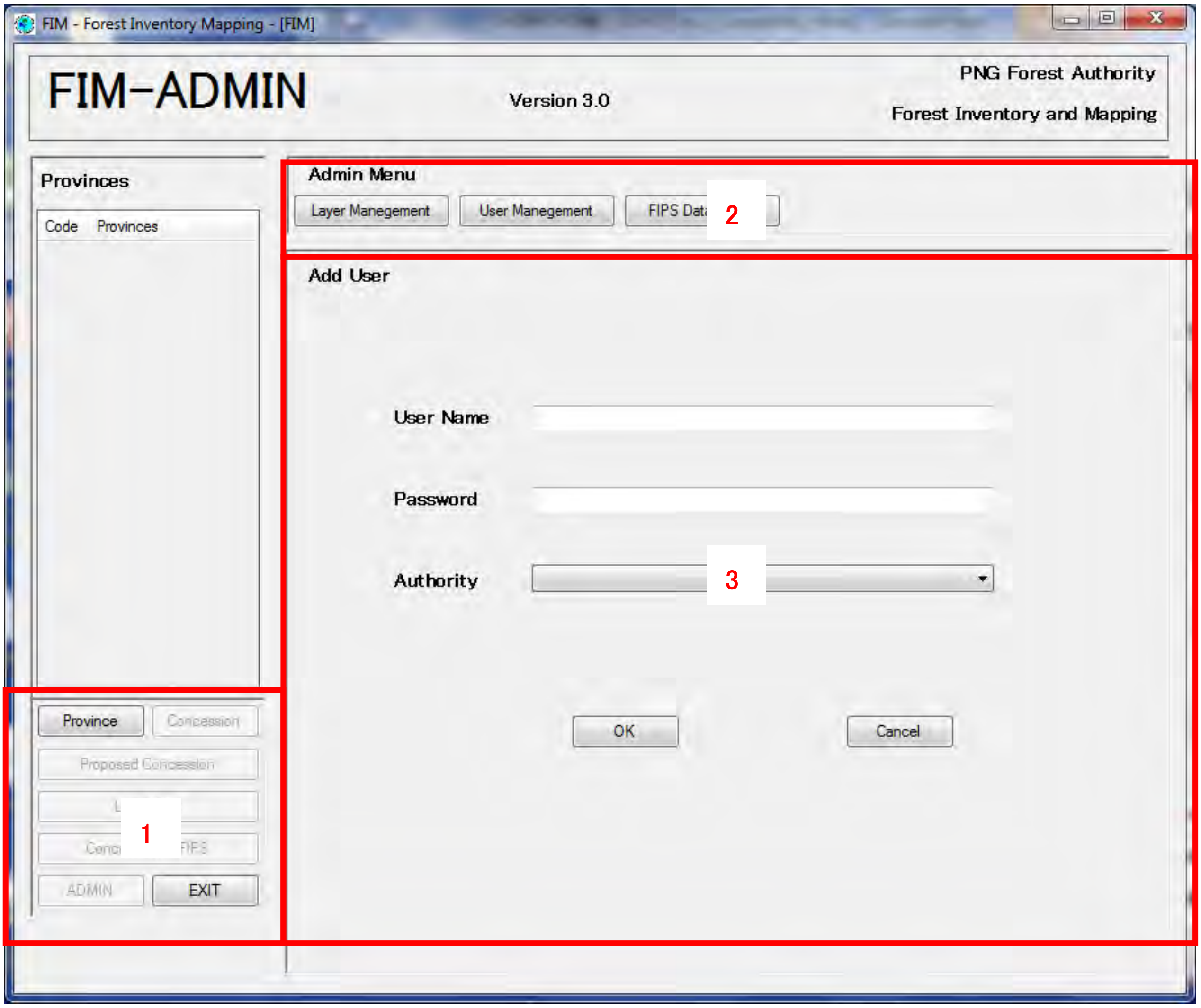
   Edit: Click to go to the Edit User screen.

   Delete: Click to delete user information.

   Add: Click to go to the Add User screen.

2.6. Add User

This screen is displayed by clicking the Add button in the User Management screen.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

   EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to the User Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen.

3. Displays user information.

   User Name: Enter the user name.

   Password: Set the password.

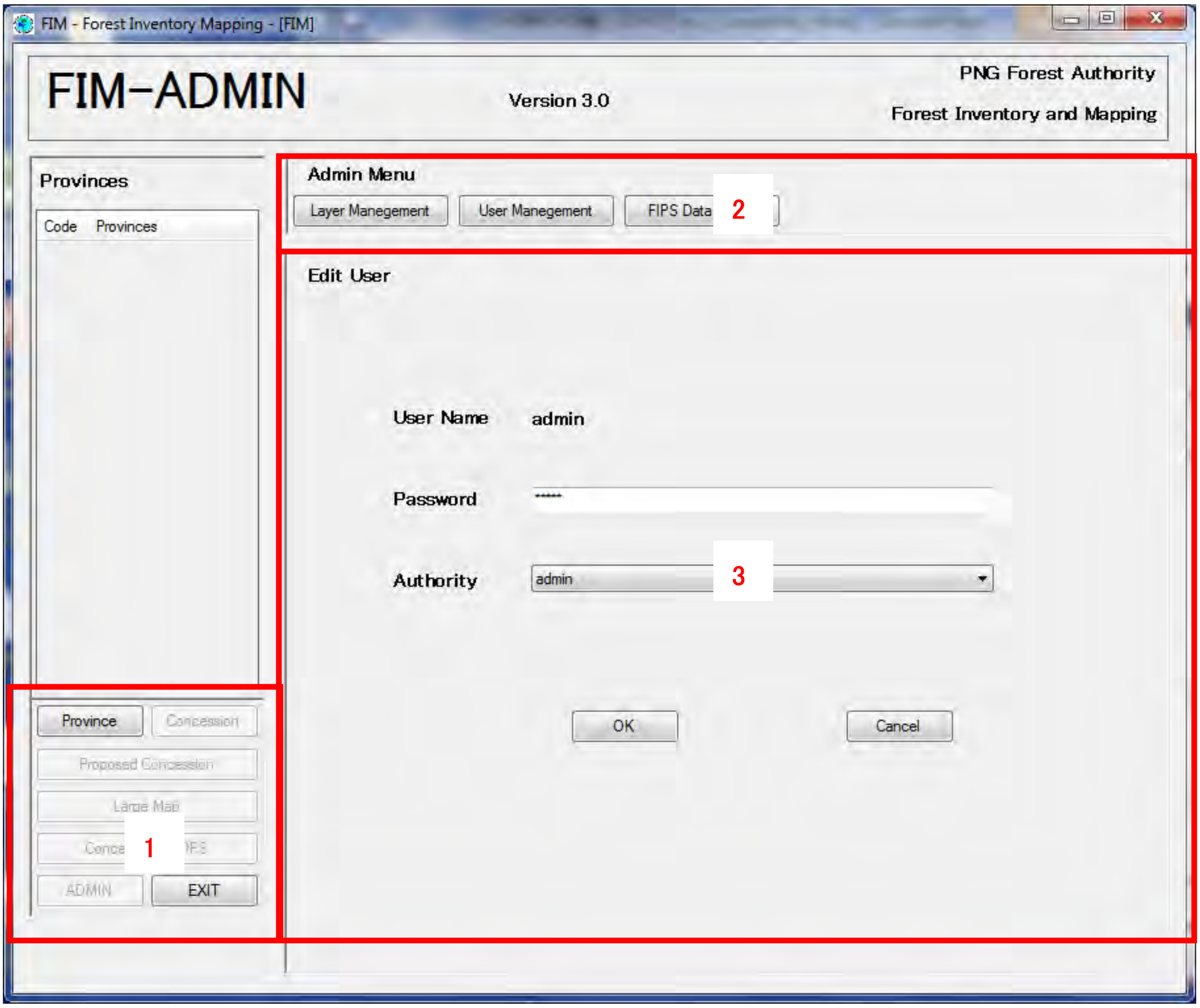
   Authority: Set user authority.

   OK: Click to add a user.

   Cancel: Click to go to the User Management screen.

2.7. Edit User

This screen is displayed by clicking the Edit button in the User Management screen.



1. **Province**: Click to go to the Provinces screen and display the list of provinces.

   EXIT: Click to exit the system.

2. **Layer Management**: Click to go to the Layer Management screen.

   User Management: Click to go to the User Management screen.

   FIPS Data Import: Click to go to the FIPS Data Import screen.

3. Displays user information.

   User Name: Displays the user name.

   Password: Sets the password.

   Authority: Sets user authority.

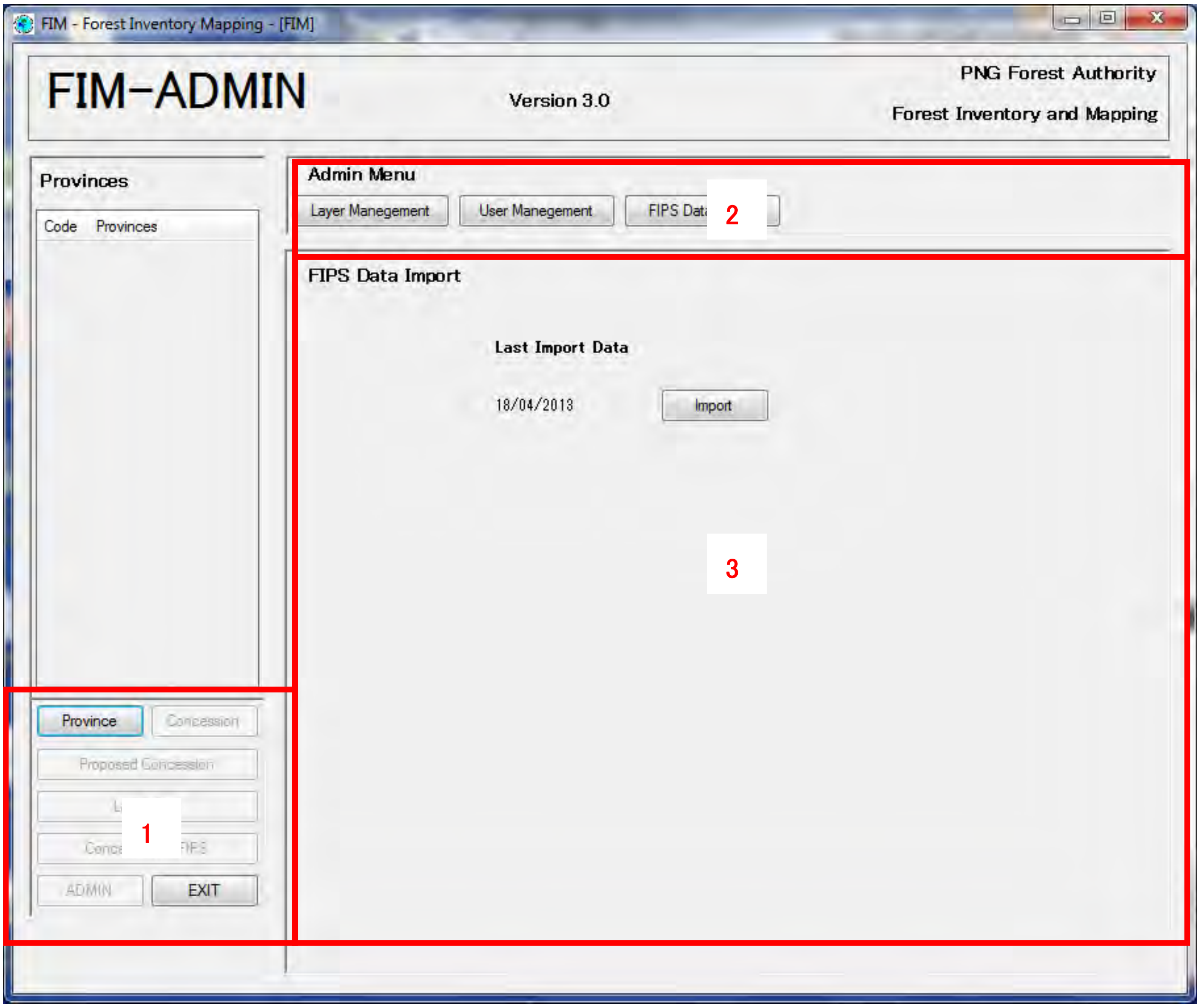
   OK: Click to change the target user settings.

   Cancel: Click to go to the User Management screen.

2.8. FIPS Data Import

This screen is displayed by pressing the FIPS Data Import button in the Admin screen.

This function is to import Survey data from FIPS.



1. **Province**: Changes to the Province screen, which displays a list of provinces, when pressed.

   EXIT: Terminates the system when pressed.

2. **Layer Management**: Changes to the Layer Management screen when pressed.

   User Management: Changes to the User Management screen when pressed.

   FIPS Data Import: Changes to the FIPS Data Import screen when pressed.

3. Import FIPS data.

   ・**Import**: Imports FIPS data when pressed.

   When importing, if there is the same SurveyNumber it is Updated, and if not it is Inserted. (Survey or Strip data cannot be deleted)

   The following are the conditions under which data is not imported.

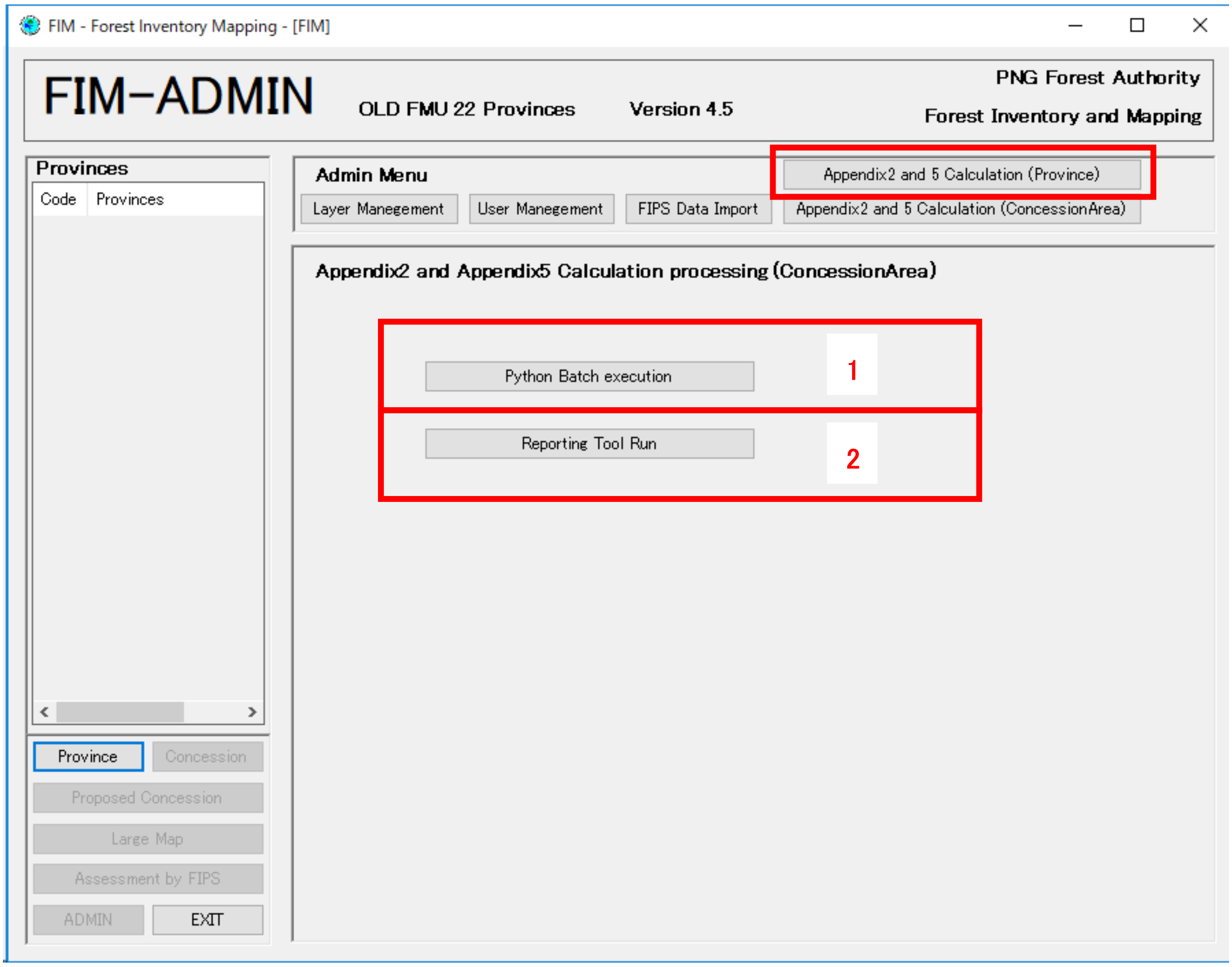
- There is no main key（plan_id, survey number, strip number）.
- There are no coordinate values（Start lat/Start lon, End lat/End lon）.

When importing is completed ,“Import Success” is displayed. If there is no FIPS data to be imported the message “FIPSDB No Data” is displayed. If “Import Failed” is displayed, connection to the FIPS database failed. Check the settings file.

2.9. Appendix2 and 5 Calculation (AAC calculation by province)

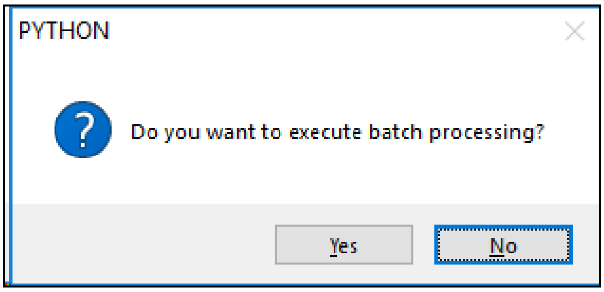
The following screen will appear after clicking “Appendix2 and Appendix5 calculation (Province)” button in the Admin screen.

This function outputs estimate of Annual Allowable Cut (AAC) by province using Forest Base Map 2012 or old FMU.



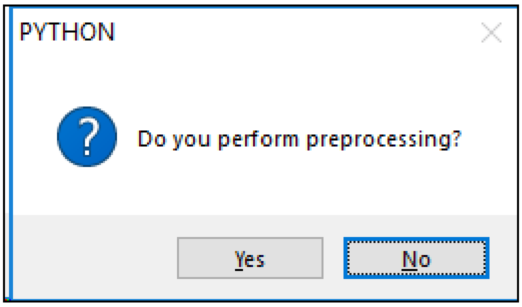
1. “Python Batch execution” button is to start batch processes with python for Appendix 2 and Appendix 5. The procedure is as below.

   1) The following window will open after clicking “Python Batch execution” button.



The processing will start after clicking the Yes button. Click on the No button when you want not to continue.

2) The following window will appear when the Yes button was chosen.

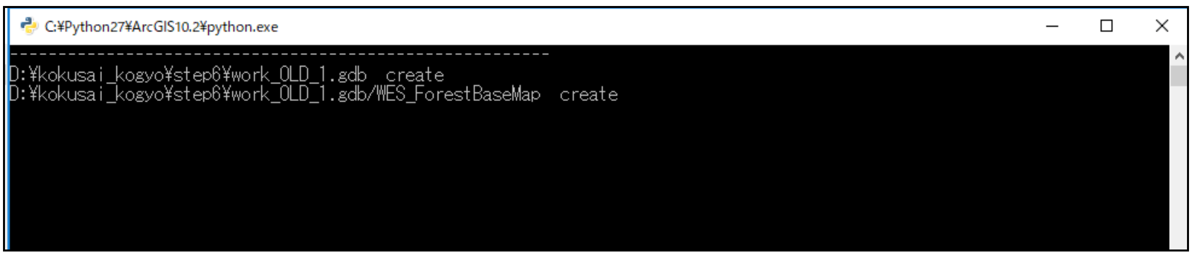


You need to choose whether pre-processing will be carried out or not. You can usually choose “Yes”. Because the pre-processing is a common process for Forest Base Map 2012 and old FMU, you can choose “No” and reduce time for processing if you have already processed once. But in case that forest information related AAC calculation is updated, you always have to choose “Yes”.

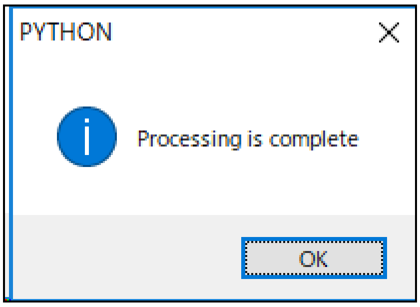
3) The following command prompt will open when you choose “Yes” above.

This screen is a command prompt for pre-processing of AAC calculation. Command line displayed on the screen is getting increased as process goes. Next process starts automatically after the pre-processing finished.

4) Main processing on AAC calculation starts after pre-processing.



Command line displayed on the screen is getting increased as process goes. The following window will appear when the main processing finished.

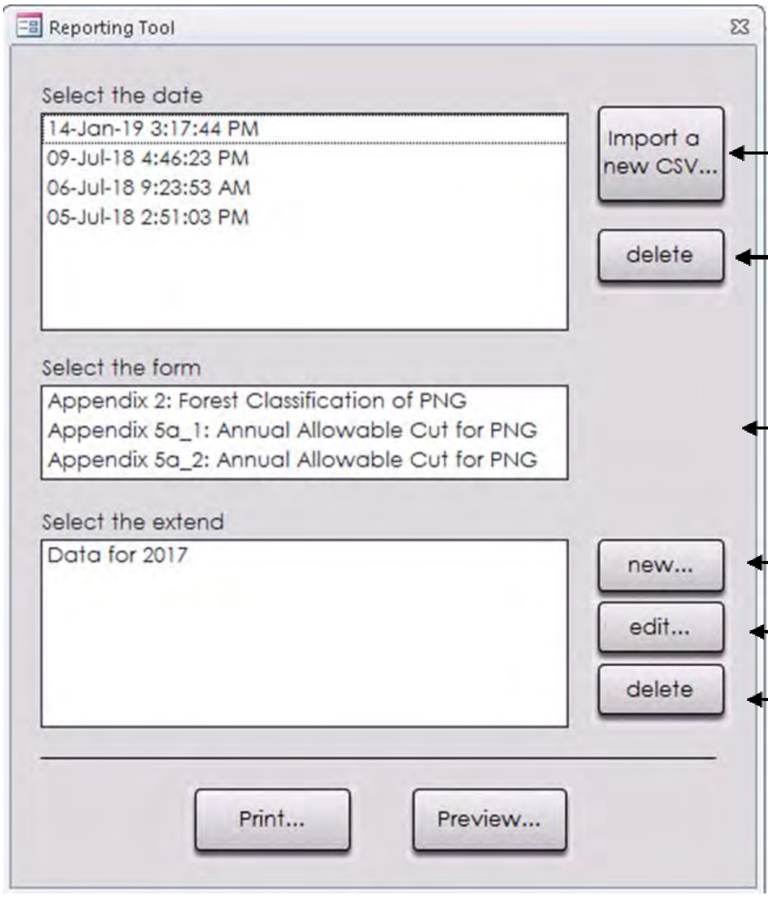


Close the window with clicking the OK button.

With that, the processing with phython for making reports of Appendix 2 and Appendix 5 is completed.

2. "Reporting Tool Run" button is for viewing the results of "Pyhthon Batch execution" to see the reports of Appendix 2 and Appendix 5 with Microsoft Access. The procedure is as below.

1) Click "Reporting Tool Run button and then Microsoft Access will open.



Register a result of AAC calculation which is a csv file generated under the folder "C:¥fims¥appendix25"with the Reporting Tool in MS-Access.

Delete a result registered before.

There are three reporting formats for this function. You need to select the one before you start printing.

Set "Permitted Cut" by province which is managed by Projects Branch.

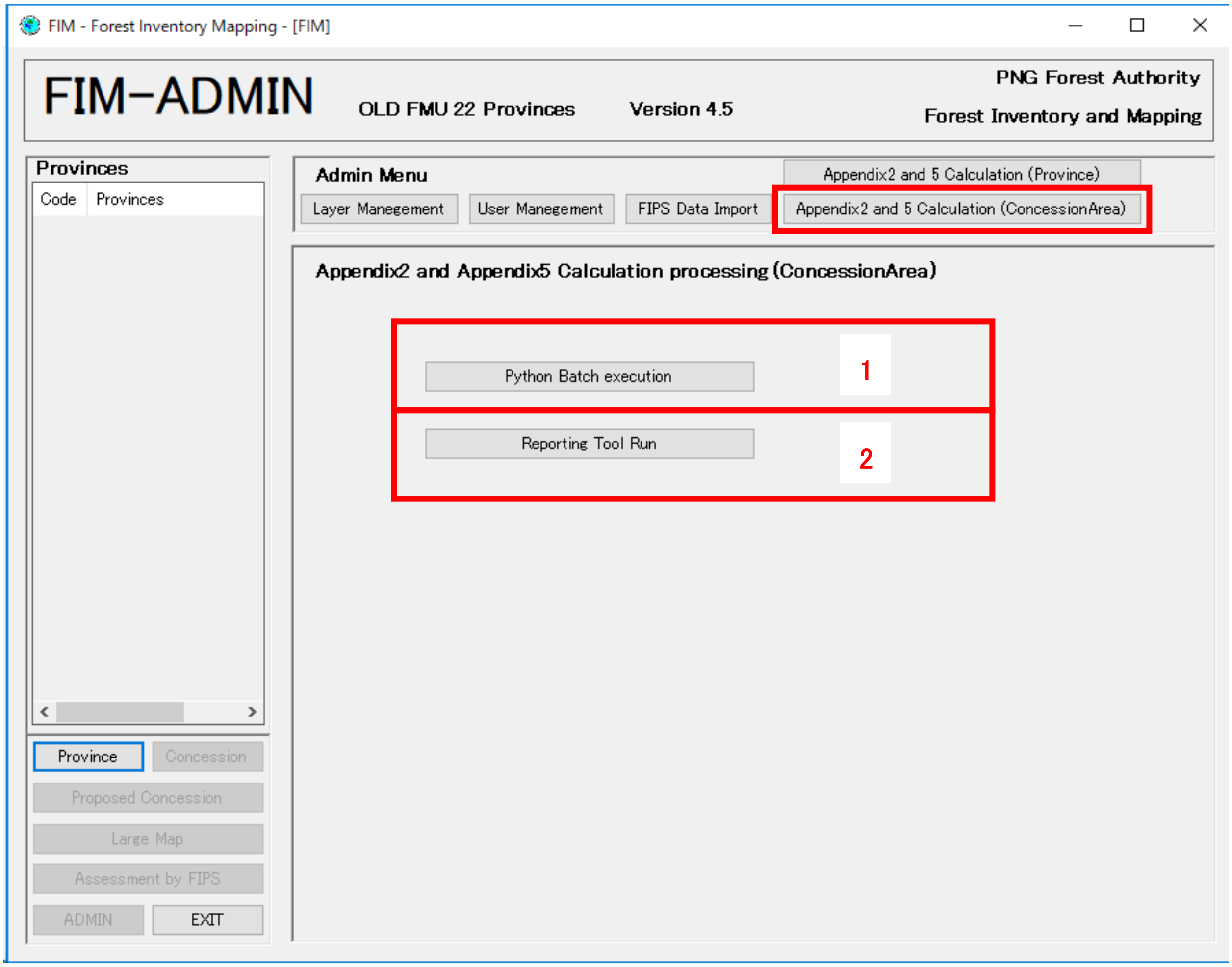
Edit a "Permitted Cut" registered.

Delete a "Permitted Cut" registered before.

2.10. Appendix2 and 5 Calculation (by ConcessionArea)

The following screen will appear after clicking “Appendix2 and Appendix5 calculation (ConcessionArea)” button in the Admin screen.

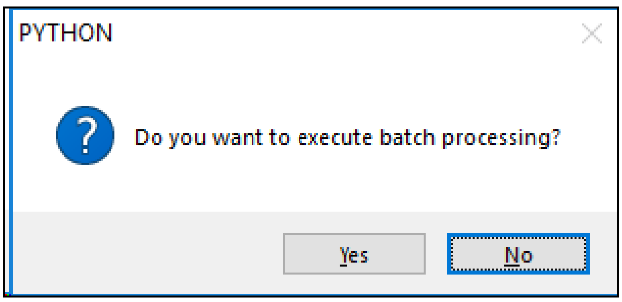
This function outputs estimate of Annual Allowable Cut (AAC) by concession area using Forest Base Map 2012 or old FMU.



1. “Python Batch execution” button is to start batch processes with python for Appendix 2 and Appendix 5. The procedure is as below.

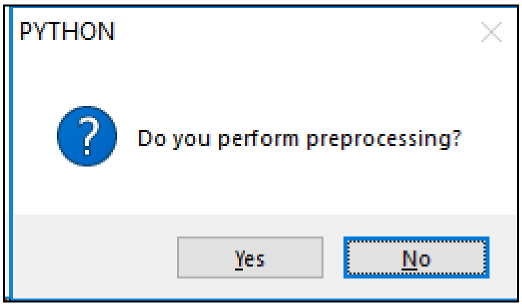
   1) The following window will open after clicking “Python Batch execution” button.

2.



The processing will start after clicking the Yes button. Click on the No button when you want not to continue.

2) The following window will appear when the Yes button was chosen.

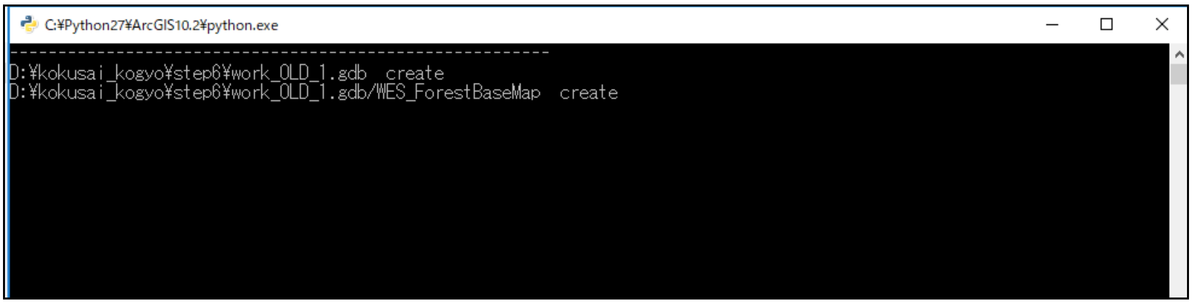


You need to choose whether pre-processing will be carried out or not. You can usually choose “Yes”. Because the pre-processing is a common process for Forest Base Map 2012 and old FMU, you can choose “No” and reduce time for processing if you have already processed once. But in case that forest information related AAC calculation is updated, you always have to choose “Yes”.

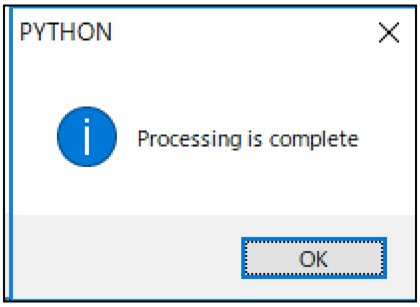
3) The following command prompt will open when you choose “Yes” above.

This screen is a command prompt for pre-processing of AAC calculation by concession. Command line displayed on the screen is getting increased as process goes. Next process starts automatically after the pre-processing finished.

4) Main processing on AAC calculation starts after pre-processing.



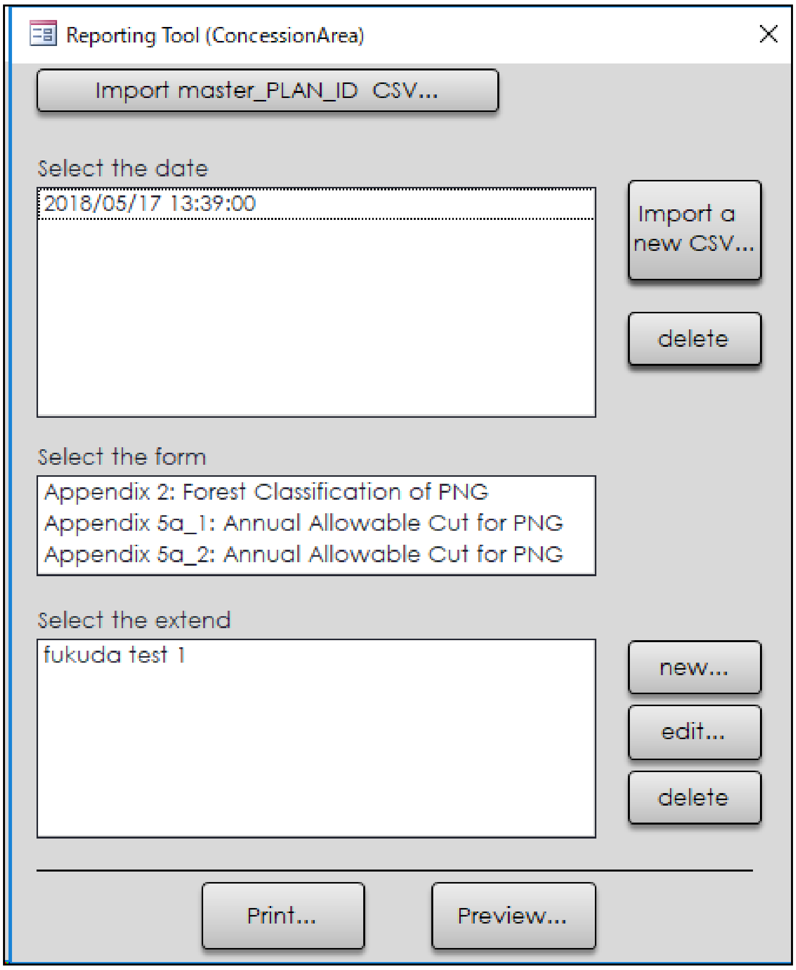
Command line displayed on the screen is getting increased as process goes. The following window will appear when the main processing finished.



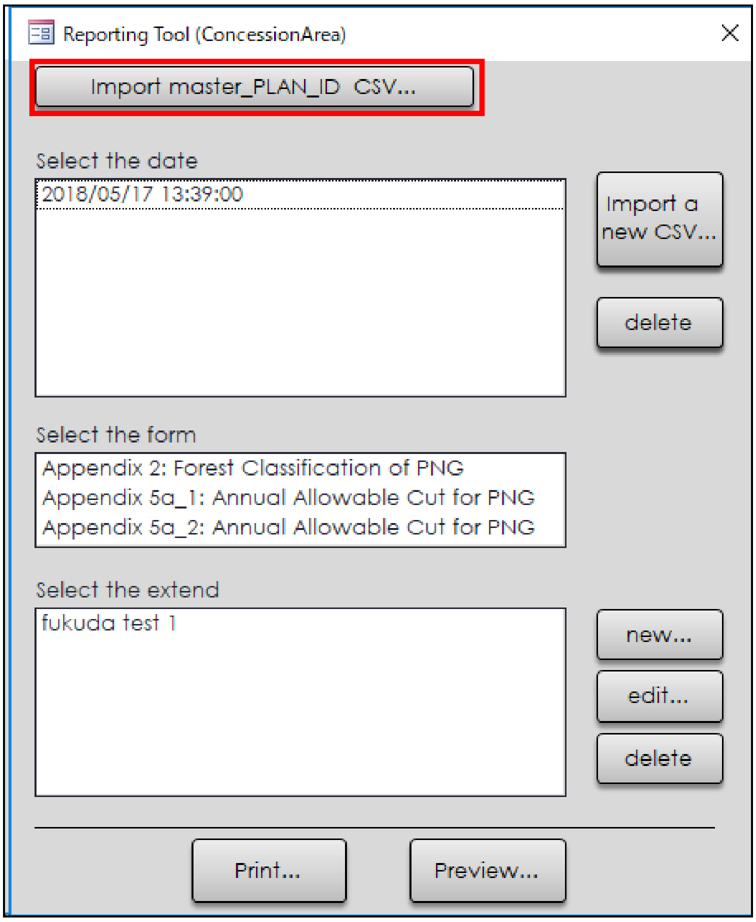
Close the window with clicking the OK button. With that, the processing with phython for making reports of Appendix 2 and Appendix 5 is completed.

3. "Reporting Tool Run" button is for viewing the results of "Pyhthon Batch execution" to see the reports of Appendix 2 and Appendix 5 with Microsoft Access. The procedure is as below.

1) Click "Reporting Tool Run button and then Microsoft Access will open.



2) The functions of Reporting Tool for concession area are almost as same as the Reporting Tool for province, but the button for concession area is prepared on the upper left.

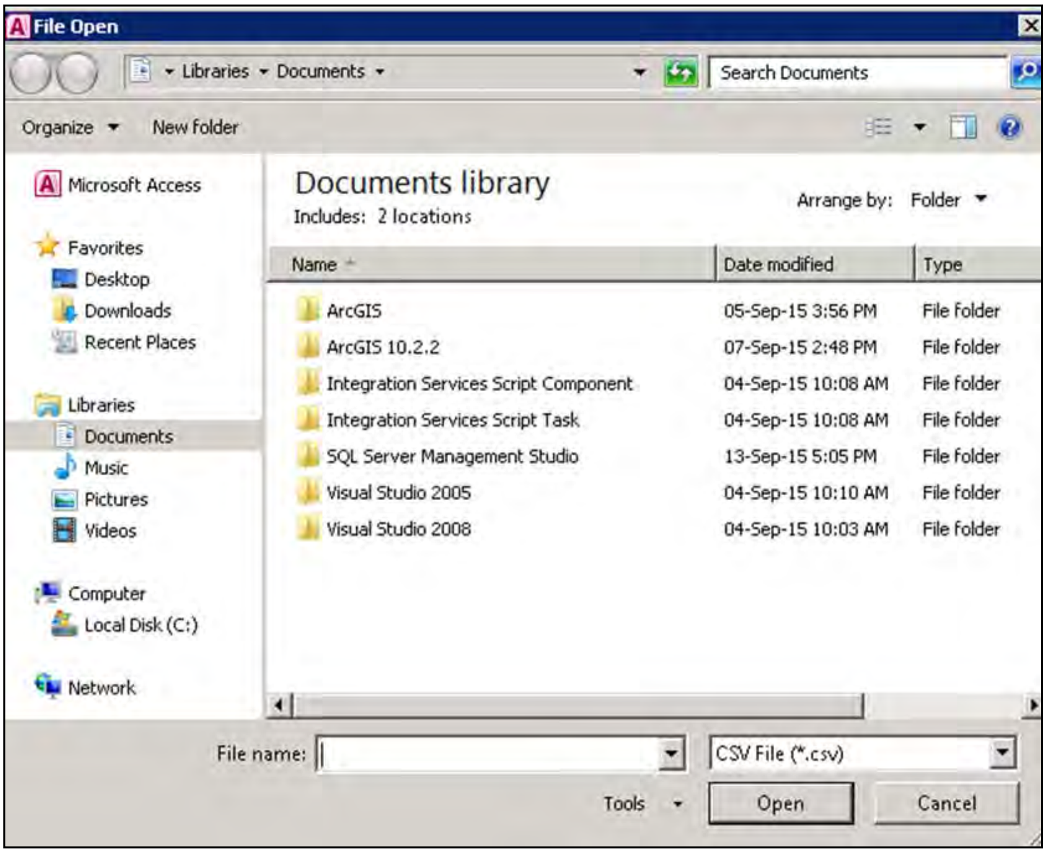


The reporting tool for concession area can control the display of concession area list using the "Import master_PLAN_ID" button. You can import the csv file including concession area names and its plan ids that you want to see the result of AAC calculation on the report. The csv file will be registered with the MS-Access file.

The format of the csv file imported is as below. The first row is the field name, "PLAN_ID" and "PLAN_NAME". You can add concession areas that you want show the result of AAC calculation after the second row.

```
PLAN_ID,PLAN_NAME
1001,Wimare (Oriomo)
1002,Wawoi Guavi Block 1
1003,Wawoi Guavi Block 2
1004,Wawoi Guavi Block 3
```

2-1) The open file dialogue will open after clicking on the "Import master PLAN_ID CSV…" button.



2-2) You can select a csv file including “PLAN_ID” and “PLAN_NAME” of concession areas that you want to see the result of AAC calculation.

3. FIM – USER

FIM – USER can only view results of processing by FIM – ADMIN functions. The results of processing by FIM – ADMIN are stored in JICA Server (pngfa-hq-srv3) as tables of SQL Server 2008 R2.

FIM – USER can access to the SQL Server and retrieve tables using reporting functions of FIMS.

When you start FIMS using POM-MAP-GIS01, GIS02, GIS03, GIS04 and GIS05, you must log in FIMS using FIM – USER. Because the five workstations do not have a replica of Forest Base Map 2012 inside the FIMS installation folder of each workstation. (as of June 2019)

FIM - USER consists of the following files:

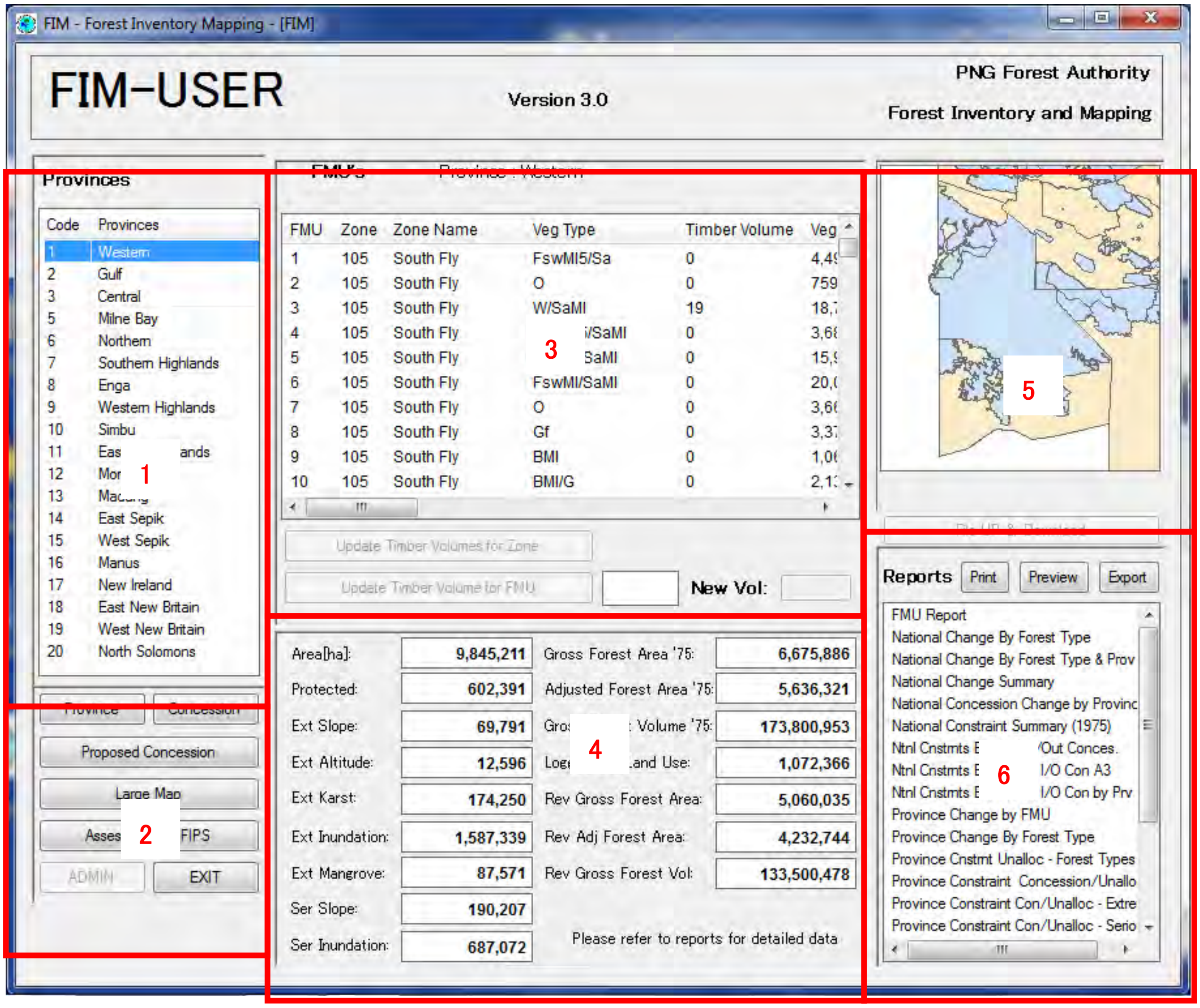
Folder	Executable files placed
C:¥fims¥exe	Connection to pngfa-hq-srv3.sde
	FIMS.exe
	FIMS.exe.config
	FIMS.vshost.exe
	FIMS.vshost.exe.manifest
	GISLibrary.dll
	GISLibrary.pdb
	Interop.ADODB.dll
	Interop.DAO.dll
	log4net.dll
	MASTER_PLAN_ID_201806.csv
	MASTER_PLAN_ID_201806_operationalConcession.csv
	report.dsn
	ReportingTool_forNew.accdb
	ReportingTool_forNew_ConcessionArea.accdb
	ReportingTool_forOld.accdb
	ReportingTool_forOld_ConcessionArea.accdb
	Report_FIMS_forNew.accdb
	Report_FIMS_forOld.accdb
C:¥fims¥mxd	PNG.mxd
	minimap.mxd
	template.mxd

3.1. Main Screen（Province）

This screen is displayed when a guest user logs in.

The following operations can be performed in this screen.

- You can check the details of the province FMUs.
- You can check the total values for the province.
- You can print out the province reports.



1. Provinces: Displays the list of province codes and names.
   When you select a province from the list, areas 3, 4 and 5 are updated.

2. **Province**: Click to display the list of Provinces.
   Concession: Click to display the list of Concession Area codes and names in the selected province.
   Proposed Concession: Click to display the list of Proposed Concession Area codes and names in the selected province.

   Large Map: Click to display the Large Map screen.

   Assesment by FIPS: Click to jump to the Concession(FIPS) screen of the selected province.

   EXIT: Click to exit the system.

3. Displays the list of FMUs in the selected province.
4. Displays the totals for the selected province.
5. Displays the map.
6. Displays the list of available reports (ledgers).
   See the Ledger Design Document for details of ledgers.

   Print: Click to print the selected report in A4 or A3 format.

   For paper sizes, refer to Report Printing Sizes below.

   "Last update" which is displayed when printing is controlled in province or concession units.

   Preview: Click to display a preview of the selected report.

   Export: Outputs the selected ledger in rtf or xls format when pressed.

   * The standard Access function is used to output ledgers.

   For the rtf format, output is in the ledger format.

   For the XLS format, output is in the format 1 record on 1 line. Basically, the column names of the ledger are used as the column names of the table, but for ledgers in special format, such as an FMU report, the row name is column name_ledger of the ledger.

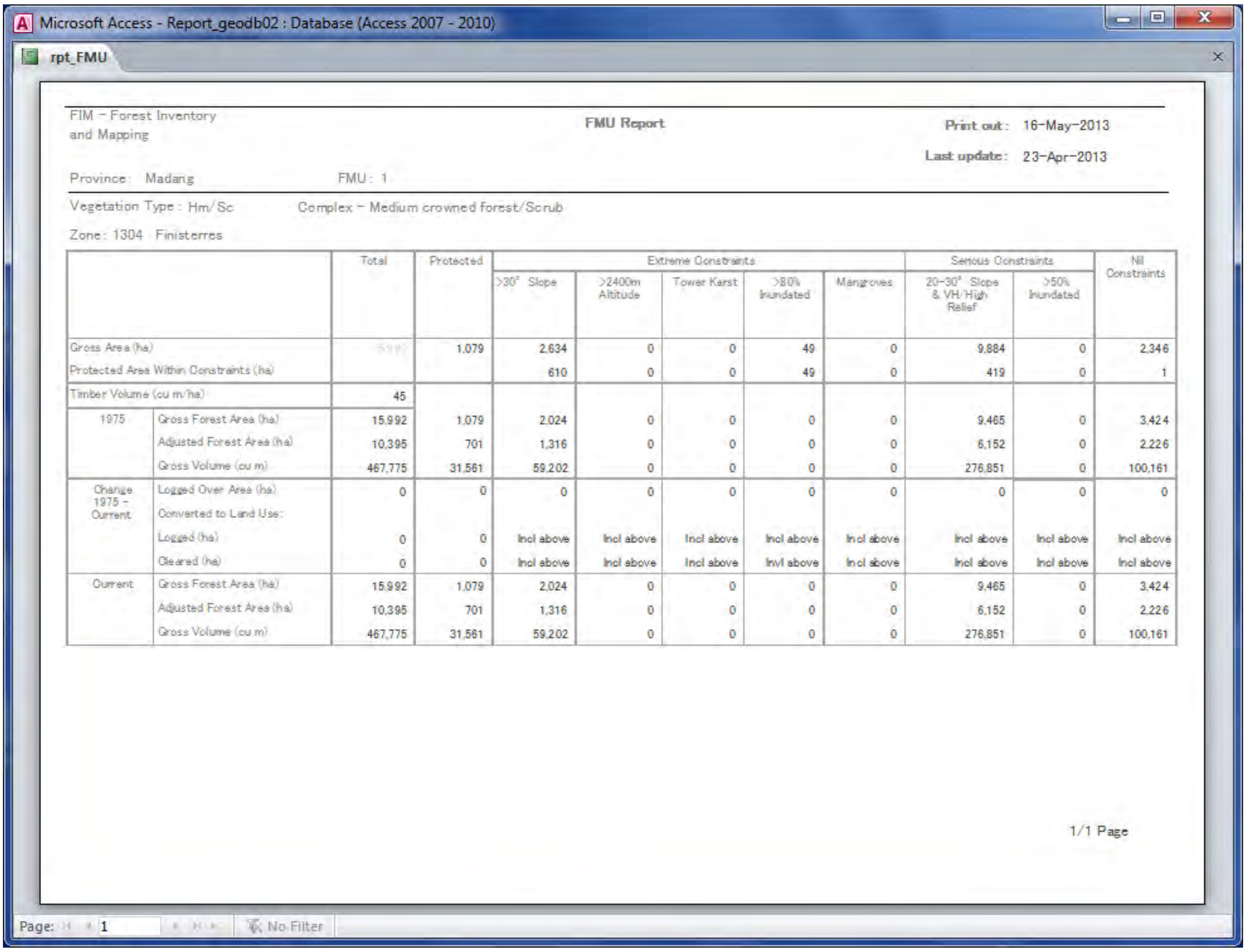
* The width of areas 5 and 6 and areas 3 and 4 can be changed with the mouse.

・Report Printing Sizes

Report Name	Paper Size
FMU Report(Province)	A4
National Change By Forest Type	A4
National Change By Forest Type & Prov	A4
National Change Summary	A4
National Concession Change by Province	A4
National Constraint Summary (1975)	A4
Ntnl Cnstrnts Ext Frst In/Out Conces.	A3
Ntnl Cnstrnts Ext N/Frst I/O Con A3	A3
Ntnl Cnstrnts Ext N/Frst I/O Con by Prv A3	A3
Province Change by FMU	A4
Province Change By Forest Type	A4
Province Cnstrnt Unalloc – Forest Types	A4
Province Constraint Concession/Unalloc	A4
Province Constraint Con/Unalloc - Extreme	A4
Province Constraint Con/Unalloc - Serious	A4
Province Resource by FMU - 1975	A4
Province Resource by FMU - Current	A4
Province Species Distribution	A4
Province Timber Volumes	A4
Province Unallocated – Non-Forest Types	A4
Vegetation Types - All	A4
Vegetation Types - Grouped	A4

3.2. Preview Window(Report)

To display the print image, select a report from the Report list on the main screen and click the Preview button.



Microsoft Access - Report_geodb02 : Database (Access 2007 - 2010)

rpt_FMU

FIM – Forest Inventory and Mapping

FMU Report

Print out: 16–May–2013

Last update: 23–Apr–2013

Province: Madang FMU: 1

Vegetation Type: Hm/Sc Complex – Medium crowned forest/Scrub

Zone: 1304 Finisterres

		Total	Protected	Extreme Constraints					Serious Constraints		Nil Constraints
				>30° Slope	>2400m Altitude	Tower Karst	>80% Inundated	Mangroves	20–30° Slope & VH/High Relief	>50% Inundated	
Gross Area (ha)		[illegible]	1,079	2,634	0	0	49	0	9,884	0	2,346
Protected Area Within Constraints (ha)				610	0	0	49	0	419	0	1
Timber Volume (cu m/ha)		45									
1975	Gross Forest Area (ha)	15,992	1,079	2,024	0	0	0	0	9,465	0	3,424
	Adjusted Forest Area (ha)	10,395	701	1,316	0	0	0	0	6,152	0	2,226
	Gross Volume (cu m)	467,775	31,561	59,202	0	0	0	0	276,851	0	100,161
Change 1975 – Current	Logged Over Area (ha)	0	0	0	0	0	0	0	0	0	0
	Converted to Land Use:										
	Logged (ha)	0	0	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above	Incl above
	Cleared (ha)	0	0	Incl above	Incl above	Incl above	Invl above	Incl above	Incl above	Incl above	Incl above
Current	Gross Forest Area (ha)	15,992	1,079	2,024	0	0	0	0	9,465	0	3,424
	Adjusted Forest Area (ha)	10,395	701	1,316	0	0	0	0	6,152	0	2,226
	Gross Volume (cu m)	467,775	31,561	59,202	0	0	0	0	276,851	0	100,161

1/1 Page

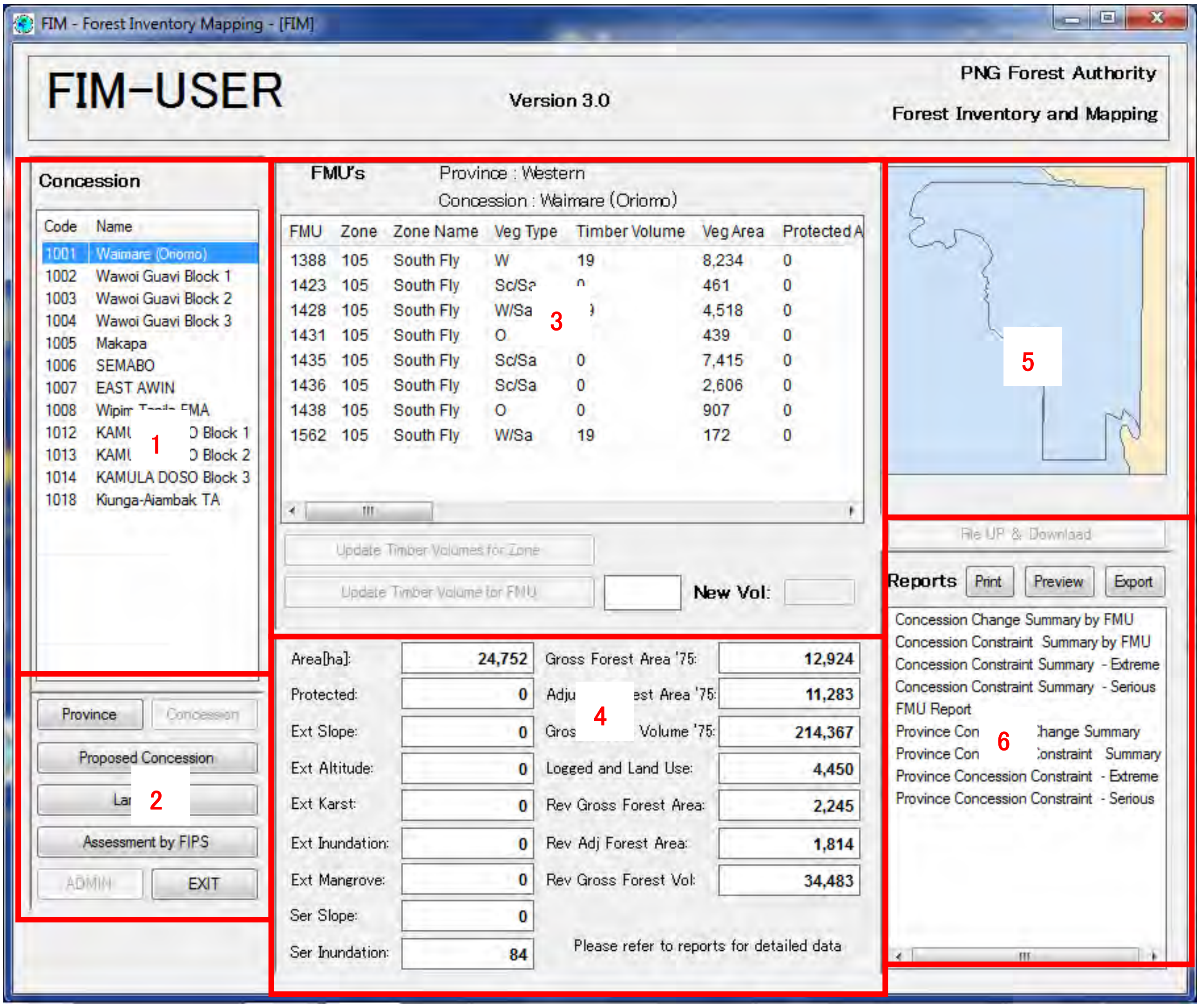
Page: 1 No Filter

3.3. Main Screen（Concession data）

This screen is displayed by selecting Province and clicking the Concession or Proposed Concession button.

The following operations can be performed in this screen.

- You can check the details of the concession FMUs.
- You can check the total values for the concession.
- You can print out the concession reports.



1. Concession : Displays the list of Concession Area codes and names.
   Proposed Concession : Displays the list of Proposed Concession Area codes and names.
   When you select a Concession Area or Proposed Concession Area from the list, areas 3, 4 and 5 are updated.
2. **Province** : Click to display the list of Provinces.

   Concession : Click to display the list of Concession Area codes and names in the selected province.
   Proposed Concession : Click to display the list of Proposed Concession Area codes and names in the selected province.

   Large Map : Click to display the Large Map screen.

   Assesment by FIPS: Click to jump to the Concession (FIPS) screen of the selected province.

EXIT: Click to exit the system.

3. Displays the list of FMUs in the selected Concession Area.
4. Displays the totals for the selected Concession Area provinces.
5. Displays the map.
6. Displays the list of available reports (ledgers).
   See the Ledger Design Document for details of ledgers.

Print: Click to print the selected report in A4 or A3 format.

For paper sizes, refer to Report Printing Sizes below.

"Last update" that is displayed when printing is controlled in province or concession units

Preview: Click to display a preview of the selected report.

Export: Outputs the selected ledger in rtf or xls format when pressed.

* The standard Access function is used to output ledgers.

For the rtf format, output is in the ledger format.

For the XLS format, output is in the format 1 record on 1 line. Basically, the column names of the ledger are used as the column names of the table, but for ledgers in special format, such as an FMU report, the row name is column name_ledger of the ledger.

* The width of areas 5 and 6 and areas 3 and 4 can be changed with the mouse.

・Report Printing Sizes

Report Name	Paper Size
Concession Change Summary by FMU	A4
Concession Constraint Summary by FMU	A4
Concession Constraint Summary - Extreme	A4
Concession Constraint Summary - Serious	A4
FMU Report(Concession)	A4
Province Concession Change Summary	A4
Province Concession Constraint Summary	A4
Province Concession Constraint – Extreme	A4
Province Concession Constraint - Serious	A4

3.4. Large Map

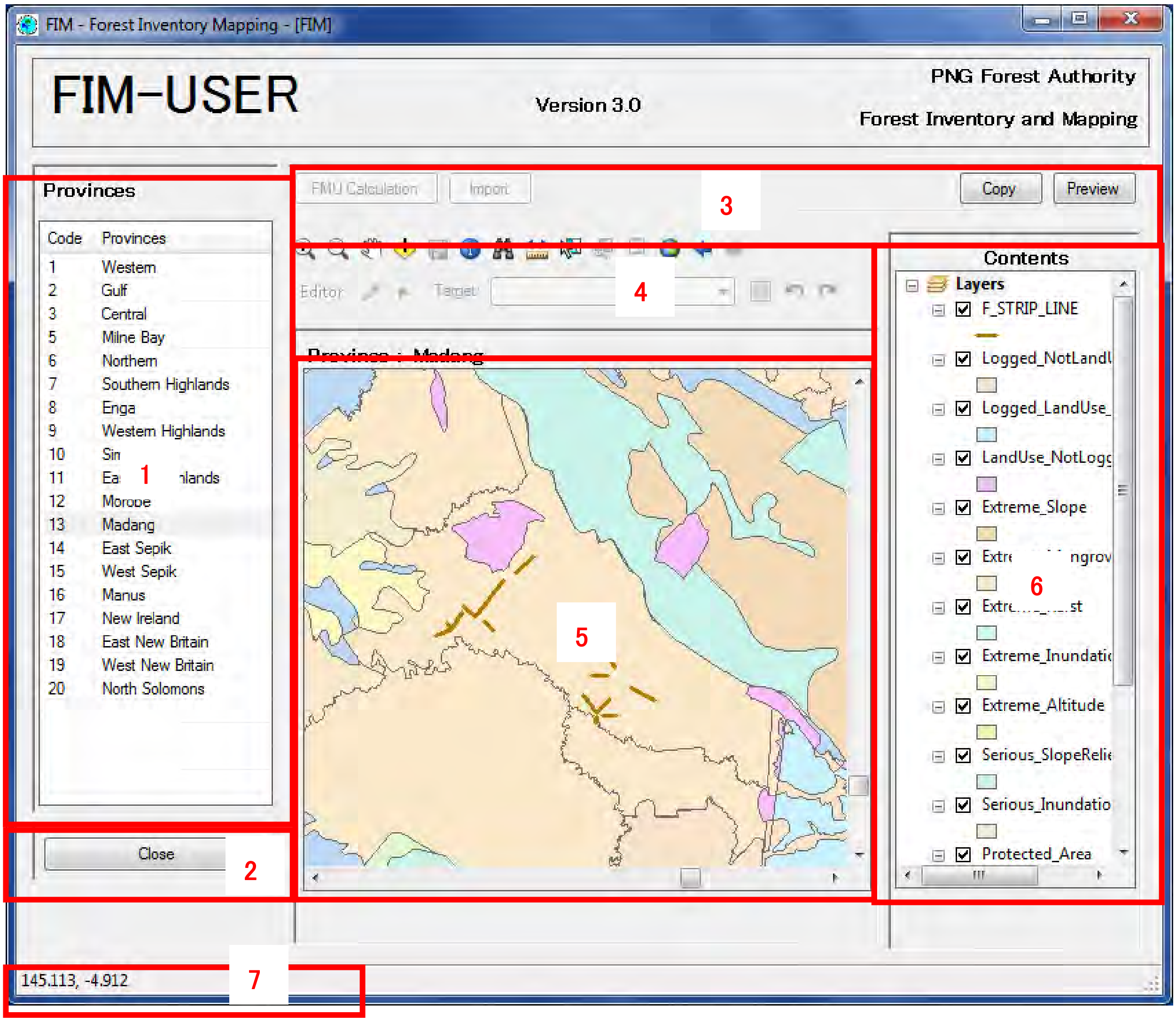
Click the Large Map button on the main screen to jump to the following screen.

To change the style of the map, right-click on the layer with the mouse, and select Property. For details refer to the official manual or the website. Also, for details of the toolbar likewise refer to the official manual or the website.

http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

The following operations can be performed in this window.

You can print the map.



1. Displays the list of province codes and names.
2. **Close**: Click to close the LargeMap screen.
3. **Copy**: Click to copy the currently displayed map to the clipboard.

   Preview: Click to display the preview screen for the currently displayed map.
4. **Tool bar:** The details are described later.
5. Displays the map.

6. Manages the order of layer display, legend changes, etc.
The layer display sequence can be changed by Dragging & Dropping a layer.
The legend can be changed by right clicking a layer with the mouse, and selecting Property.
A layer that is added to the map by Drag&Drop can be deleted by right clicking with the mouse and selecting Remove Layer.

7. Displays the coordinates at the mouse pointer.

*The width of area 6 and areas 4 and 5 can be changed with the mouse.

・Tool Bar

① **Zoom In/Out**: Enlarges and reduces the map.

② **Pan**: Moves the map.

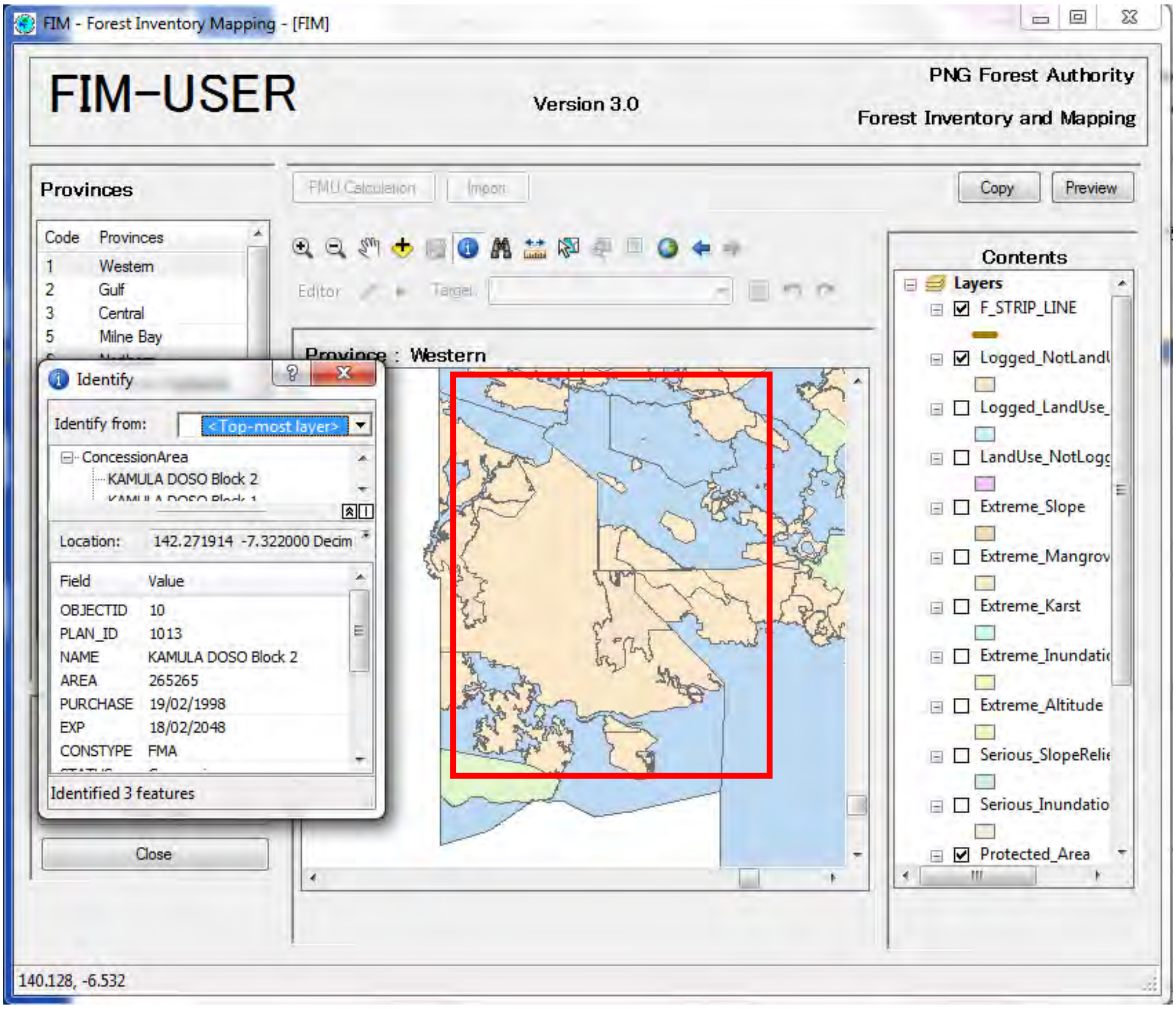
③ **Add Layer**: Adds a displayable layer (.shp file or .tif file) on the screen.

This function is for displaying local data on the map; it is not for sharing (with another client computer).

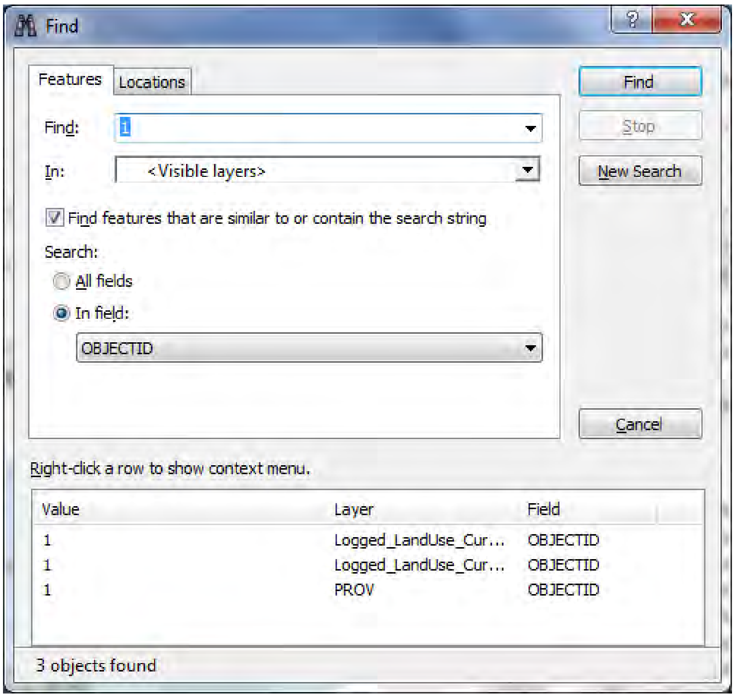
To delete an added layer, open and edit the PNG.mxd file on ArcMap.

To delete a layer that has been added, select the layer that has been added from the Contents tree by right clicking with the mouse and select the Remove Layer.

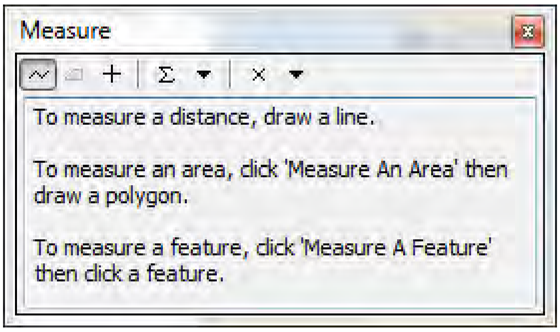
④ **Identify**: Displays information on the selected location. (Red frame: Selected location)



⑤ **Find**: Enter the conditions and search for features.



⑥ **Measure:** Measures distance and area. Measurement can be carried out by drawing a line or a surface and measuring, or by selecting a linear feature or a planar feature and measuring the distance or the area.



⑦ **Select Feature**: Selects a feature. You can only select a layer that is registered in the version-compliant layers.
Version-compliant layers are Concession Area, Protected Area, LandUse_NotLogged_Current, Logged_LandUse_Current and Logged_NotLandUse_Current.

*To select a layer other than the above

・Select a feature in the individual attributes window, right-click on the feature name and click Select.
・Right-click on the search results and click Select.

When a feature is selected, the function in ⑧ can be used.

To cancel a selection, use the function in ⑨.

⑧ **Zoom Selected Feature**: Displays the selected feature in maximum size.

⑨ **Cancel Select**: Cancels selection of a feature

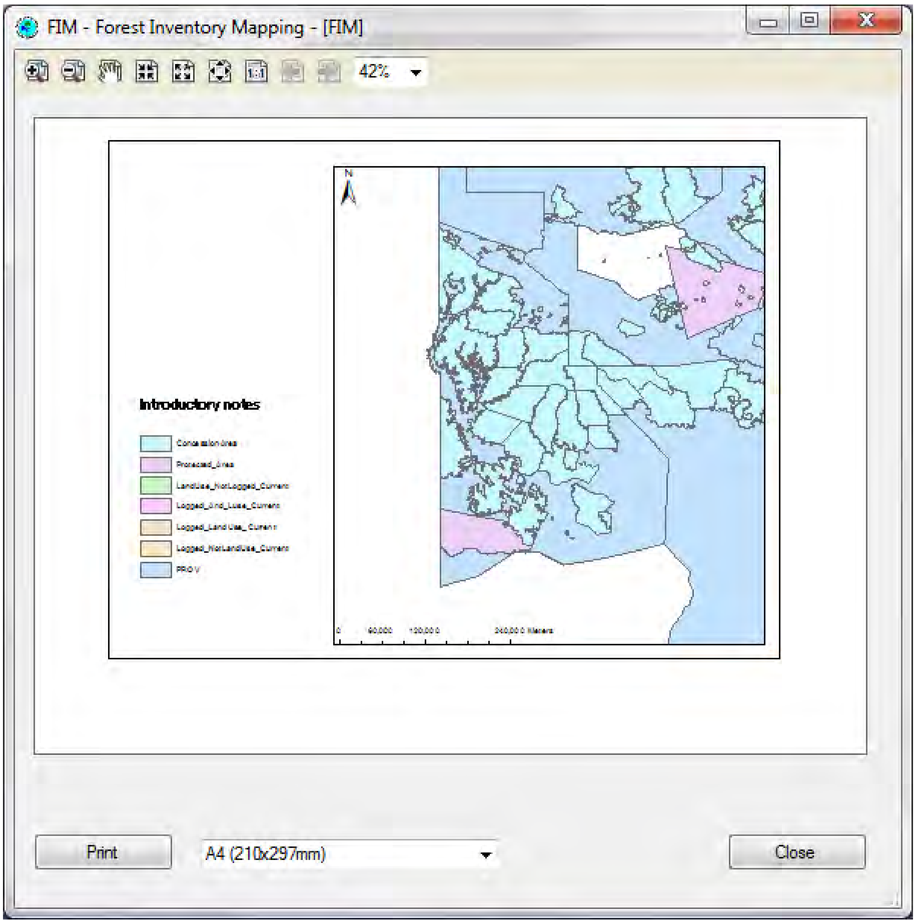
⑩ **Full Extent**: Displays the entire map.

⑪ **Go Back To Previous Extent/Go to Next Extent**: Goes to previous or next map display range.

3.4.1. Preview Window(Map)

・You can display the print image of the currently displayed map by clicking the Preview button in the Large Map screen.

・Legend and scale are displayed.



・Specify the print paper size from the pull-down list.

・Print: Click to print.

*If you want to change the print image, open and edit the template.mxd file in ArcMap.

For details of how to operate ArcMap, refer to the official manual or website.

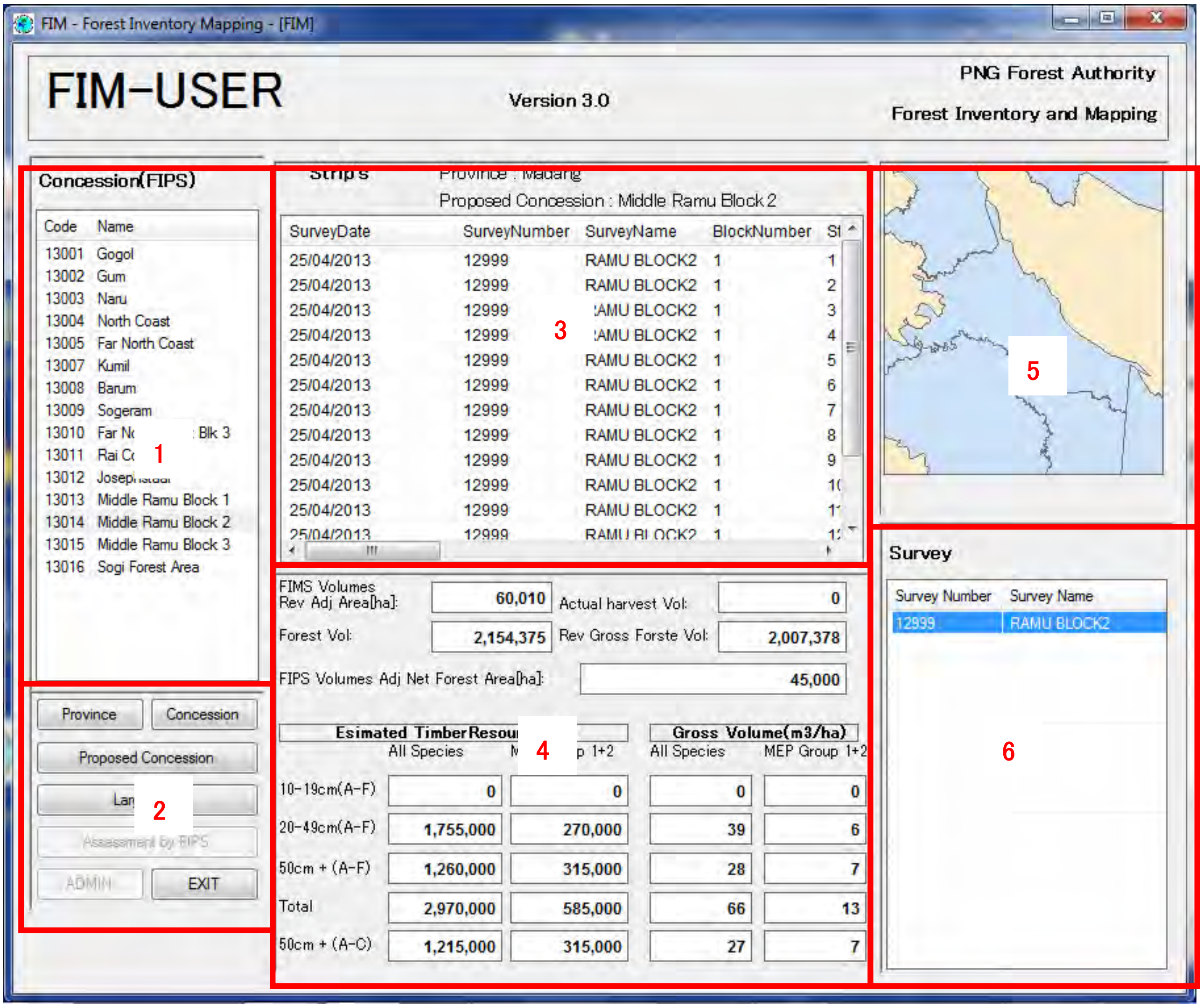
http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

3.5. Concession (FIPS)

When Province is selected in the Main Screen, and the Assesment by FIPS button is pressed, this screen is displayed.

The following operations can be carried out in this screen.

- A detailed StripLine for a selected FIPS Survey can be checked.
- The quantity of forest in a Concession can be compared and checked with the quantity of forest in a selected Survey.



1. A list of codes and names of Concession Areas (including Proposed Concession Area) are output. If a Concession Area is selected from the list, the areas of 5 and 6 are updated.
2. **Province**: A list of provinces is displayed when pressed.
   Concession: A list of codes and names of concession areas is displayed when pressed.
   Proposed Concession: A list of codes and names of Proposed Concession Areas is displayed when pressed.
   Large Map: The Large Map screen is displayed when pressed.
   EXIT: The system is terminated when pressed.
3. A list of StripLines of the selected Survey is displayed.

4. The total value of both the selected Concession Area and Survey are displayed.
5. A map is displayed.
6. A list of Surveys (SurveryNumber, SurveyName) of FIPS tied to the selected Concession Area is displayed. When a survey is selected from the list, the areas 3 and 4 are updated.

* The width of areas 5 and 6 and areas 3 and 4 can be changed with the mouse.

・Details of Items Displayed in 4

No	Item name	Details
1	Rev Adj Area[ha]	Total value of Adjusted_Forest_Area75 of selected Concession (plan_id)
2	Forest Vol	Total value of Gross_Forest_Vol_75 of selected Concession (plan_id)
3	Rev Gross Forest Vol	Total value of Rev_Gross_Forest_Vol of selected Concession(plan_id)
4	Actual_harvest_Vol	Total value of ACHARVOL of Logged Over Area having the same plan_id as the selected Concession
5	Adj_Net Forest_Area[ha]	Value of ADJ_NET_FOREST_AREA of selected Survey
6	Gross Volume(m3/ha) All Species	Value of Gross Volume (m3/ha) of selected Survey
7	Gross Volume(m3/ha) MEP Group 1+2	Value of Gross Volume (m3/ha) of selected Survey * Limited to MEP Group 1+2 only
8	Esimated TimberResource(m3) All Species	Value of Estimated TimberResource (m3) of selected Survey
9	Esimated TimberResource(m3) MEP Group 1+2	Value of Estimated TimberResource (m3) of selected Survey * Limited to MEP Group 1+2 only

4. FIM – Operating Procedures

4.1. FMU Data Replacement Procedure

4.1.1. Data Replacement Using FIMS

(1) Prepare a shape file having FMU data.

The type of the shape file is taken as polygons.

The names and details of attributes are the same as the layers of the FMU. A list of attributes is shown in table 4-1.

As a rule, if the field names are the same, attribute is registered, but take care that some of the attributes do not match (the blue colored items are such items).

Table 4-1 List of shape attributes for FMU replacement

PROVINCE	EXT_KST	EXT_MAN0
FMU	EXT_IN	SER_SL0
ZONE	EXT_MAN	SER_IN0
MAP_NO	SER_SL	CURRENT
MAP_ID	SER_IN	CURRENT0
VEG_TYPE	TYPE	CURRENT1
VEG_AREA	NO_DIST	CURRENT2
SLOPE	TYPE_BASE	EXT_SL1
ALTITUDE	INDEX	EXT_ALT1
KARST	PERCENT	EXT_KST1
INUNDATION	AREA_75	EXT_IN1
MANGROVE	AREA_750	EXT_MAN1
SLOPERELIE	VOLUME	SER_SL1
INUNDATI0	VOL_75	SER_IN1
AREA	TO96	AREA2
AREA0	TO960	AREA3
EXTREME	TO961	FOREST_VOL
SERIOUS	EXT_SL0	VEG_TYPE_1
AREA1	EXT_ALT0	VEG_TYPE_2
EXT_SL	EXT_KST0	VEG_TYPE_3
EXT_ALT	EXT_IN0	

Also, the correspondence between FMU attribute names and the formal names (details) is as follows.

* TVol = TimberVolume calculation, Calc = LargeMap screen Calculation

The unit of area is ha in all cases.

Table 4-2 Table of correspondence between FMU attribute abbreviation name and formal name

Abbreviation name	Formal name	Details	Calculation	
			TVol	Calc
PROVINCE	Province	Province ID to which FMU belongs		
FMU	FMU	FMU ID Has sequentially numbered values within a province		
ZONE	ZONE	Zone ID A province is divided into 1 to 7 to form blocks		
MAP_NO	MAP_NO	(Data for old system)		
MAP_ID	MAP_ID	(Data for old system)		
VEG_TYPE	VEG_TYPE	Vegetation Type (with Disturbance Index)		
VEG_AREA	VEG_AREA	FMU area		○
SLOPE	Extreme_Slope	Overlapping area of FMU and Extreme_Slope layers		○
ALTITUDE	Extreme_Altitude	Overlapping area of FMU and Extreme_Altitude layers		○
KARST	Extreme_Karst	Overlapping area of FMU and Extreme_Karst layers		○
INUNDATION	Extreme_Inundation	Overlapping area of FMU and Extreme_Inundation layers		○
MANGROVE	Extreme_Mangrove	Overlapping area of FMU and Extreme_Mangrove layers		○
SLOPERELIE	Serious_SlopeRelief	Overlapping area of FMU and Serious_SlopeRelief layers		○
INUNDATI0	Serious_Inundation	Overlapping area of FMU and Serious_Inundation layers		○
AREA	Extreme_Constraints_Area	Total overlapping area of FMU and five Extreme_* layers		○
AREA0	Serious_Constraints_Area	Total overlapping area of FMU and two Serious_* layers		○
EXTREME	Prop_Extreme	Percentage overlapping area of FMU and Extreme layers (unit: %)		○
SERIOUS	Prop_Serious	Percentage overlapping area of FMU and Serious layers (unit: %)		○
AREA1	Protected_Area	Overlapping area of FMU and Protected_Area layers		○
EXT_SL	Protected_Extreme_Slope	Overlapping area of FMU and Protected_Area layer and Extreme_Slope layer		○
EXT_ALT	Protected_Extreme_Altitude	Overlapping area of FMU and Protected_Area layer and Extreme_Altitude layer		○

Abbreviation name	Formal name	Details	Calculation	
			TVol	Calc
EXT_KST	Protected_Extreme_Karst	Overlapping area of FMU and Protected_Area layer and Extreme_Karst layer		○
EXT_IN	Protected_Extreme_Inundation	Overlapping area of FMU and Protected_Area layer and Extreme_Inundation layer		○
EXT_MAN	Protected_Extreme_Mangrove	Overlapping area of FMU and Protected_Area layer and Extreme_Mangrove layer		○
SER_SL	Protected_Serious_SlopeRelief	Overlapping area of FMU and Protected_Area layer and Serious_SlopeRelief layer		○
SER_IN	Protected_Serious_Inundation	Overlapping area of FMU and Protected_Area layer and Serious_Inundation layer		○
TYPE	Fragile_Forest_Type	Fragile_Forest_Type		
NO_DIST	Vegetation_Type_No_Disturbance_Index	Vegetation Type (without Disturbance Index)		
TYPE_BASE	Forest_Type_Base	Vegetation Type that can be counted as timber		
INDEX_	Disturbance_Index	Disturbance_Index		
PERCENT_	Complex_Percent	Complex_Percent		
AREA_75	Gross_Forest_Area_75	0 when TimberVolume = 0 Veg_Area in all other cases	○	○
AREA_750	Adjusted_Forest_Area_75	Area_75 * (INDEX_/10)*(PERCENT_/100)	○	○
VOLUME	Timber_Volume	Timber Volume		
VOL_75	Gross_Forest_Volume_75	VOLUME * AREA_750	○	○
TO96	Logged_NotLandUse_75to96	Overlapping area of FMU and Logged_NotLandUse 75to96 layer		○
TO960	Logged_LandUse_75to96	Overlapping area of FMU and Logged_LandUse_75to96 layers		○
TO961	LandUse_NotLogged_75to96	Overlapping area of FMU and LandUse_NotLogged 75to96 layers		○
EXT_SL0	LogAndLUse_75to96_Extreme_Slope	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Extreme_Slope layer		○
EXT_ALT0	LogAndLUse_75to96_Extreme_Altitude	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Extreme Altitude layer		○
EXT_KST0	LogAndLUse_75to96_Extreme_Karst	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Extreme_Karst layer		○

Abbreviation name	Formal name	Details	Calculation	
			TVol	Calc
EXT_IN0	LogAndLUse_75to96_Extreme_Inundation	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Extreme Inundation layer		○
EXT_MAN0	LogAndLUse_75to96_Extreme_Mangrove	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Extreme Mangrove layer		○
SER_SL0	LogAndLUse_75to96_Serious_SlopeRelief	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Serious SlopeRelief layer		○
SER_IN0	LogAndLUse_75to96_Serious_Inundation	Overlapping area of FMU and three LoggedOverArea_75to96 layers and Serious Inundation layer		○
CURRENT_	Logged_NotLandUse_Current	Overlapping area of FMU and Logged_NotLandUse Current layers		○
CURRENT0	Logged_LandUse_Current	Overlapping area of FMU and Logged_LandUse_Current layers		○
CURRENT1	LandUse_NotLogged_Current	Overlapping area of FMU and LandUse_NotLogged Current layer		○
CURRENT2	LogAndLuse_Current	Overlapping area of FMU and three Logged Over Area layers		○
EXT_SL1	LogAndLUse_Current_Extreme_Slope	Overlapping area of FMU and LogAndLuse_Current layer and Extreme_Slope layer		○
EXT_ALT1	LogAndLUse_Current_Extreme_Altitude	Overlapping area of FMU and LogAndLuse_Current layer and Extreme_Altitude layer		○
EXT_KST1	LogAndLUse_Current_Extreme_Karst	Overlapping area of FMU and LogAndLuse_Current layer and Extreme_Karst layer		○
EXT_IN1	LogAndLUse_Current_Extreme_Inundation	Overlapping area of FMU and LogAndLuse_Current layer and Extreme_Inundation layer		○
EXT_MAN1	LogAndLUse_Current_Extreme_Mangrove	Overlapping area of FMU and LogAndLuse_Current layer and Extreme_Mangrove layer		○
SER_SL1	LogAndLUse_Current_Serious_SlopeRelief	Overlapping area of FMU and LogAndLuse_Current layer and Serious_SlopeRelief layer		○
SER_IN1	LogAndLUse_Current_Serious_Inundation	Overlapping area of FMU and LogAndLuse_Current layer and Serious_Inundation layer		○

Abbreviation name	Formal name	Details	Calculation	
			TVol	Calc
AREA2	Rev_Gross_Forest_Area	AREA_75-Current_-Current0-Current1 * If the value is minus, it is set to 0	○	○
AREA3	Rev_Adjusted_Forest_Area	Area2*(Index_/10)*(Percent_/100)	○	○
FOREST_VOL	Rev_Gross_Forest_Volume	Area3*VOLUME	○	○
VEG_TYPE_1	VEG_TYPE_1	First VegType（VegType consists of a maximum of three types）		
VEG_TYPE_2	VEG_TYPE_2	Second VegType		
VEG_TYPE_3	VEG_TYPE_3	Third VegType		

For Concession_FMU, when calculating the overlap, also take into consideration the overlap of ConcessionArea.

Example: Protected_Area = Overlapping area of FMU layer and Protected_Area layer and ConcessionArea layer

(2) Replace data using the replace function of the FMU layer in the ADMIN menu of FIMS.

Select Layer Management from the ADMIN menu of FIMS, select the FMU “replace” button and specify the shape that has been prepared.

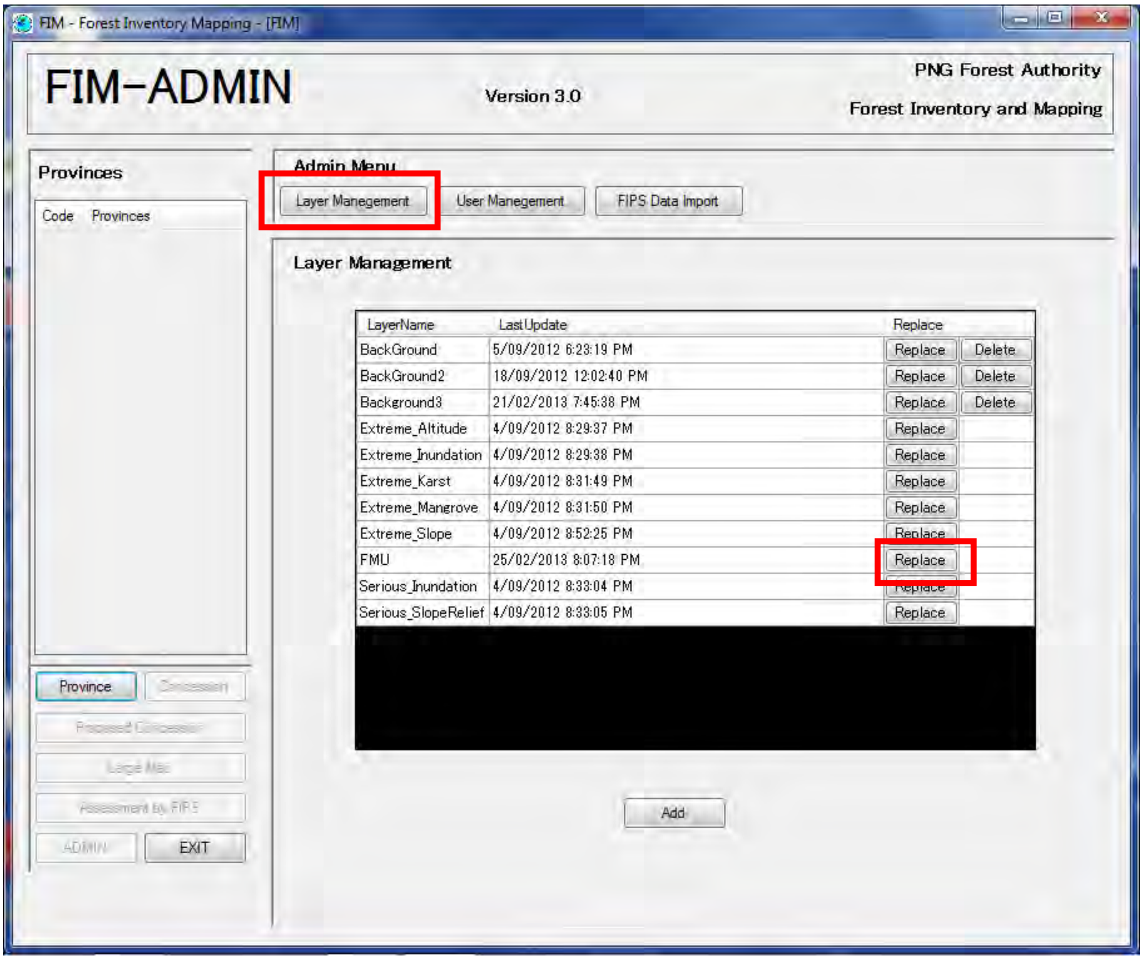


Figure 4-1 Layer Management Window

(3) Perform a recalculation

There is no recalculate process included within the FMU replace process, so after replace, execute FMU Calculation.

Calculate for both FMU（Province）, and Concession.

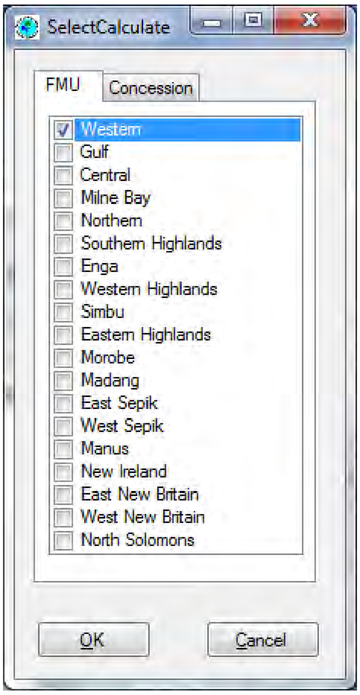


Figure 4-2 Calculation Dialog

4.1.2. Response to Import Errors

(1) Change the Geometry form

When importing a shape file in LargeMap, etc., if the import fails for the reason that the Geometry type does not match (presence of Z, etc.), change the Geometry type of the shape file.

4.2. LoggedOverArea Data Replacement (Addition) Procedure

To replace (or add) LoggedOverArea using FIMS, carry out the following procedure.

4.2.1. Importing

(1) Prepare a shape file having LoggedOverArea data.

The type of the shape file is taken as polygons.

Match the name and form of the attributes to the LoggedOverArea layer. The list of attributes is shown below.

Even if there is a mismatch in the type of an item, there is no problem as long as the type of the values match.

Name	Type	Details	Essential
PROVINCE	Double	Province that the Logged Over Area belongs to	○
AREA	Double	Extent of Logged Over Area (manual input, units: ha)	
AREA2	Double	Extent of Logged Over Area (automatic input, units: ha)	
TYPE	Text	Logged Over Area type	
ACHARVOL	Double	Actual harvest Volume	
PLAN_ID	Double	Plan id of the Concession to which the Logged Over Area belongs	
YEAR	Text	The date of the Logged Over Area is input in the following format Format: mm/yyyy	
NAME	Text	Logged Over Area name	

Example: When the type of the AREA of a shape is text

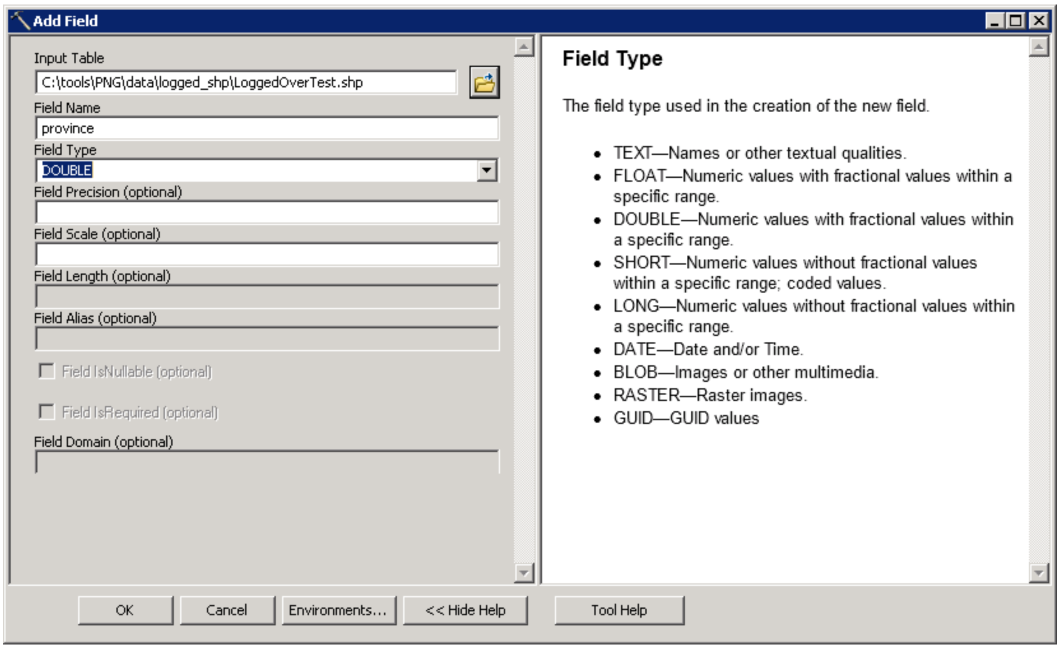
If the input values are numerals only, they can be imported, but if characters other than numbers are input, the import will fail.

(2) If there is no Province item

Add attributes to shape using the ArcToolbox of ArcCatalog.

Start up ArcCatalog and select ArcToolbox -> Data Management Tools -> Fields -> Add Field.

Specify the shape file in Input Table, add “Province” to the FieldName, and press the OK button.



(3) When the value of an attribute does not match the type

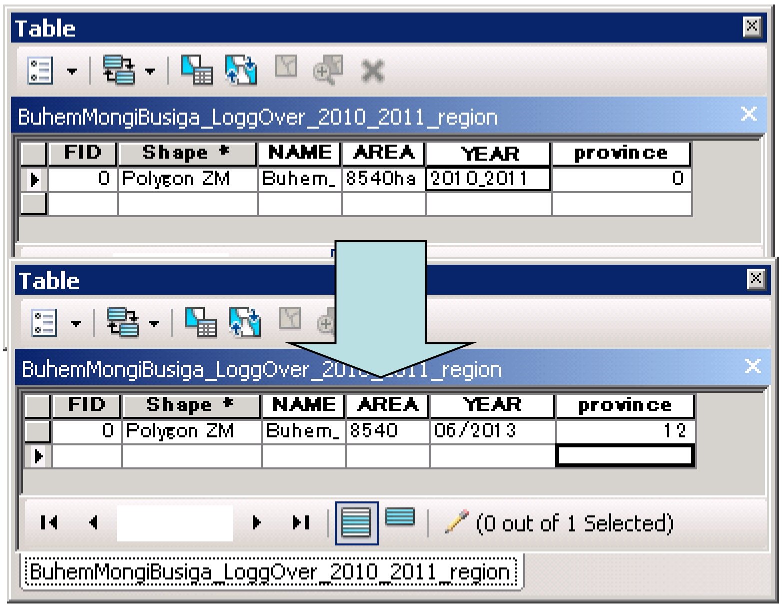
Edit the shape attribute value in ArcMap. The procedure is as follows.

1. Read the shape file into ArcMap and select Editor -> Start Editing.

2. Right click shape from the Contents with the mouse and select OpenAttributeTable.

3. Edit the value of the attribute to match the type of Logged Over Area. In particular, take care to input the correct value into Province.

4. Save the result of the editing with Save Edits and terminate.



(4) When the type of the spatial attributes do not match

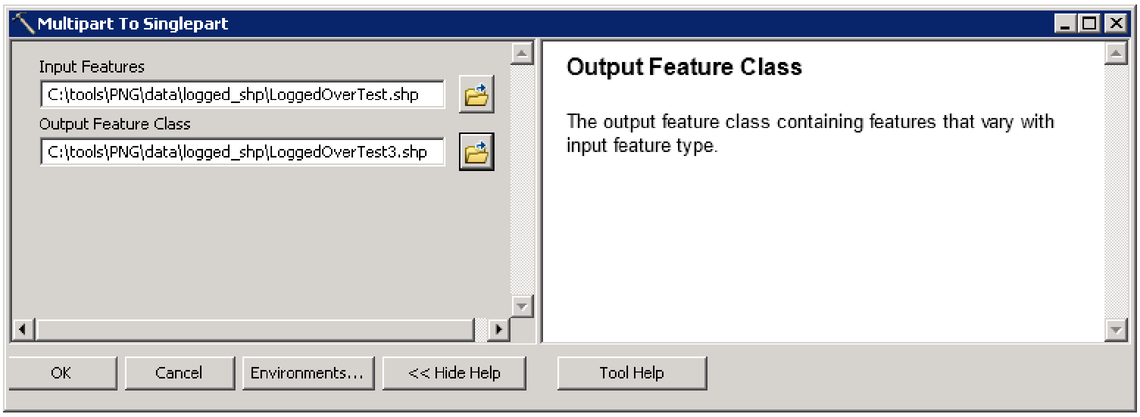
Correct t the type to polygons by ArcMap or ArcCatalog.

(5) When several polygons are grouped together to form a single feature

When several polygons are grouped together to form a single feature and when the polygons straddle several Concessions, it is necessary to convert to the type of one feature one polygon.

Select ArcToolBox -> Feature -> Multipart → Singlepart.

Specify the shape before division in Input Features, input the file name of the shape output after division in Output Feature Class and press the OK button.

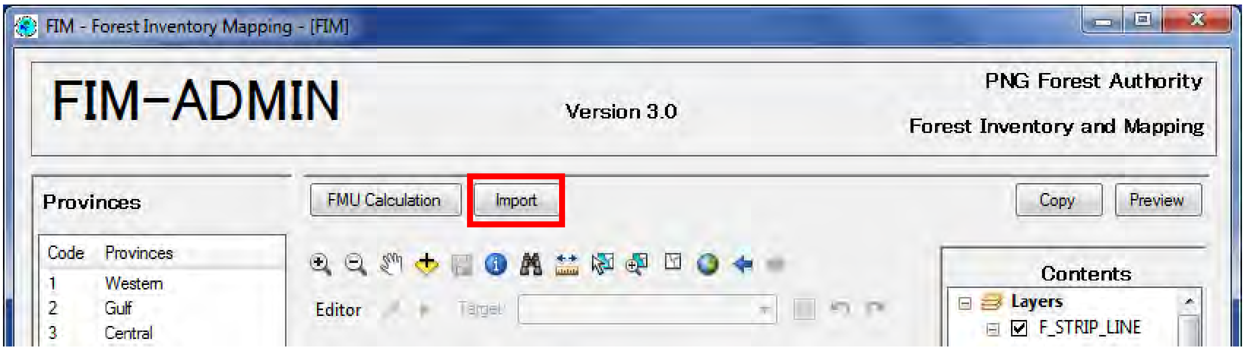


In shape files with divided polygons, an “ORIG_FID” file is added, but this is discarded when importing, so it is ok as it is.

(6) Execute Import

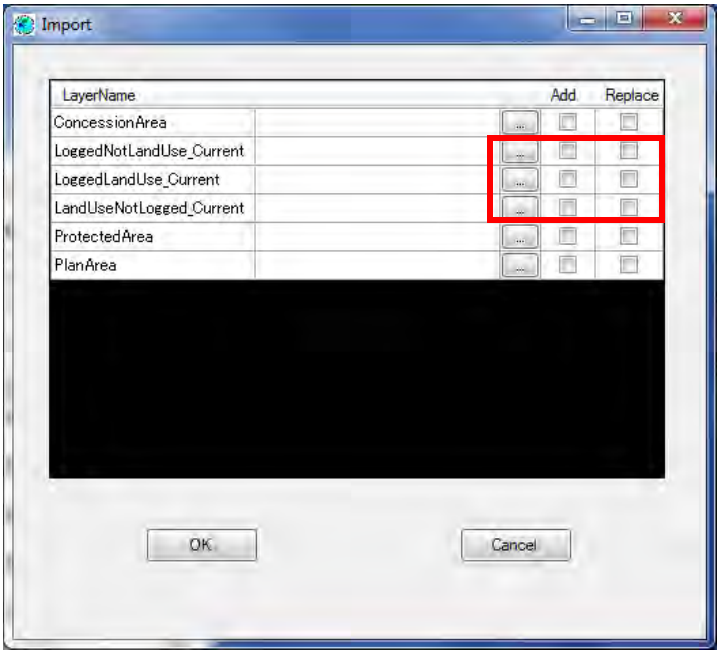
Execute Import in the LargeMap screen.

Open the LargeMap screen and press the Import button.



To add data, check “Add” in the layer to which it will be added and specify the prepared shape file.

To replace data, check “Replace” in the layer to which it will be added and specify the prepared shape file.



If the import fails and the message "The value type is incompatible with the field type" is displayed in the log, edit the attribute values, referring to Section 2.2(3) of the Operation and Maintenance Manual.

If the import fails and the message "Geometry cannot have Z values." is displayed in the log, correct the Polygon, referring to Section 3.2.12 of the Operation and Maintenance Manual.

(4) Re-calculate

There is no recalculate process in the replace process, so execute Calculation.

Calculate for both FMU（Province） and Concession.

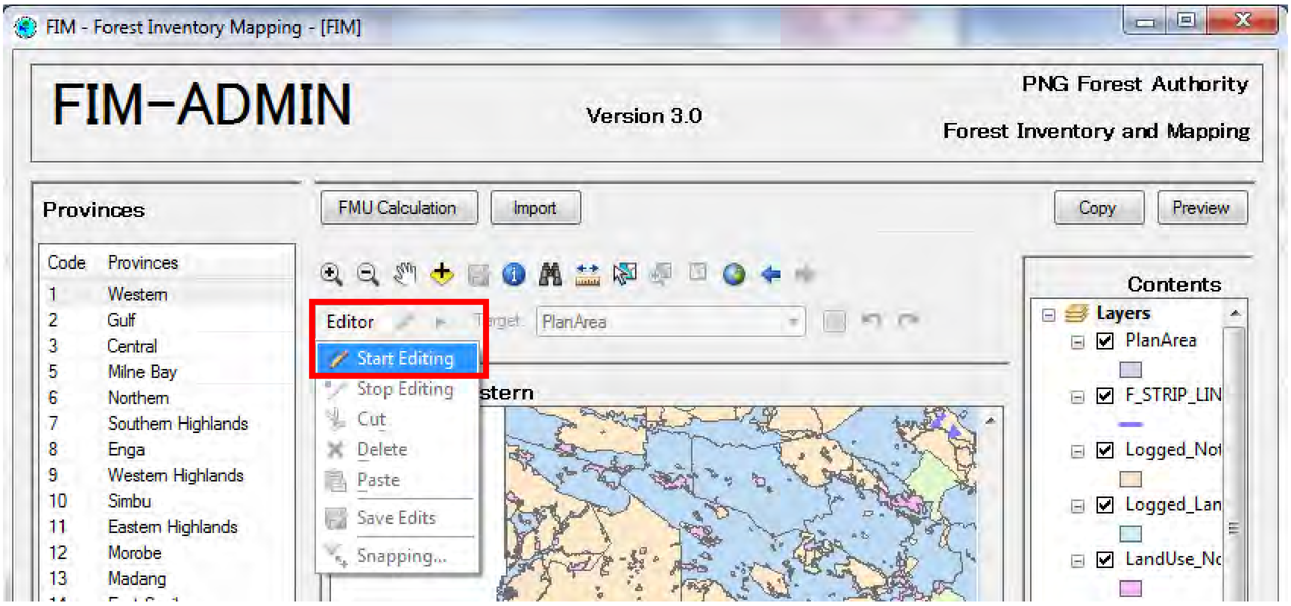
If the import succeeds and even though Calculation is executed subsequently there is no change in the values, the reason is that the value of the province has not been input into Feature of the imported Logged Over Area. Select the imported feature in the LargeMap screen and input the correct province value.

4.2.2. Drawing Figures

(1) Carry out drawing preparations

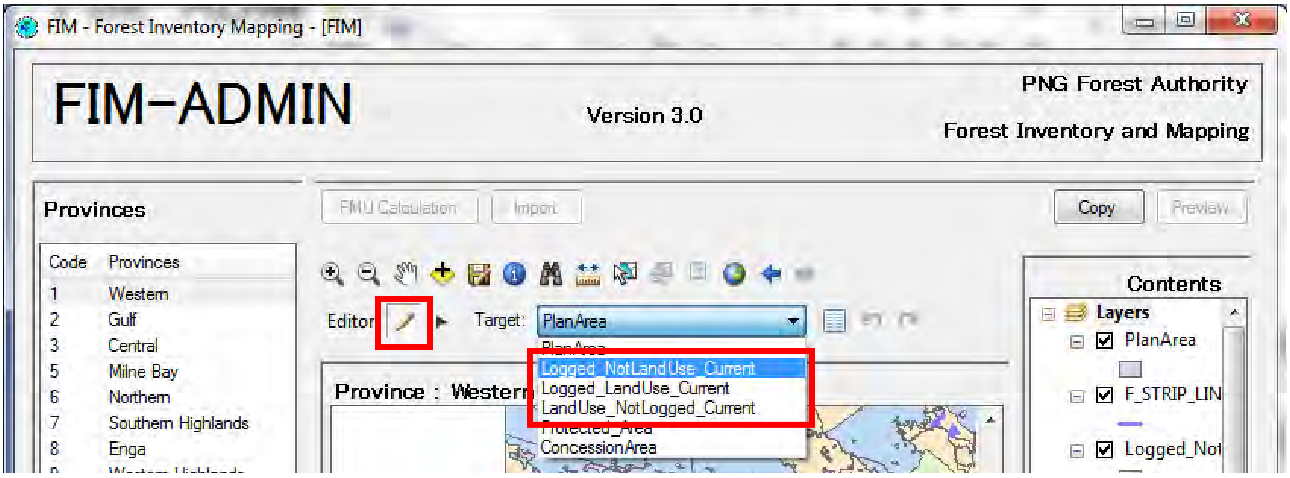
Open the FIMS LargeMap screen.

Select Editor from the toolbar and select "Start Editing".



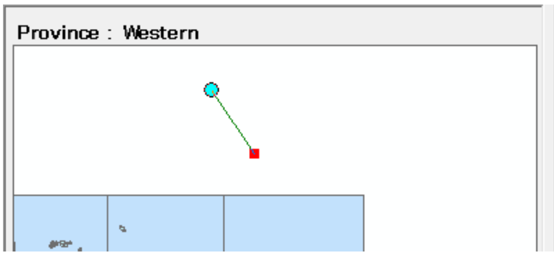
(2) Specify the layer in which the drawing will be carried out

Select SketchTool from the toolbar, and from the pull down menu, select the layer in which drawing will be carried out（Logged_NotLandUse_Current, Logged_LandUse_Current, LandUse_NotLogged_Current）.

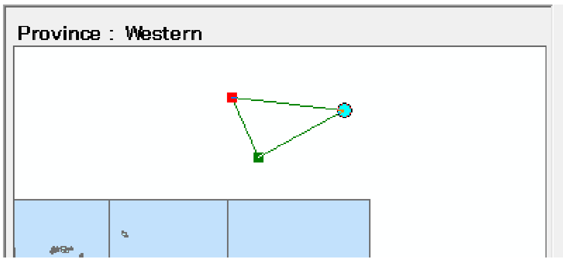


(3) Carry out the drawing

1. Click within the screen and set the node points.



2. Form a feature.



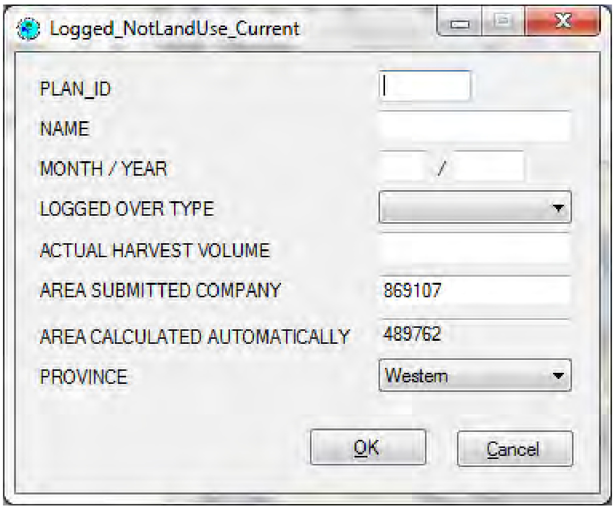
3. Double click to confirm.

(4) Input attributes

The Attribute screen opens, so input the attribute values.

For details of the attributes, refer to Section 4.2.1 (1).

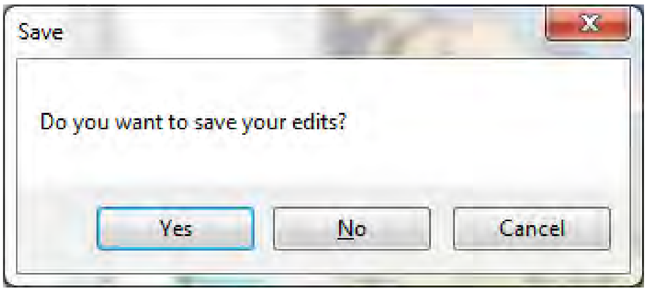
When input is completed, press the OK button to close.



(5) Complete the drawing

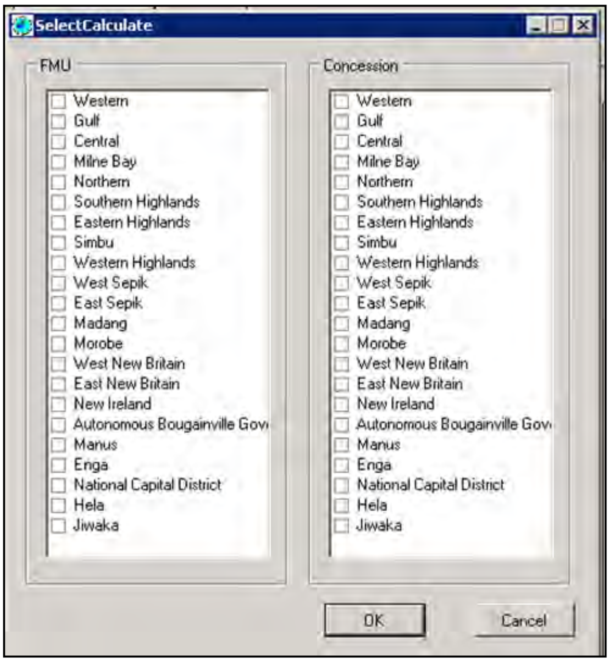
Select Editor from the toolbar and select "Stop Editing".

A screen asking you whether or not to save is displayed, so press the "Yes" button.



(5) Calculate

Perform the Calculation. Calculate for both FMU（Province）and Concession.



4.3. ConcessionArea Data Replacement (Addition) Procedures

Data is replaced (added) using FIMS by the following procedures.

4.3.1. Importing

(1) Prepare a shape file having the ConcessionArea data.

The type of the shape file is taken as polygons.

Match the name and form of the attributes to the layer of the ConcessionArea. The following is a list of attributes.

Even if the type of an item does not match, it is not a problem as long as the type of the values match.

Name	Type	Details	Essential
PROVINCE	Double	Province to which the Concession Area belongs	○
PLAN_ID	Double	Plan_id	○
STATUS	Test	Input the status of either of the following Concession or Proposed	○
AREA	Double	Extent of Concession Area (units: ha)	
purchase	Date		
Exp	Date		
CONSTYPE	Text		
SCALE	Text		
NAME	Text	Concession Area name	

Example: When the type of the AREA of the shape is text

When the input values are numbers only, it is possible to import, but when characters other than numbers are input, it is not possible to import.

(2) When there is no Province, plan_id, or status item

Add a field by ArcMap or ArcCatalog.

(3) When the value of the attribute does not match the type

Edit the attribute value by ArcMap.

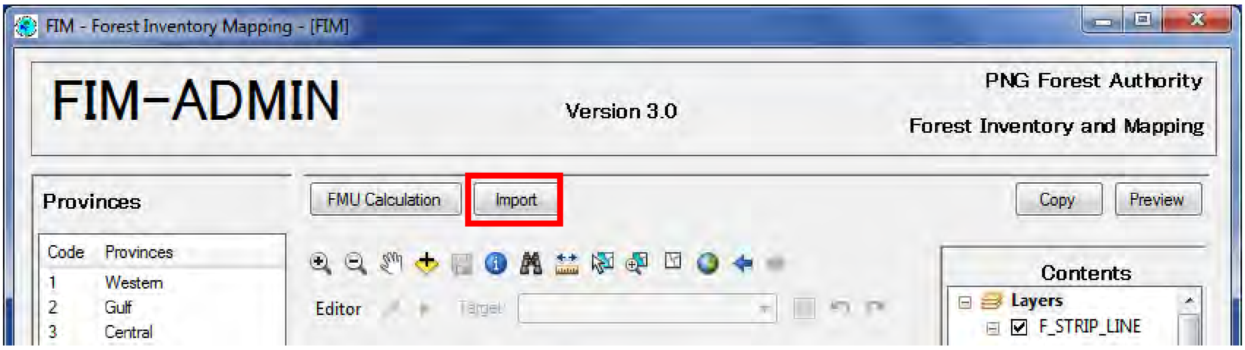
(4) When the type of the spatial attributes do not match

Correct the type to polygons by ArcMap or ArcCatalog.

(5) Execute Import

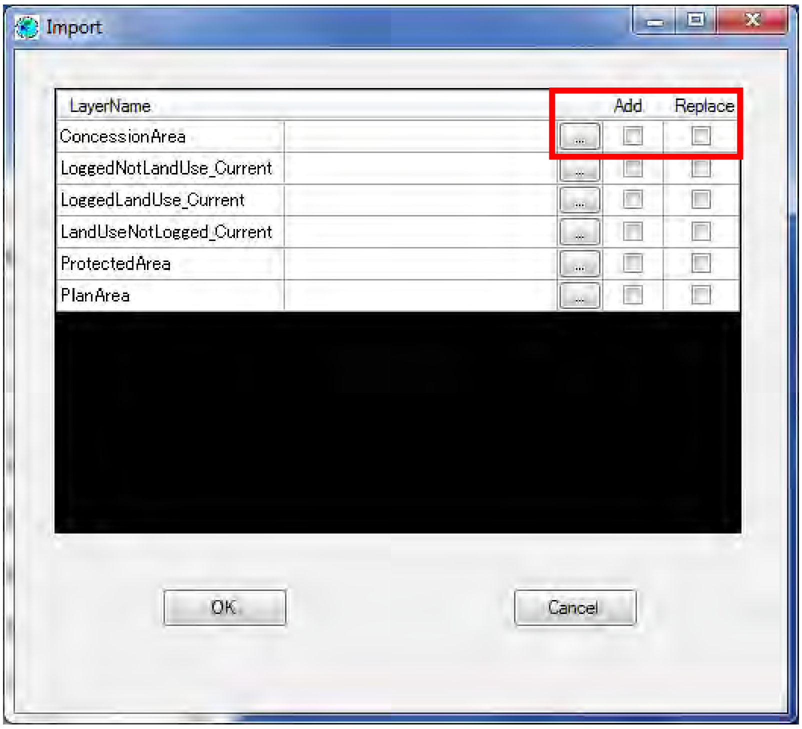
Execute Import in the LargeMap screen.

Open the LargeMap screen and press the Import button.



To add data, check “Add” in ConcessionArea and specify the prepared shape file.

To replace data, check “Replace” in ConcessionArea and specify the prepared shape file.



If the import fails and the message “The value type is incompatible with the field type” is displayed, edit the attribute values by ArcMap.

If the import fails and the message “Geometry cannot have Z values” is displayed in the log, correct the type to polygons by ArcCatalog.

(6) Recalculate

The recalculation process is not included in the replacement process, so execute Calculation.

Calculate for the Concession.

If the import succeeds and even though Calculation is executed subsequently there is no change in the values, the reason is that the value of the province has not been input into Feature of the imported Logged Over Area. Select the imported feature in the LargeMap screen and input the correct province value.

(6) Others

If a ConcessionArea is replaced, files that have been untied from the ConcessionArea may remain on the server.

Checking for files with no Relation is carried out by the following procedure.

1. Start up SQL Server Management Studio and connect to the server.

2. Press the New Query button, and check that the database name in the top left of the screen (geodb01, etc.) is correct.

3. The Query Window is displayed, so input the following SQL, and press the Execute button.

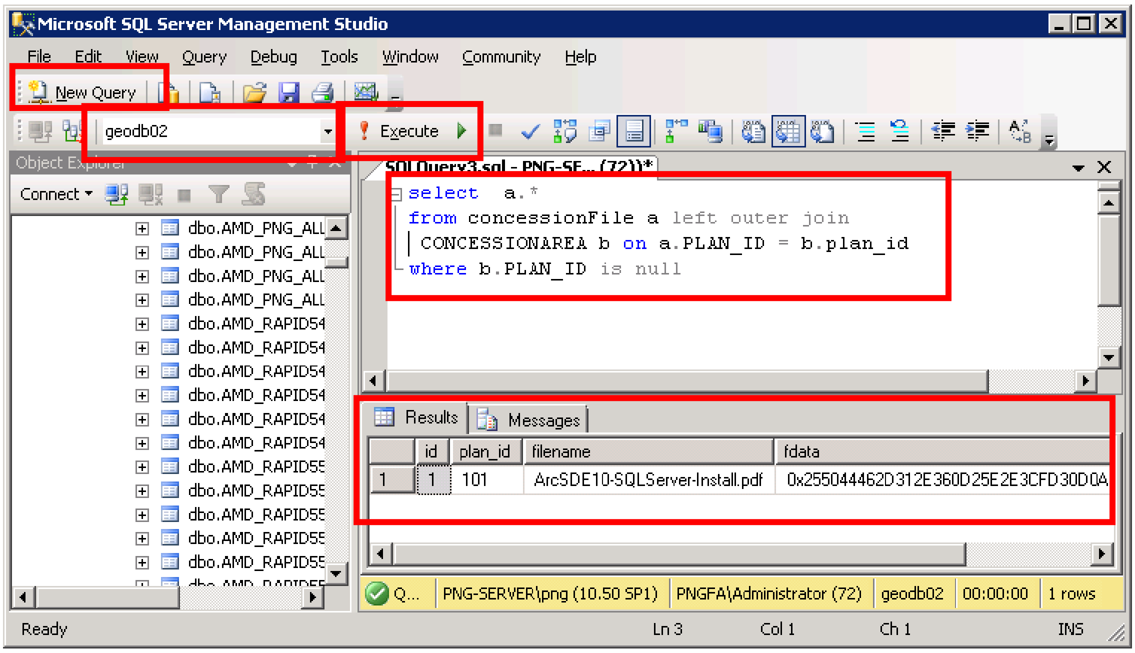
```
Select * from concessionFile

where not exists(select * from CONCESSIONAREA where concessionFile.plan_id =
CONCESSIONAREA.PLAN_ID)
```

4. If one or more records are displayed in the Results, there is unnecessary data on the server. Therefore, input the following SQL, and press Execute to delete the unnecessary files.

```
Delete from concessionFile

where not exists(select * from CONCESSIONAREA where concessionFile.plan_id =
CONCESSIONAREA.PLAN_ID)
```

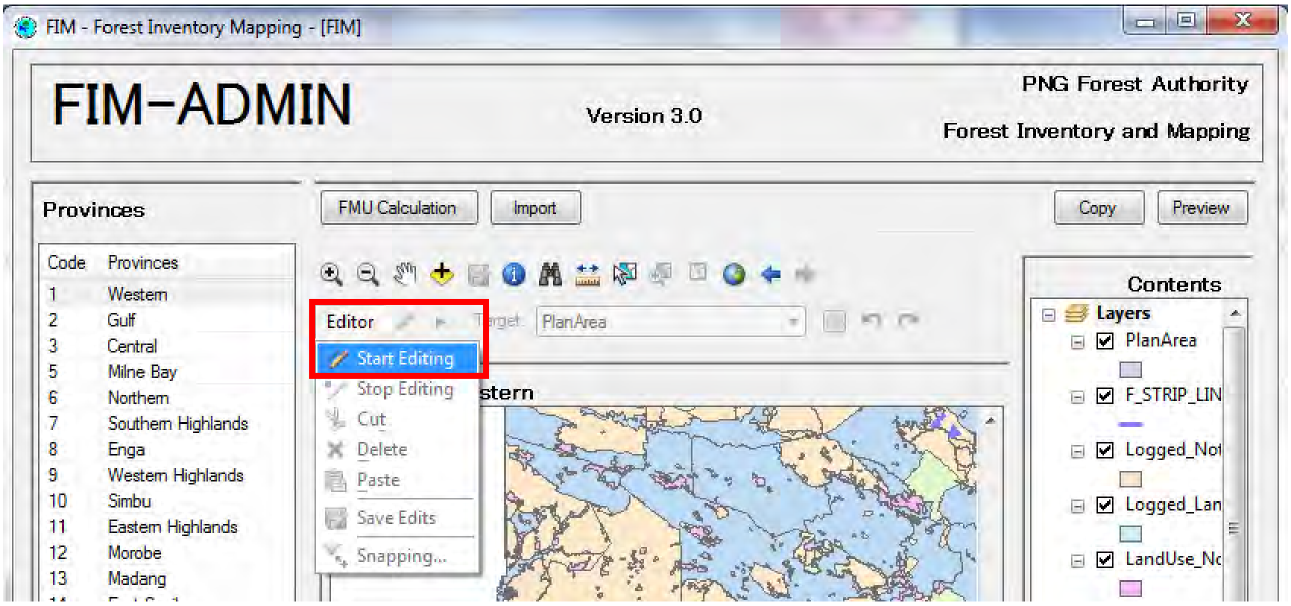

Microsoft SQL Server Management Studio
File Edit View Query Debug Tools Window Community Help
New Query
geodb02
Execute
Object Explorer
Connect
SQLQuery3.sql - PNG-SE...(72))*
select a.*
from concessionFile a left outer join
CONCESSIONAREA b on a.PLAN_ID = b.plan_id
where b.PLAN_ID is null
Results
Messages
id
plan_id
filename
fdata
1
1
101
ArcSDE10-SQLServer-Install.pdf
0x255044462D312E360D25E2E3CFD30D0A
PNG-SERVER\png (10.50 SP1)
PNGFA\Administrator (72)
geodb02
00:00:00
1 rows
Ready
Ln 3
Col 1
Ch 1
INS

4.3.2. Drawing Figures

(1) Preparation for drawing

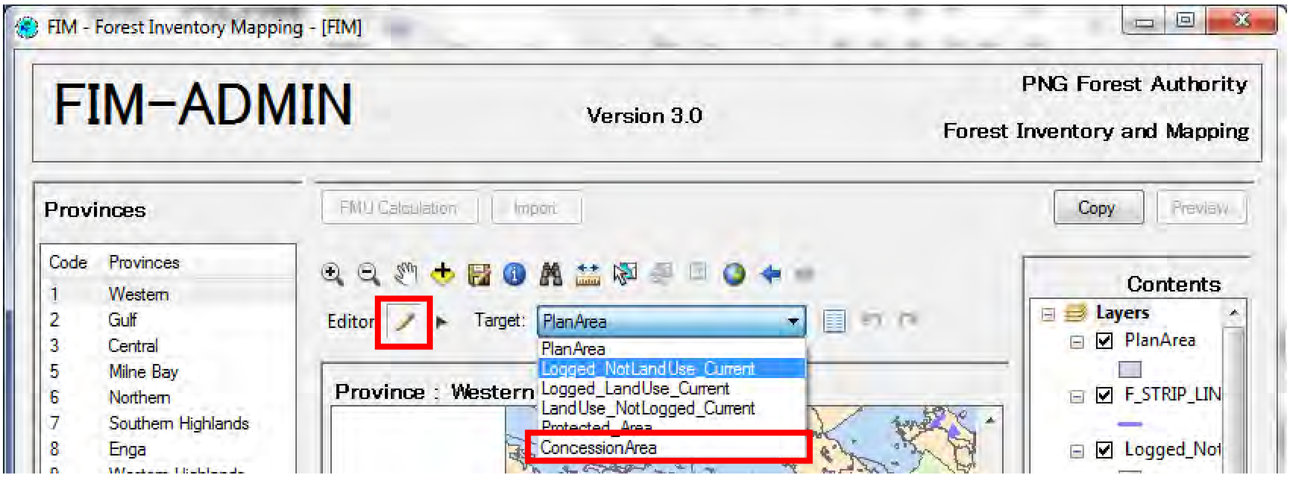
Open the FIMS LargeMap screen.

Select Editor from the toolbar, and select “Start Editing”.



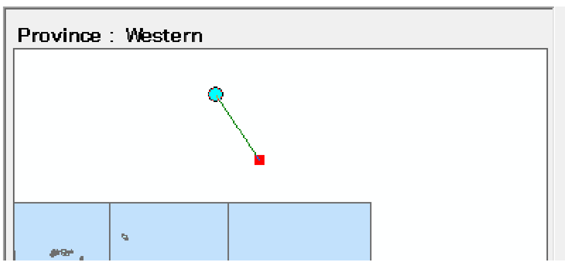
(2) Specify the layer in which the drawing will be carried out

Select SketchTool from the toolbar, and from the pull down menu select the ConcessionArea.

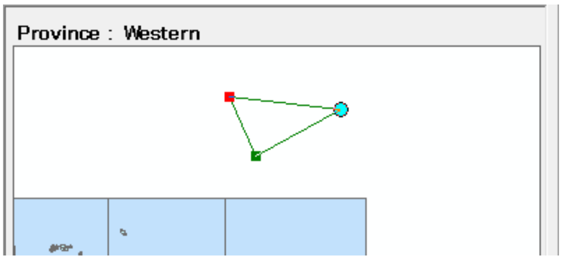


(3) Carry out the drawing

1. Click within the screen and set the node points.



2. Form a feature



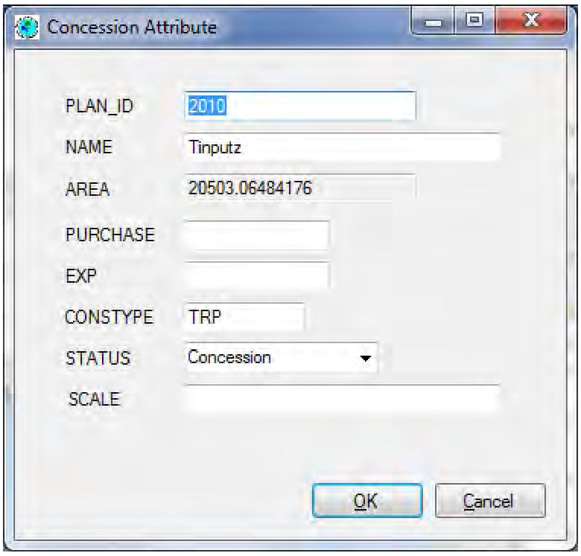
3. Double click to confirm.

(4) Input attributes

The Attribute screen opens, so input the attribute values.

For details of the attributes, refer to Section 4.2.1 (1).

When input is completed, press the OK button to close.



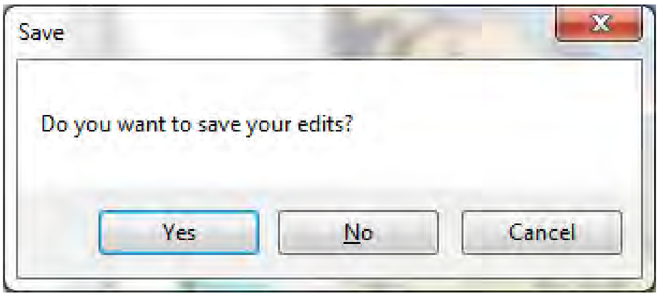
There are four important fields in the Concession Area.

- **plan_id** – enter the next plan id for the Province (these numbers are formally listed in the Plans Listing document held by the Mapping Branch Manager).
- **name** – enter the name of the new concession area.
- **area** – enter the area in hectares of the new concession area. The area can be determined by double-clicking on the polygon.
- **status** – enter the status of a new concession area as 'Proposed'. An existing concession area has the status 'Concession'. So to change a Proposed Concession Area into an official Concession Area, simply change the status from Proposed to Concession. Make sure the spelling is correct.

(5) Complete the drawing

Select Editor from the toolbar and select "Stop Editing".

A screen asking you whether or not to save is displayed, so press the "Yes" button.



(7) Calculate

Perform the Calculation for Concession.

4.4. ProtectedArea Data Replacement (Addition) Procedures

Data is replaced (added) using FIMS by the following procedures.

4.4.1. Importing

(1) Prepare a shape file having the ProtectedArea data.

The type of the Shape file is taken as polygons.

Match the name and form of the attributes to the layer of the ProtectedArea. The following is a list of attributes.

Even if the type of an item does not match, it is not a problem as long as the type of the values match.

Name	Type	Details	Essential
PROVINCE	Double	Province to which the Protected Area belongs	○
PROTECT_ID	Double	Protected Area ID	
NAME	text	Protected Area name	
TYPE	text	Protected Area type	
GAZ_DATE	Text	Designated date by protected area	
LOCATION	Text	protected area's location (Character string)	
TENURE	Text	protected area's holder	
AREA	Double	Extent of Protected Area (units: ha)	
ALTITUDE	Text	altitude description	
LOGITUDE	Text	protected area's location (longitude)	
LATITUDE	Text	protected area's location (latitude)	

Example: When the type of the AREA of the shape is text

When the input values are numbers only, it is possible to import, but when characters other than numbers are input, it is not possible to import.

(2) When there is no Province item

Add a field by ArcMap or ArcCatalog.

(3) When the value of the attribute does not match the type

Edit the attribute value by ArcMap.

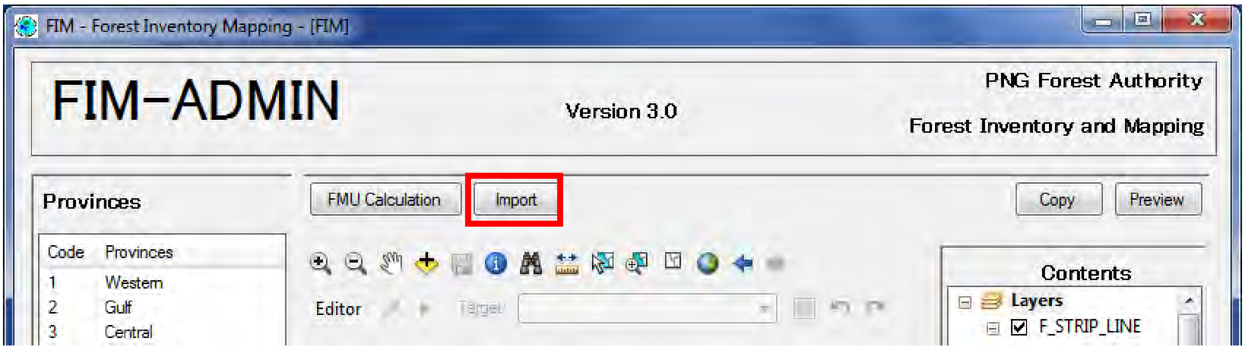
(4) When the type of the spatial attributes do not match

Correct the type to Polygon by ArcCatalog.

(5) Execute Import

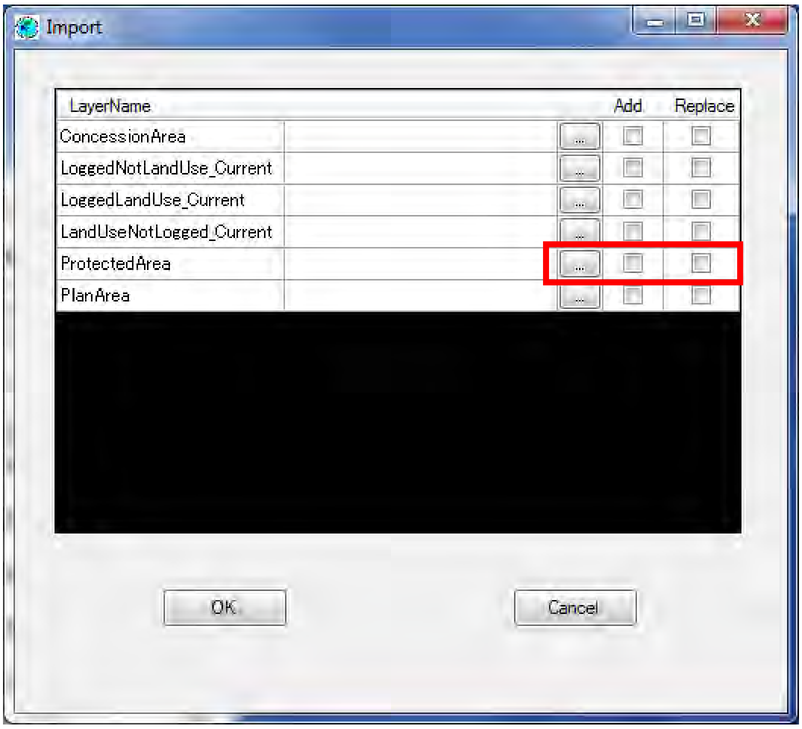
Execute Import in the LargeMap screen.

Open the LargeMap screen, and press the Import button.



To add data, check “Add” in ProtectedArea, and specify the prepared shape file.

To replace data, check “Replace” in ProtectedArea, and specify the prepared shape file.



If the import fails and the message “The value type is incompatible with the field type” is displayed in the log, edit the attribute values by ArcMap.

If the import fails and the message “Geometry cannot have Z values” is displayed in the log, correct the type to polygons by ArcCatalog.

(8) Recalculate

The recalculation process is not included in the replacement process, so execute Calculation.

Calculate for the Concession.

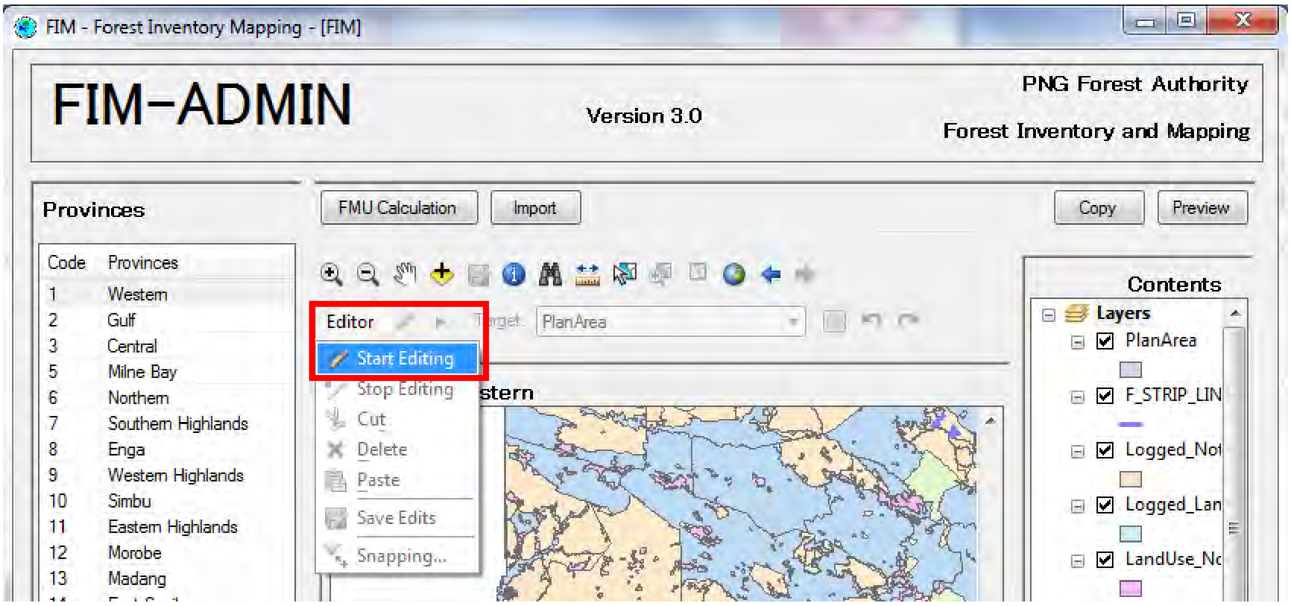
If the import succeeds and even though Calculation is executed subsequently there is no change in the values, the reason is that the value of the province has not been input into Feature of the imported ProtectedArea. Select the imported feature in the LargeMap screen, and input the correct province value.

4.4.2. Drawing Figures

(1) Prepare for drawing.

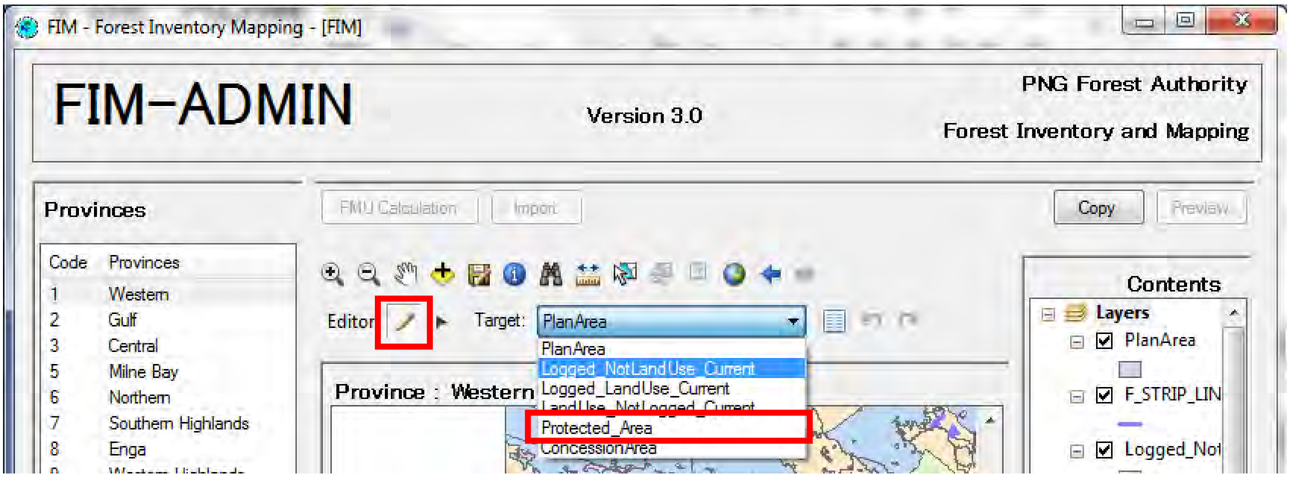
Open the FIMS LargeMap screen.

Select Editor from the toolbar and select “Start Editing”.



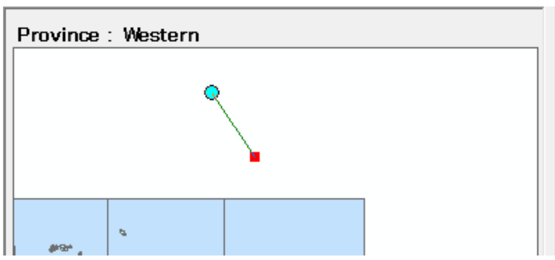
(2) Specify the layer in which the drawing will be carried out.

Select SketchTool from the toolbar, and from the pull down menu select the ProtectedArea.

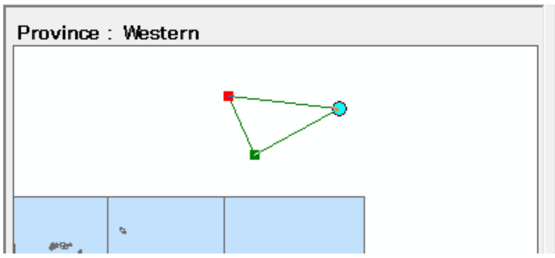


(3) Carry out the drawing

1. Click within the screen and set the node points.



2. Form a feature.



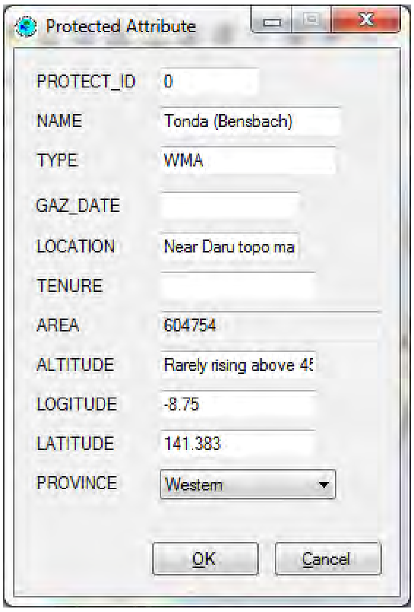
3. Double click to confirm.

(4) Input attributes.

The Attribute screen opens, so input the attribute values.

For details of the attributes, refer to Section 4.2.1 (1).

When input is completed, press the OK button to close.

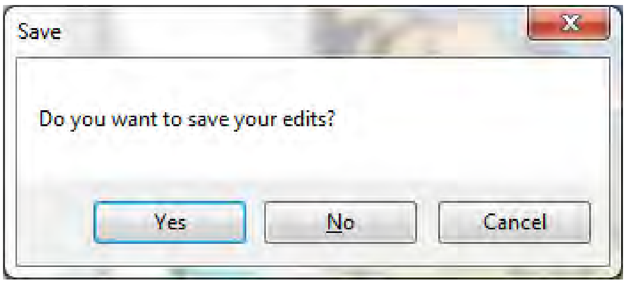


All Protected areas for Western province are displayed. To modify current Protected Areas, or to create new Protected Areas, make the Protected Area layer editable, and then use the this drawing tools.

(5) Complete the drawing

Select Editor from the toolbar, and select “Stop Editing”.

A screen asking you whether or not to save is displayed, so press the “Yes” button.



(9) Calculate

Perform the Calculation for Province (FMU) and Concession.

4.5. PlanArea Data Replacement (Addition) Procedures

Data is replaced (added) using FIMS by the following procedures.

4.5.1. Importing

(1) Prepare a shape file having the PlanArea data.

The type of the Shape file is taken as polygons.

Match the name and type of the attributes to the layer of the PlanArea. The following is a list of attributes.

Even if the type of an item does not match, it is not a problem as long as the type of the values match.

Name	Type	Details	Essential
PROVINCE	Double	Province to which the Plan Area belongs	○
AREA	Double	Extent of Plan Area (units: ha)	
AREA2	Double	Extent of Plan Area (automatic input, units: ha)	
TYPE	Text	Plan Area type	
PRJHARVOL	Double	Project harvest Volume	
PLAN_ID	Double	Plan id of the Concession to which the Plan Area belongs	
YEAR	Text	The date of the Plan Area is input in the following format Format: mm/yyyy	
NAME	Text	Plan Area name	

Example: When the type of the AREA of the shape is text

When the input values are numbers only it is possible to import, but when characters other than numbers are input it is not possible to import.

(2) When there is no Province item

Add a field by ArcCatalog.

(3) When the value of the attribute does not match the type

Edit the attribute value by ArcMap.

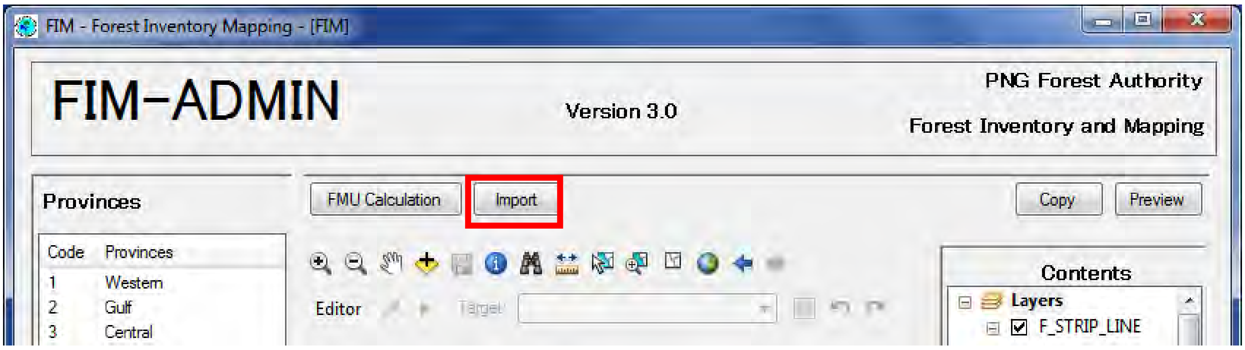
(4) When the type of the spatial attributes do not match

Correct the type to Polygon by ArcCatalog.

(5) Execute Import

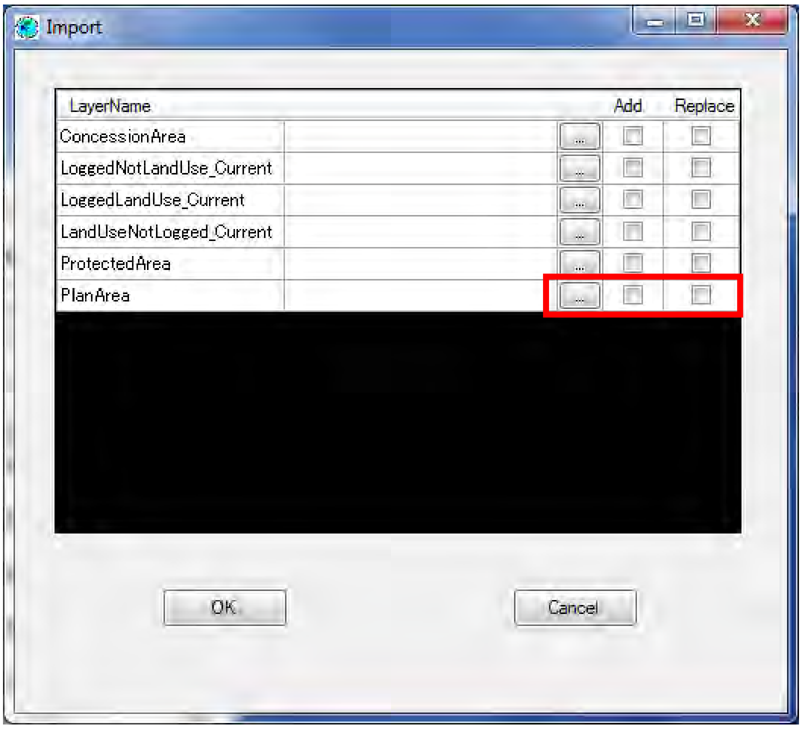
Execute Import in the LargeMap screen.

Open the LargeMap screen and press the Import button.



To add data, check “Add” in PlanArea and specify the prepared shape file.

To replace data, check “Replace” in PlanArea and specify the prepared shape file.



If the import fails and the message “The value type is incompatible with the field type” is displayed in the log, edit the attribute values by ArcMap.

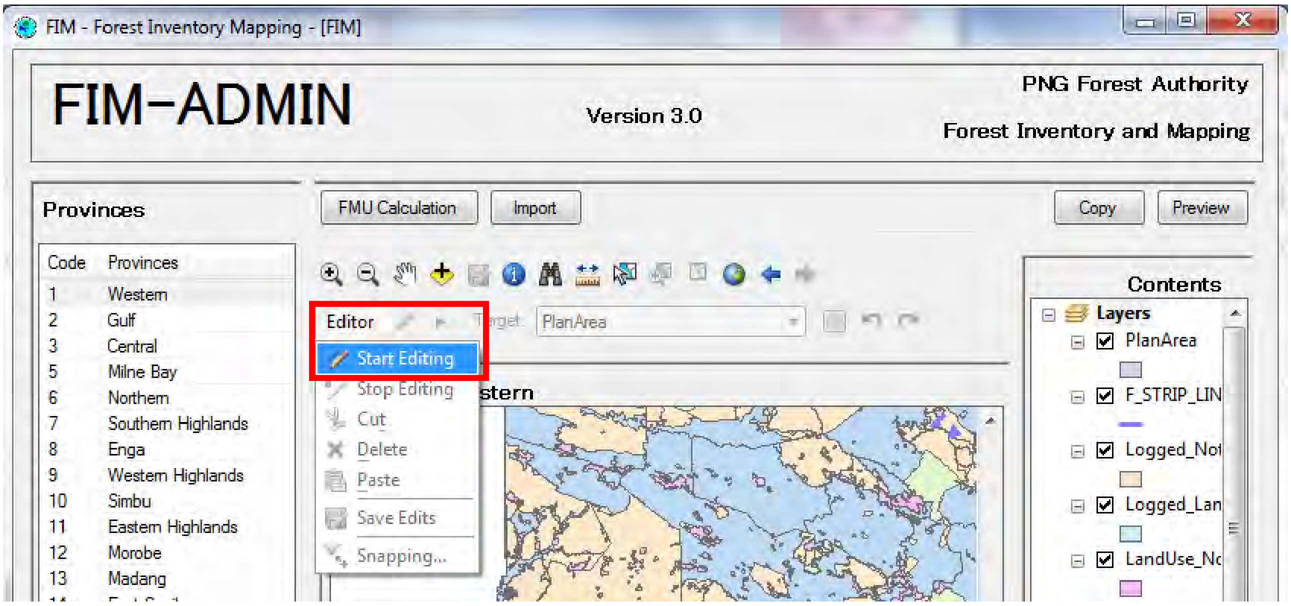
If the import fails and the message “Geometry cannot have Z values” is displayed in the log, correct the type to polygons by ArcCatalog.

4.5.2. Drawing Figures

(1) Prepare for drawing.

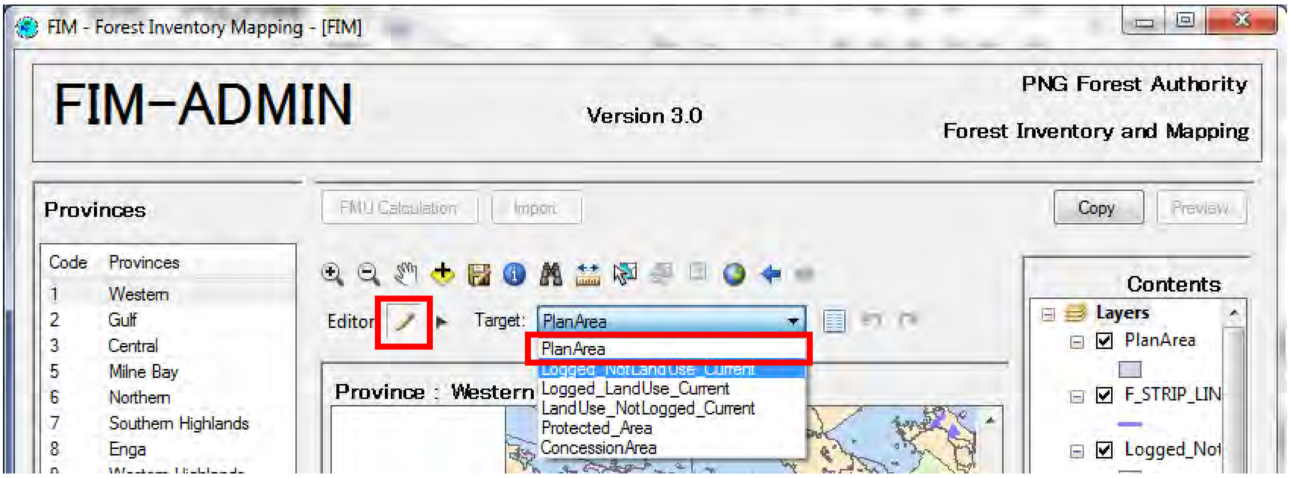
Open the FIMS LargeMap screen.

Select Editor from the toolbar, and select “Start Editing”.



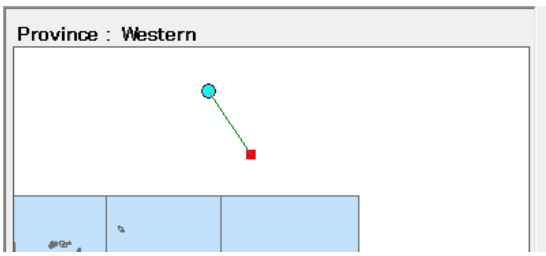
(2) Specify the layer in which the drawing will be carried out.

Select SketchTool from the toolbar, and from the pull down menu select the PlanArea.

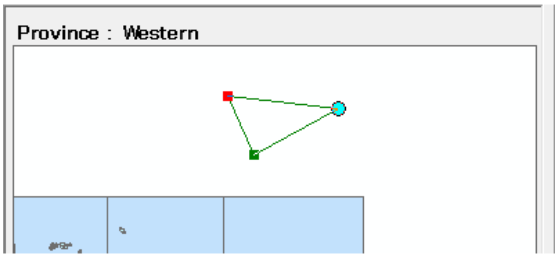


(3) Carry out the drawing.

1. Click within the screen, and set the node points.



2. Form a feature.



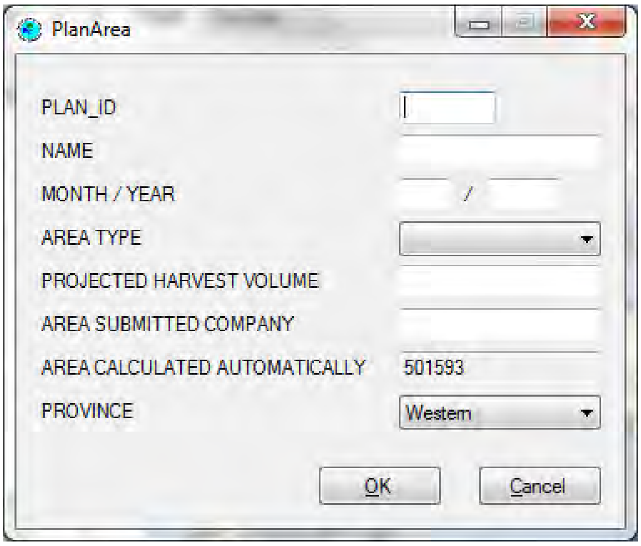
3. Double click to confirm.

(4) Input attributes.

The Attribute screen opens, so input the attribute values.

For details of the attributes, refer to Section 4.2.1 (1).

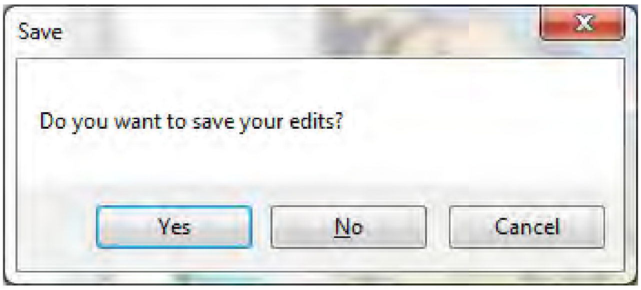
When input is completed, press the OK button to close.



(5) Complete the drawing.

Select Editor from the toolbar, and select “Stop Editing”.

A screen asking you whether or not to save is displayed, so press the “Yes” button.



4.6. Operating Procedures when Importing was Incorrectly Performed

When data is imported by the procedures above, if the data is imported into a layer in which it should not have been registered, it is necessary to delete the data.

The data can be deleted by any of the following operations.

4.6.1. Delete Data with FIMS

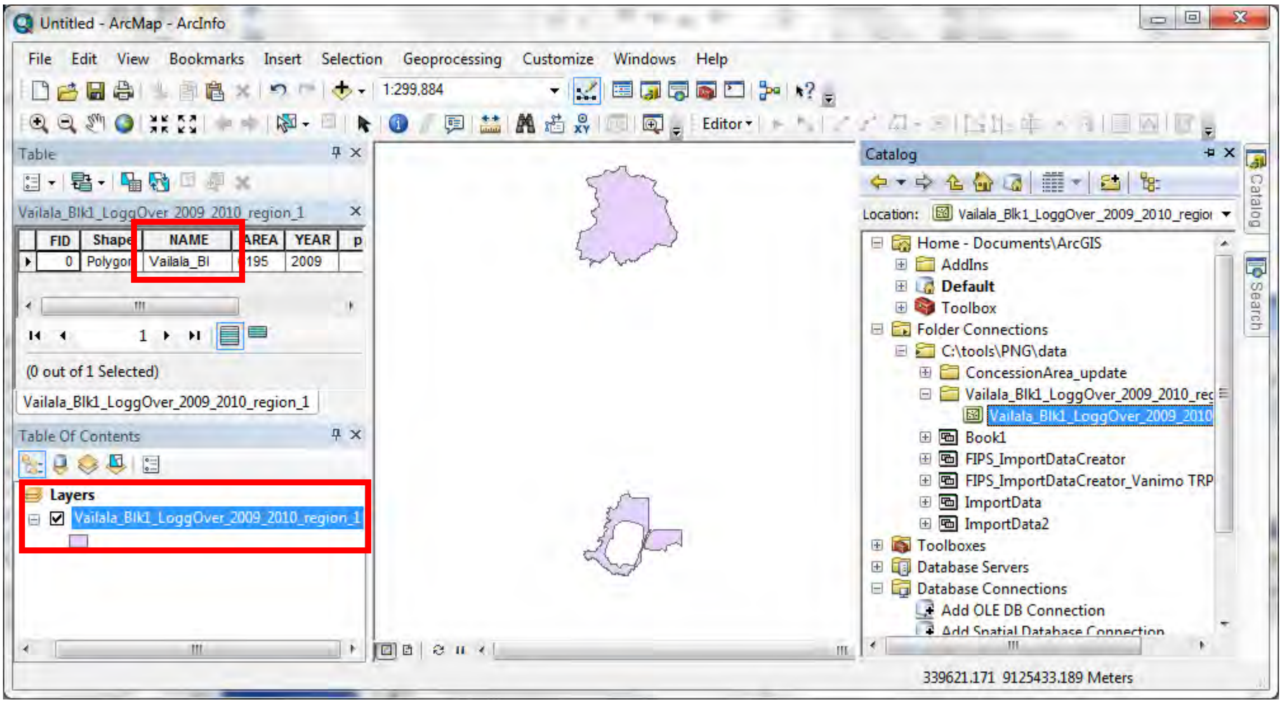
(1) Check the shape file that was imported and check the keywords for searching

Open ArcMap, and add the shape file that was imported to the Contents tree.

Right click the added shape file with the mouse and select Open Attribute Table.

Search among the displayed attributes for that which matches the attribute name of the registered destination layer and note the attribute value.

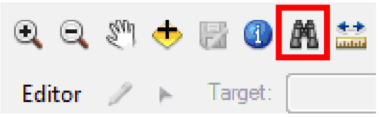
In the following figure, the key of the "Name" field is taken to be "Vailala_Bl".

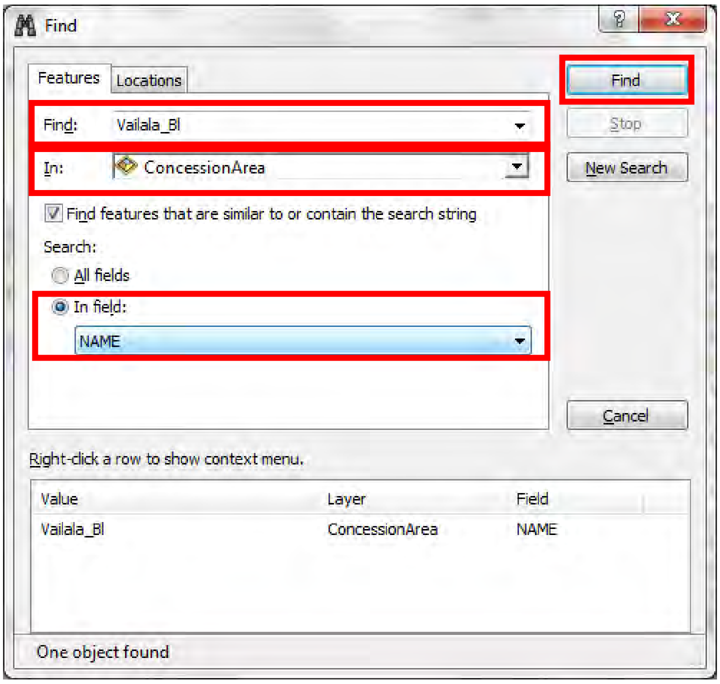


(2) Search the data using FIMS

Select Find from the toolbar of the LargeMap screen, and specify the noted keyword in Find, the incorrect import layer in In and the field name in which the keyword is recorded in In field.

Then, press Find, right click the records that were found with the mouse and select "ZoomTo".



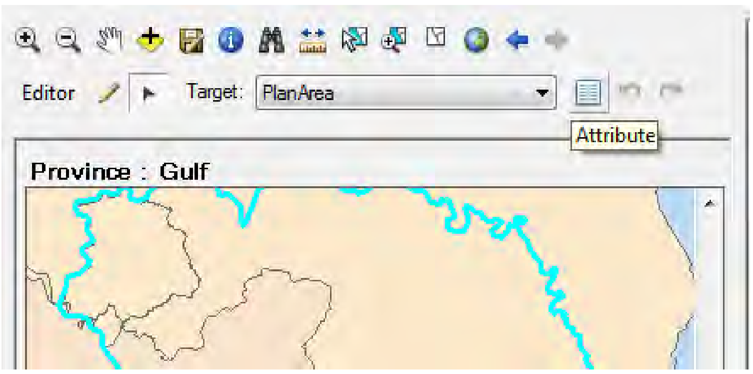


(3) Select the feature to be deleted

Select Start Editing from Editor and select the searched feature.

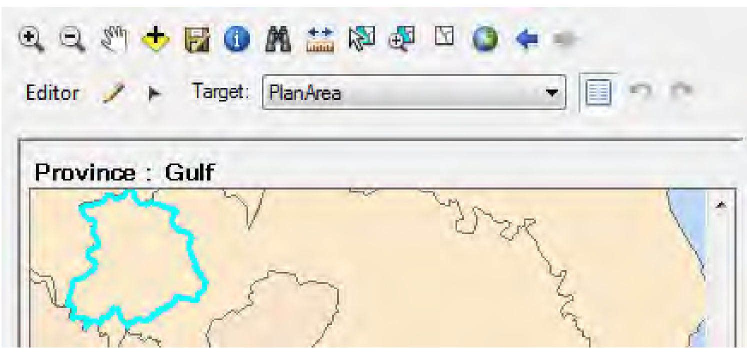
If the searched feature is selected (the outline of the feature is displayed in light blue), proceed to (4).

If a feature that is not the searched feature is selected, perform the following operations.

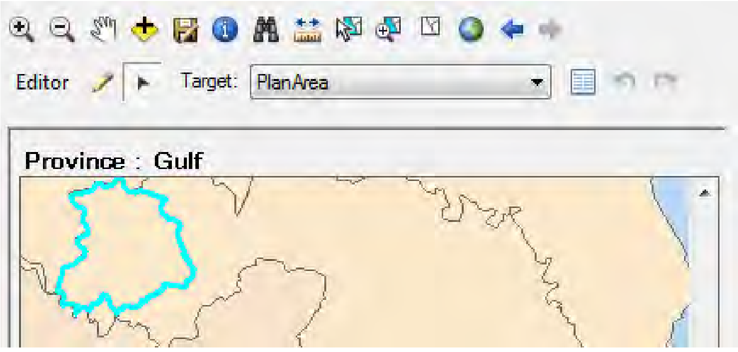


a. Select Attribute from the toolbar and select the searched feature.

b. The attribute input screen is displayed, so cancel.



c. Select Edit Tool again.



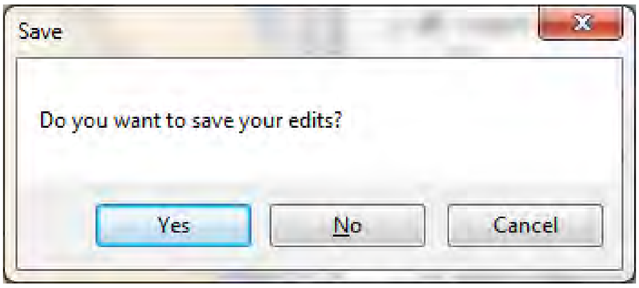
(4) Delete.

Press the keyboard Delete key, to delete the selected feature.

(5) Save.

Select Stop Editing from the Editor.

A confirmation message is displayed, so press Yes.



4.6.2. Deleting Data with ArcMap

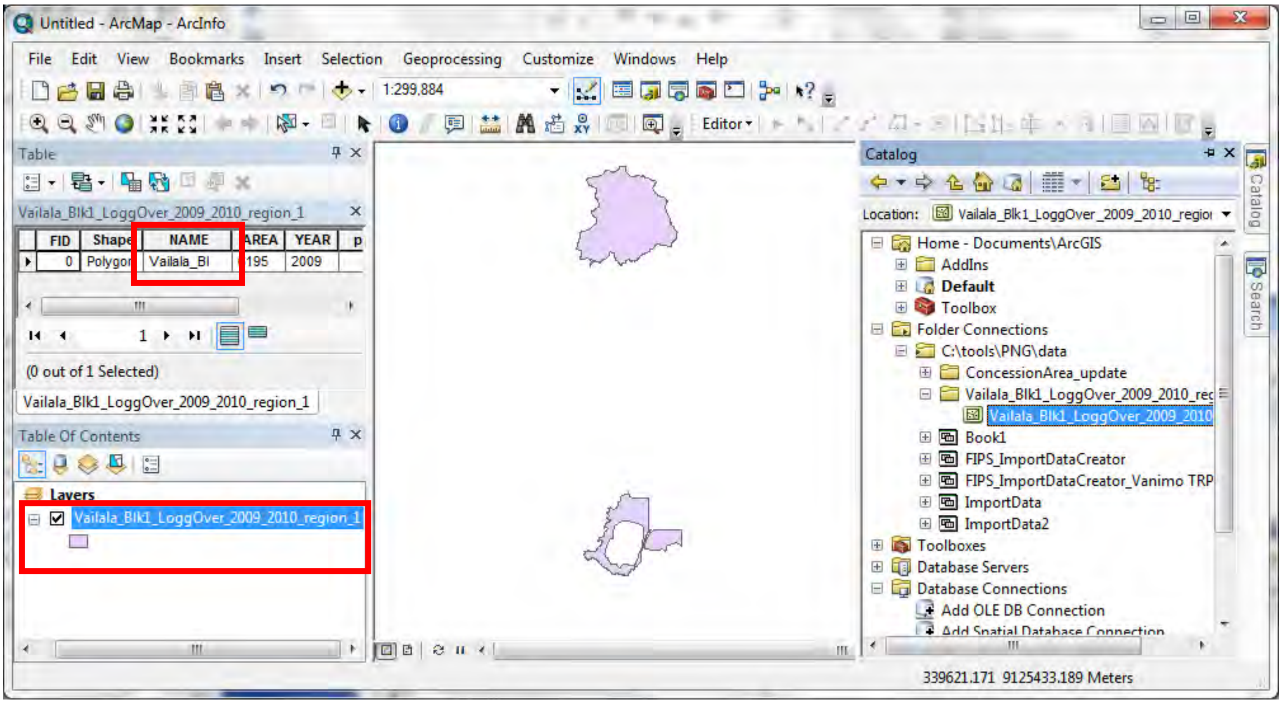
(1) Check the imported shape file and check the keywords for searching.

Open ArcMap, and add the imported shape file into the Contents tree.

Right click the added shape file with the mouse and select Open Attribute Table.

Search among the displayed attributes for that which matches the attribute name of the registered destination layer and note the attribute value.

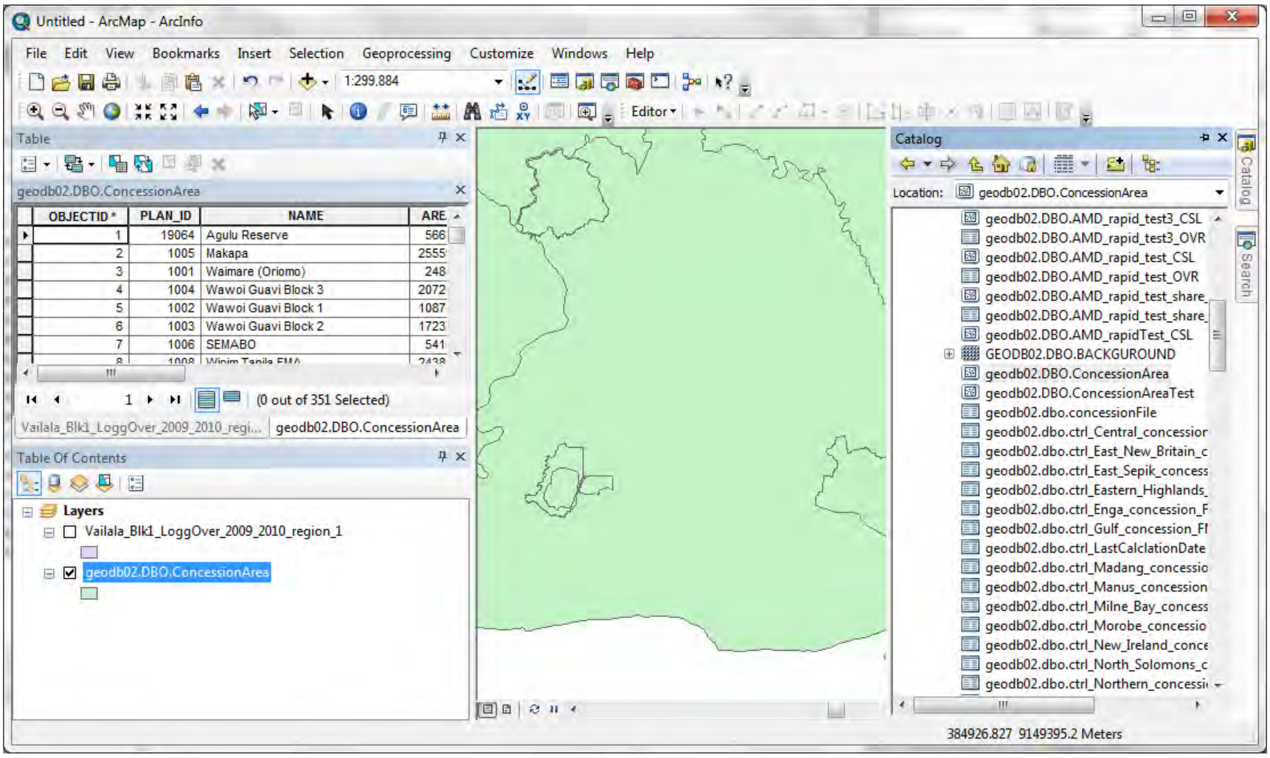
In the following figure, the key of the "Name" field is taken to be "Vailala_Bl".



(2) Register the layer to be deleted in ArcMap and open the Attribute screen.

Select the incorrectly imported layer from the Catalog tree and Drag&Drop to Contents.

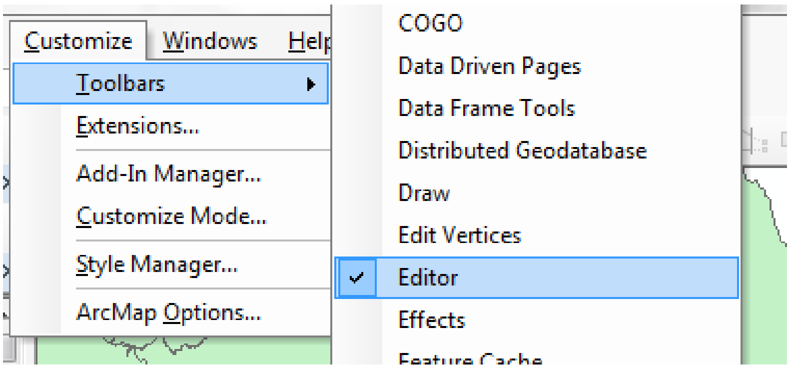
Right click the layer that has been Dragged & Dropped with the mouse and select Open Attribute Table.



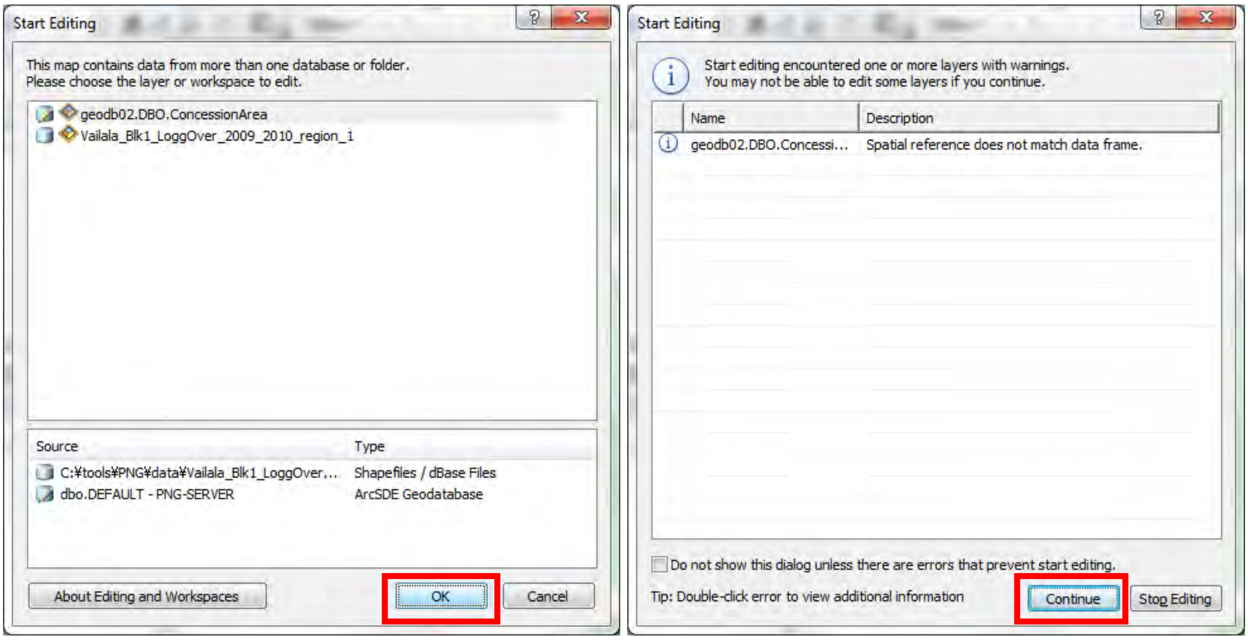
(3) Delete the feature

Select Editor from the toolbar and select Start Editing.

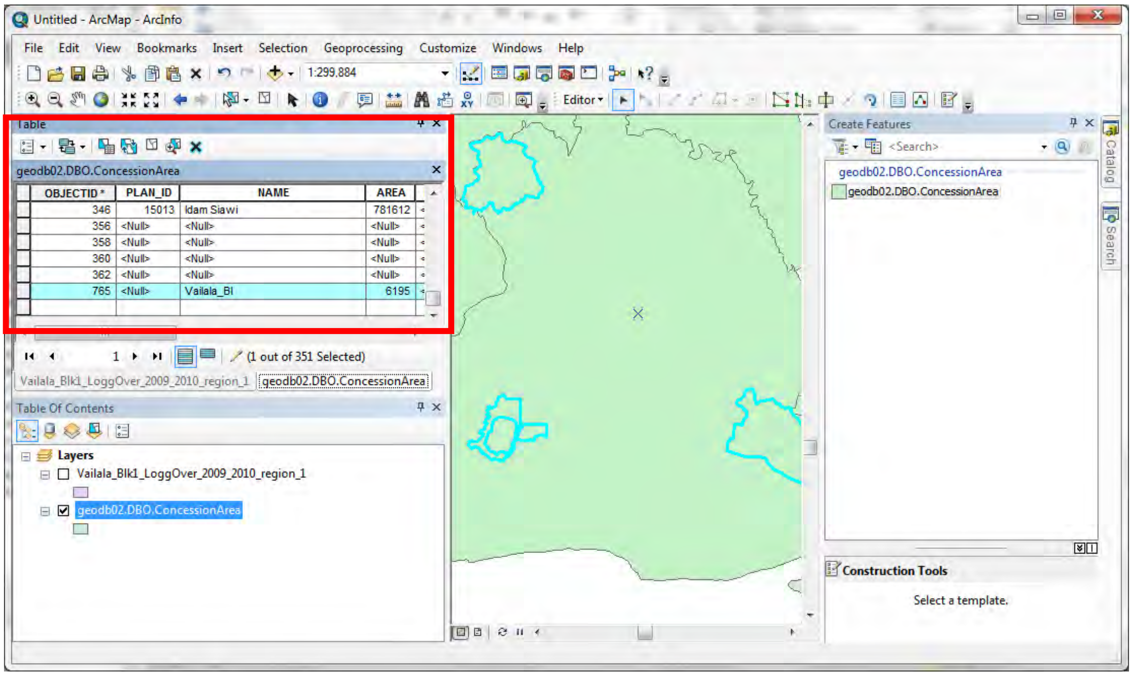
If there is no Editor toolbar, select Toolbars from the Customize menu and enter a check for Editor.



If the following screen is displayed, select OK and Continue.



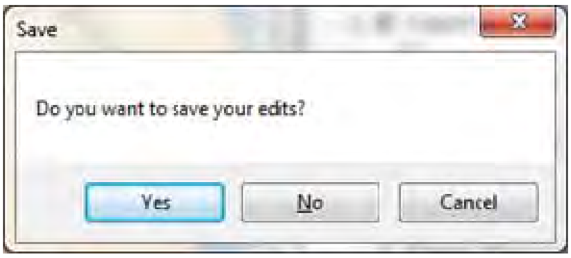
Then, select the feature to be deleted from the Attribute Window and press the Delete key to delete the feature.



(4) Save.

Select Stop Editing from Editor.

A confirmation message is displayed, so press Yes.



FIPS - Forest Inventory Processing System

FIPS Access version 1.0

User Guide

July 2019

Papua New Guinea Forest Authority (PNGFA)

Japan International Cooperation Agency (JICA)

FIPS – Forest Inventory Processing System

FIPS Access version 1.0

User Guide

FIPS – Forest Inventory Processing System
FIPS Access Version 1.0

USER GUIDE
2019/6/30 ver.1.1

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Index

PART A. Quick Guide for FIPS

1. Basic function: Importing survey results into FIPS

FIPS provides two options to enter the survey results (field book data).

Method 1) Enter data to FIPS directly (existing function)

Method 2) Import from Excel spreadsheet (new function)

This procedure is showing Method 2.

Steps

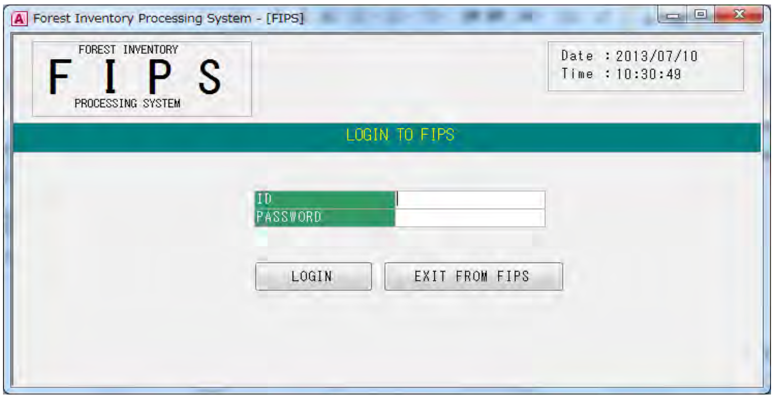
1. Enter information for a new survey
2. Input the field book data into an excel spreadsheet
3. Import the field book data from the excel spreadsheet into new FIPS
4. Run calculation, print reports and output to excel file

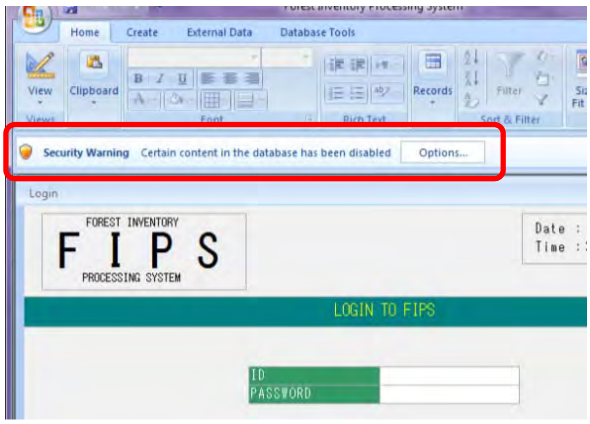
1.1 Enter information for a new survey

(1) Start FIPS.

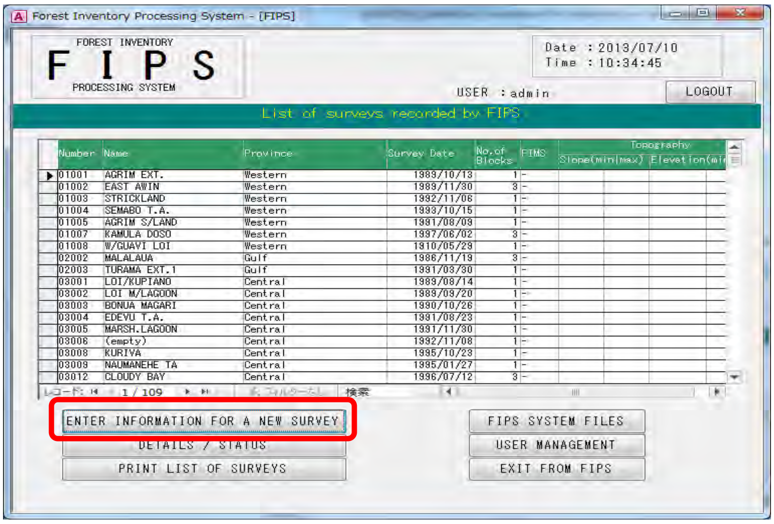
Click FIPS-Startup on the desktop, input ID and PASSWORD, then main window will open.

In case Security warning appears, Click on “Options” and select “Enable this content”.

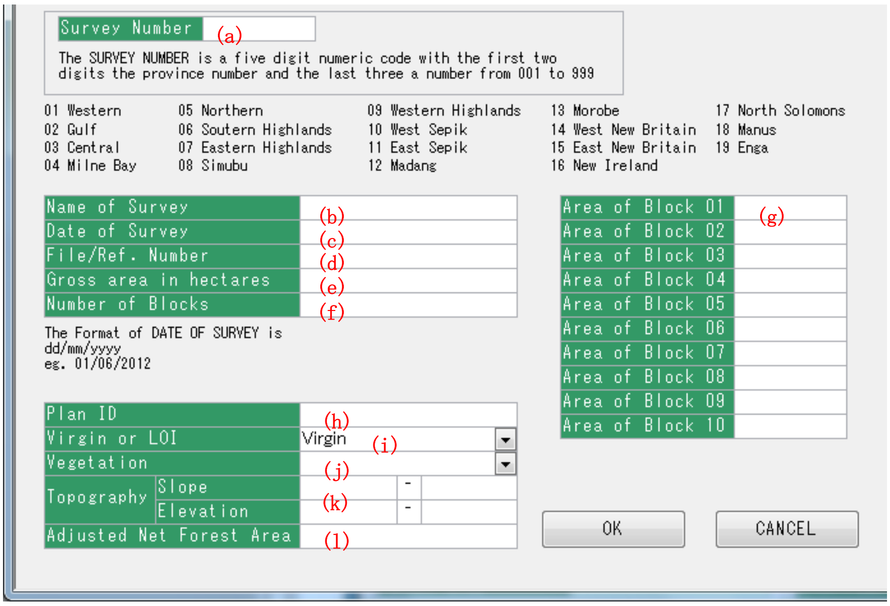




(2) Click on the “ENTER INFORMATION FOR A NEW SURVEY” button.



(3) Enter the details of the survey.



(a) Survey Number (Mandatory Item)

Check the last number which has been used already in the main window.

The survey number is a five digit numeric code with the first two digits the province number and the last three a number from 001 to 999.

(b) Name of survey (Mandatory Item)

Can be entered up to 20 characters.

(c) Date of survey

Completion date. The format of date is DD/MM/YYYY. (Eg. 01/06/2012)

(d) Gross area in hectares (Optional)

Enter the gross area of resource area in hectares. The area must be an integer number (whole number). If you recorded the area as a decimal number, you need to round it off to the nearest whole number.

(e) File / Ref .Number

(You can skip over entering this information.)

(f) Number of blocks

Enter the number blocks.

(g) Area of Block

Enter the area of each block in hectares. The area must be an integer number. If you recorded an area as a decimal number, you need to round it off to the integer number.

The entry number of Area of Block is the same with the value of "Number of Blocks". If the value of "Number of Blocks" is "2", then "Area of Block 01" and "Area of Block 02" should be filled.

(h) Plan ID (Optional)

Plan ID is for Plan ID of the concession area in FIMS.

You need to confirm the PlanID by FIMS.

If you enter the PlanID, you can link the survey result to the related FIMS concession area, and see in FIMS the estimated forest volume which is calculated by FIPS.

(i) Virgin, LOI or Unlogged Forest Survey

Choose virgin, LOI or Unlogged Forest Survey.

(j) Vegetaion (Optional)

Select the representative vegetation type in the survey area

(k) Topography (Slope and Elevation) (Optional)

Enter minimum and maximun value for slope and elevation.

(l) Adjusted Net Forest Area (in hectares) (Optional)

Enter the adjusted net forest area as an integer number.

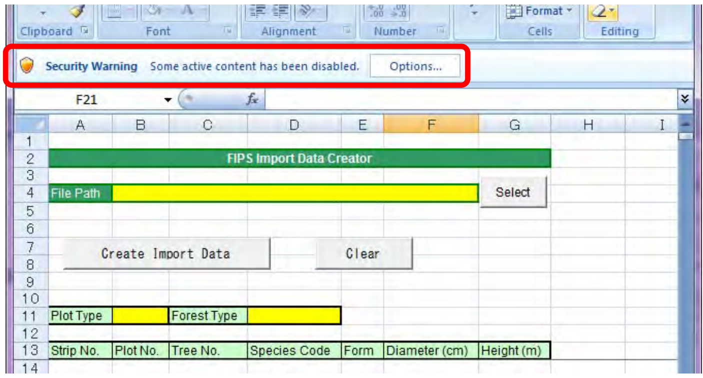
(4) Click OK, then Survey information will be saved.

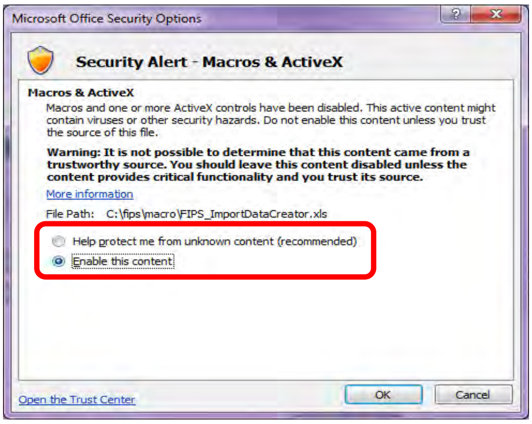
1.2 Input the field book data into an excel spreadsheet

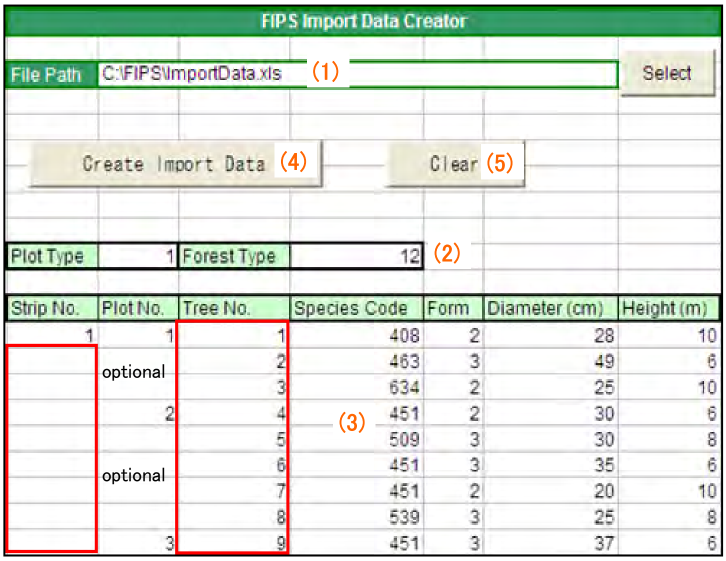
To import the field book data into new FIPS, you need to use the excel spreadsheet "FIPS Import Data Creator" which new FIPS provides.

The Excel spreadsheet is "FIPS_ImportDataCreator.xls" in C:¥fips¥macro.

If Security warning appears, Click on "Options" and select "Enable this content".



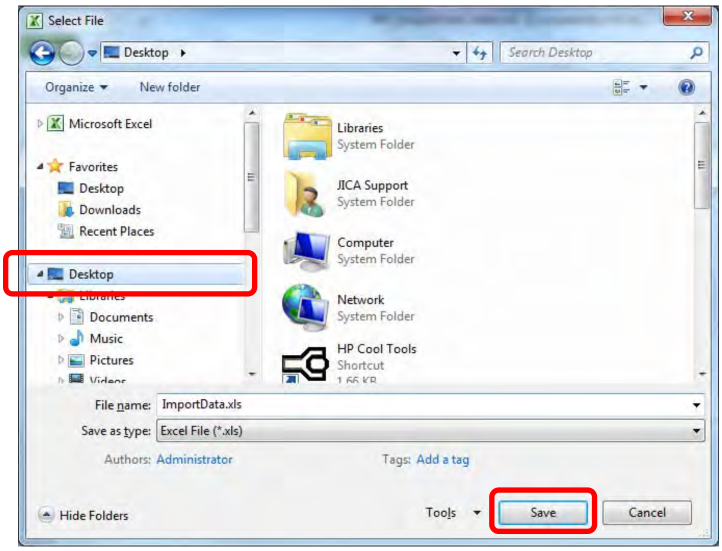




(1) Specify output path of the result Excel file

Click on the select button, and select a directory where you want to place the excel file "ImportData.xls" as the import data.

If you want to place "ImportData.xls" on desktop, select Desktop as below, then click on the save button.



(2) Select Plot Type and Forest Type

Plot Type and Forest Type are mandatory. Refer to [Reference] sheet for the code.

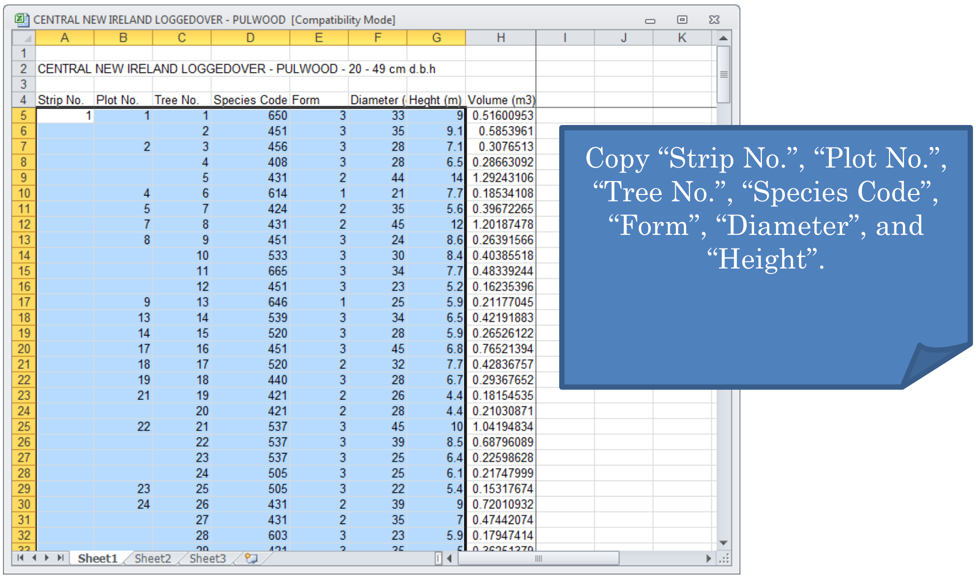
(3) Input of Tree information

You can copy from existing excel spreadsheets which you have kept.

“Strip No.”, “Plot No.”, “Tree No.”, “Species Code”, ” Form”, “Diameter” and “Height” need to be entered into the spreadsheet “FIPS Import Data Creator”. There is no need to enter “Volume”.

If you want to clear all entered data, click on the clear button. (5)

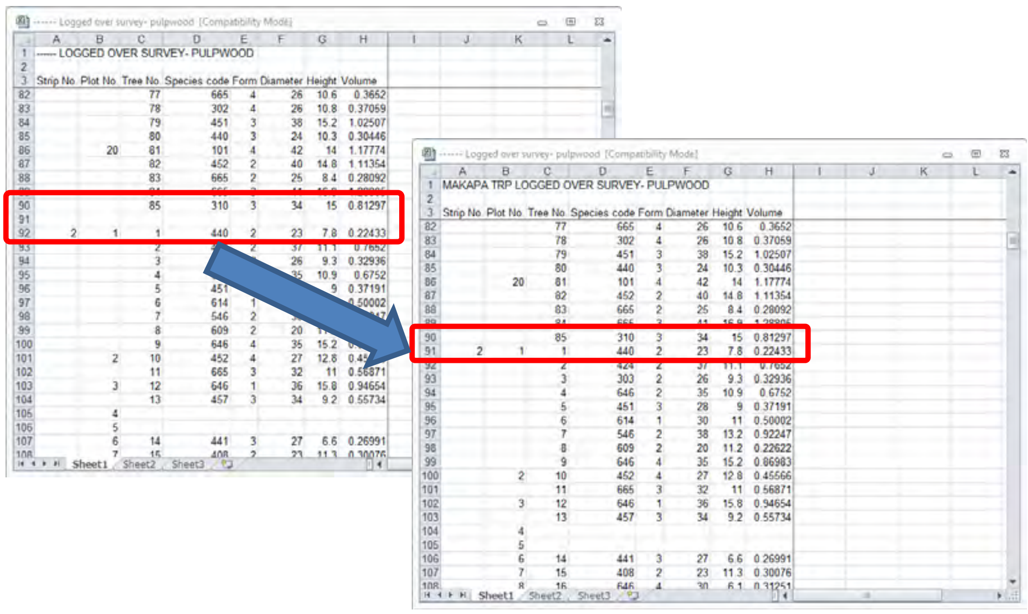
(a) Copy from existing excel spread datasheet



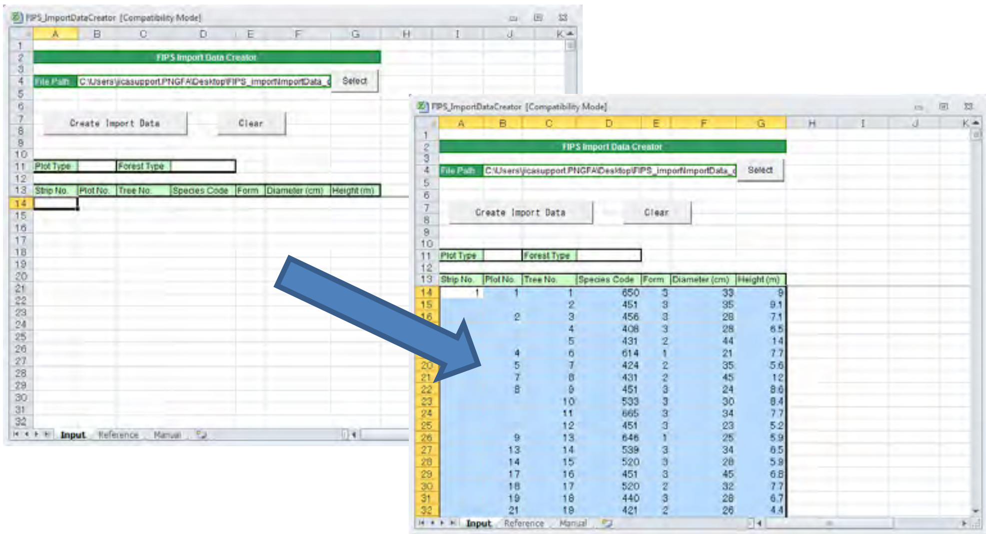
Attention

Delete blank line before copy. Don’t remain the blank line.

Otherwise, the data below the blank line are not imported.

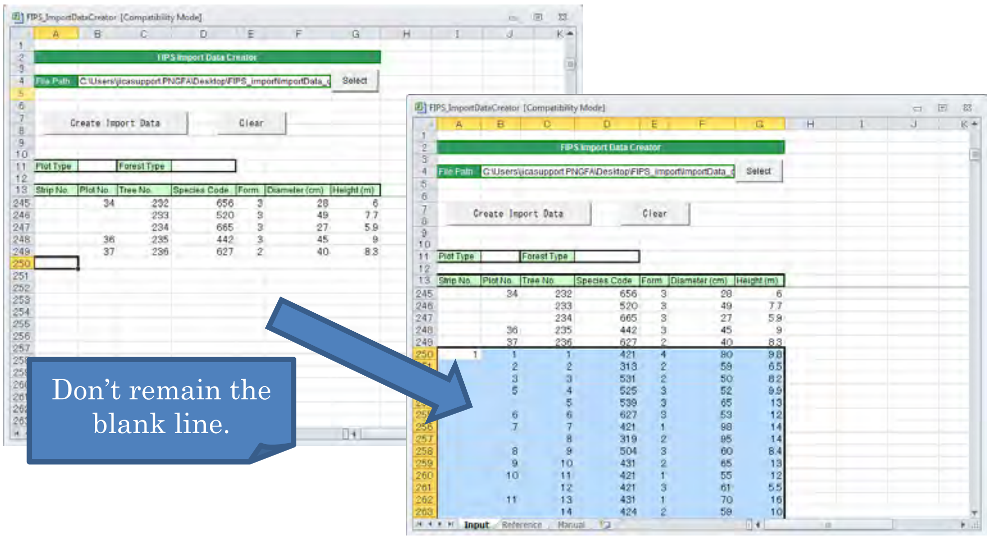


(b) Paste into the FIPS_ImportDataCreator



(c) The case for the separate field data files

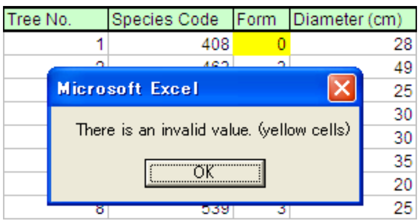
When you have separate field data sheet (e.g. pulp log and sawlog), copy and paste other field data again.



(4) Execution of process

Execute the process by clicking the "Create Import Data" button.

A confirmation dialog is displayed, after finishing the process.



Cells will be filled in, in yellow if there are errors.

Species Code has to be selected from species list in [Reference] sheet. You need to change it to the species code which [Reference] sheet shows.

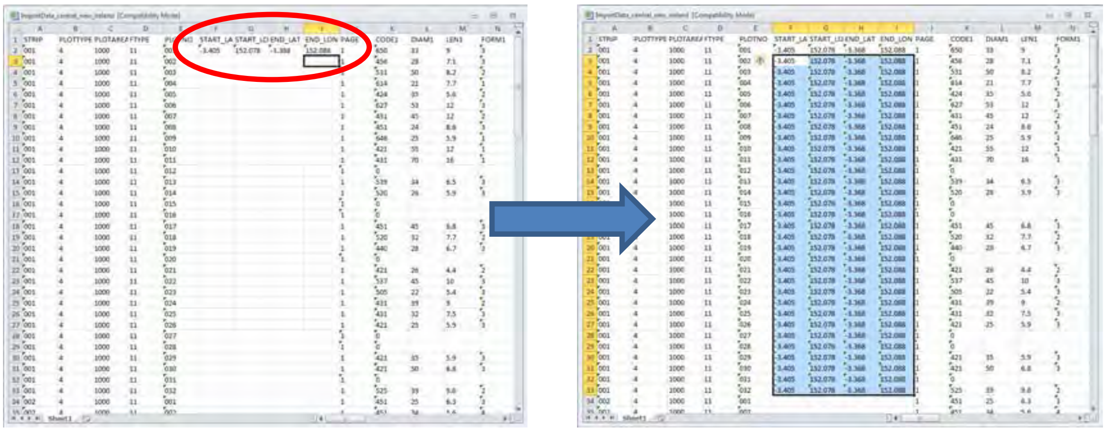
(5) Save “FIPS Import Data Creator” with a different name. It is better to add the survey name to the original excel file name.

Eg. FIPS_ImportDataCreator_vanimo_LOI.xls

(6) Open the excel file saved in (5) and add the GPS information for start point an end point of strip (The case for adding GPS information).

The excel file is listed by the plot, but GPS information is measured for each strip. You have to copy the GPS information into all plots for each strip.

After adding GPS information, save the data.



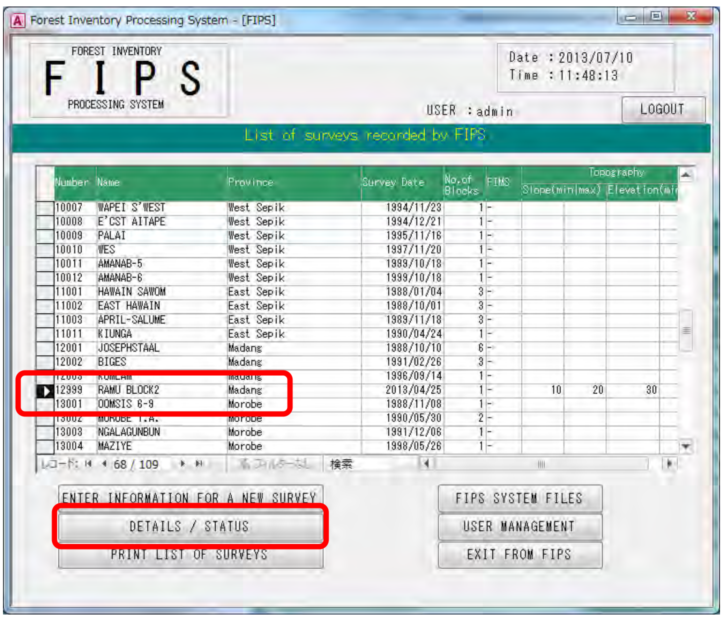
1.3 Import the field book data from the excel spreadsheet into new FIPS

After exporting the excel file “ImportData.xls” from “FIPS Import Data Creator”, you can import the excel file “ImportData.xls” to new FIPS.

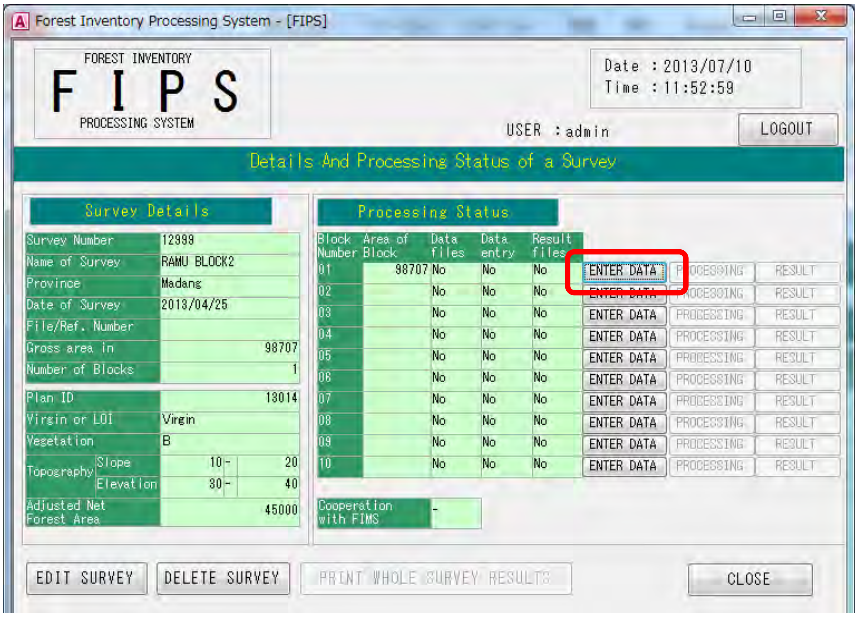
(1) Select the survey name from the FIPS main window.

(2) Click on the DETAILS/STATUS button.

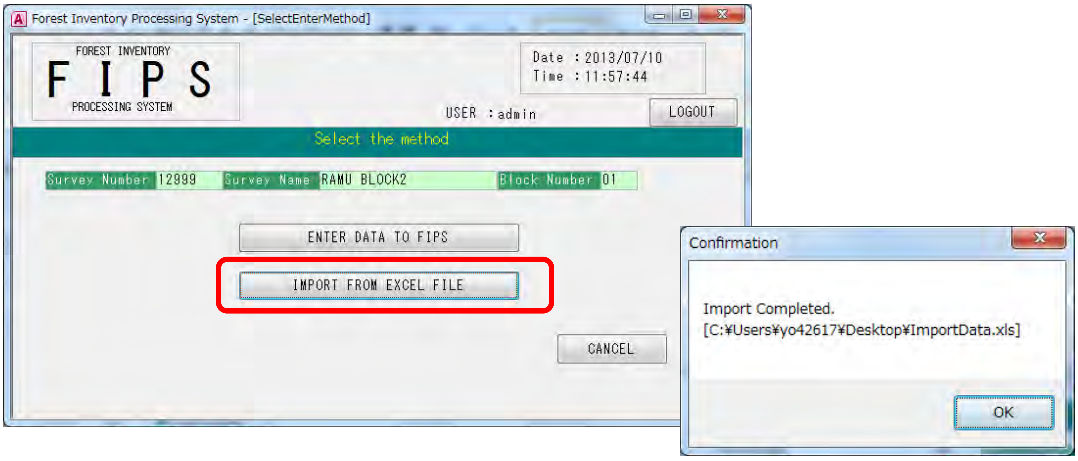
If you already have the "Details And Processing Status of a Survey" Screen of the survey open, you can go to the next step (3).



(3) Detail And Processing Status of a Survey screen is open, then click on the ENTER DATA button. You need to enter the field book data in every block.



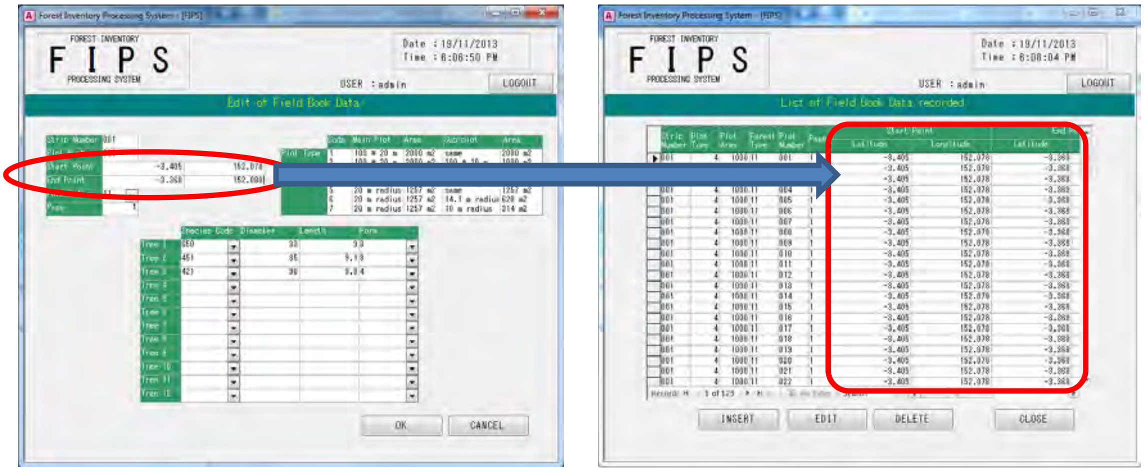
(4) Click on IMPORT FROM EXCEL FILE button, then select the excel file "ImportData.xls" exported at step 2.3.2(4) (You should select an excel file which is built with "FIPS Import Data Creator".).



(5) Click on the OK button, then click on the Cancel button.

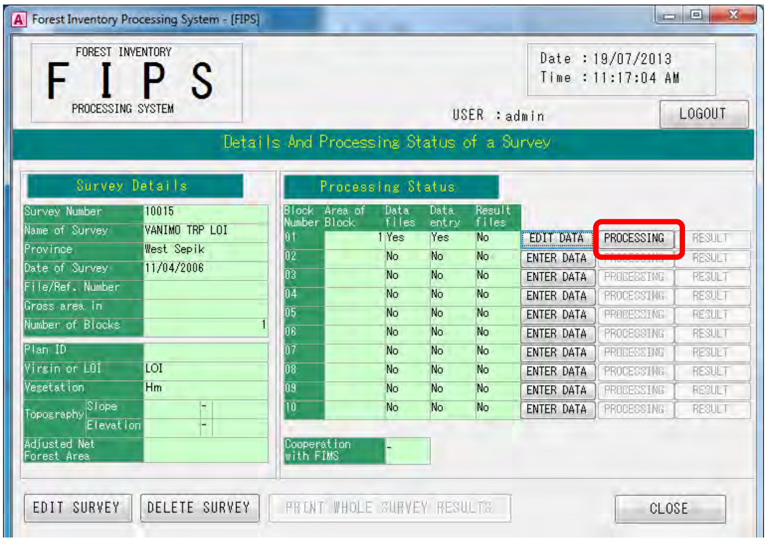
(6) Add the GPS information by FIPS, if the GPS information has not included in the excel file "ImportData.xls" exported at step 2.3.2(4).

Open the "Edit of Field Book Data" window for each strip number and enter the GPS information, then the GPS information is reflected for all of plot data that has surveyed in the same strip.



1.4 Run calculation(PROCESSING) , print reports and output to excel file

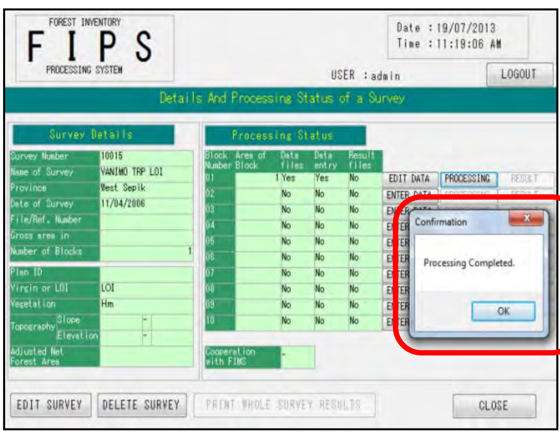
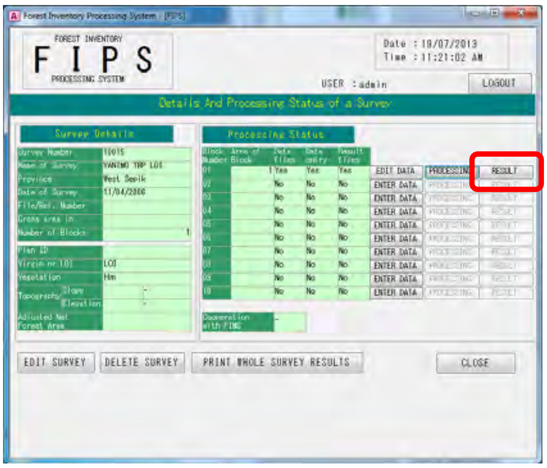
(1) After importing the Excel file, the PROCESSING button will become active.



(2) Click on the PROCESSING button, then the result will be calculated.

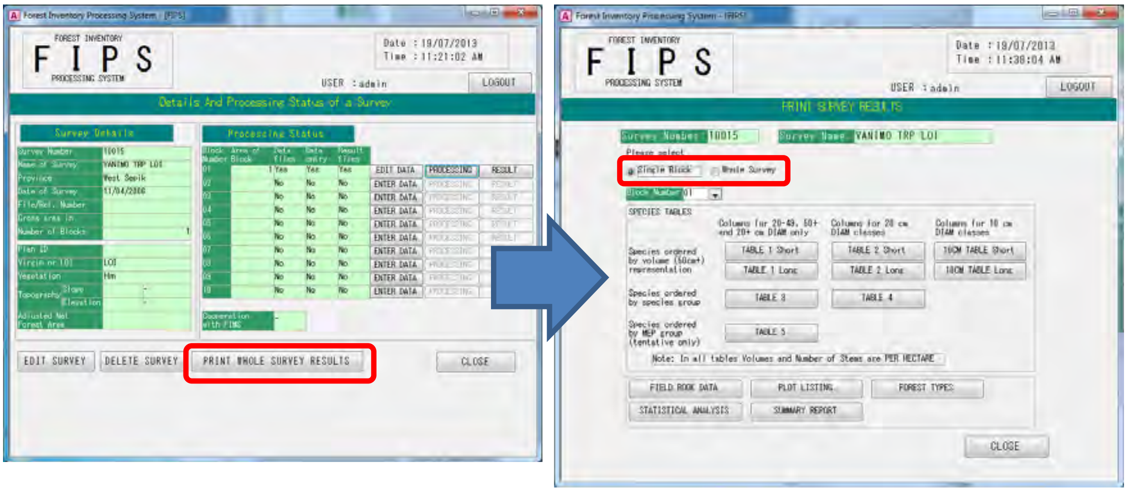
If processing is successful, a confirmation window appears and shows "Processing Completed".

After Clicking on the Ok button, the RESULT button will become active. This means that the Processing is finished. Therefore you can confirm several reports of the survey.

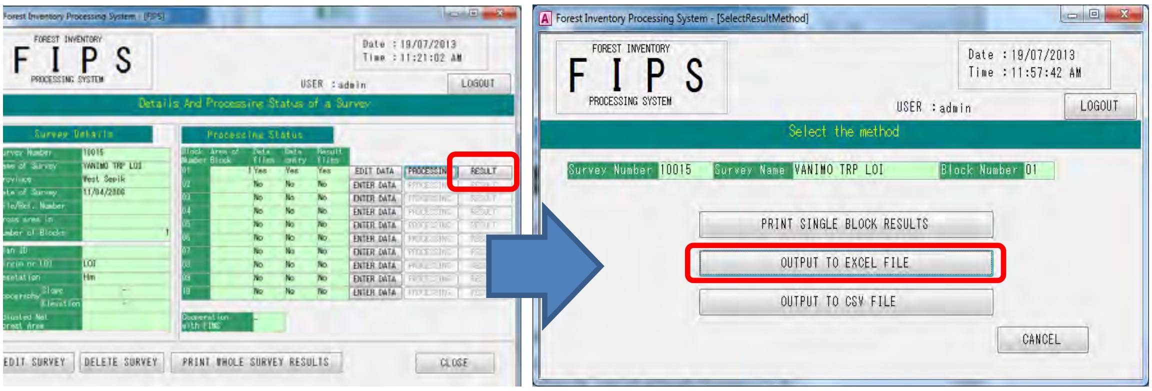



(3) If you click on the PRINT WHOLE SURVEY RESULTS, you can see all reports.

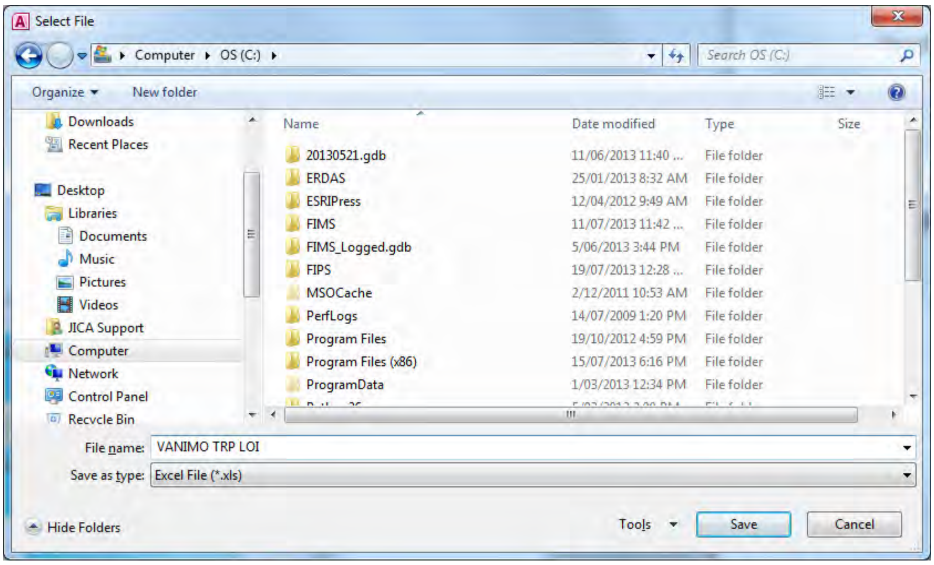
You can switch between printing Single Block or Whole Survey reports by pressing the “Please select” radio button.



(4) Click on the Result button, then you can output the result of the processing to an excel file. You can edit it for any purpose.



Specify where to save the file and its name.



The contents of the exported Excel file are followings:

Field	Field Name	Contents/Comments
1	SPEC_CODE	Species Code
2	SPEC_NAME	Species Name
3	A_VOL10	10-19cm Volume of Form A
4	B_VOL10	10-19cm Volume of Form B
5	C_VOL10	10-19cm Volume of Form C
6	D_VOL10	10-19cm Volume of Form D
7	E_VOL10	10-19cm Volume of Form E
8	F_VOL10	10-19cm Volume of Form F
9	TOTAL_VOL10	Total 10-19cm Volume
10	VOL10_PER_HA	10-19cm Volume per Hectare
11	COMP_VOL10	Percent of 10-19cm Volume
12	BA10	Total 10-19cm Basal Area
13	A_PVOL	20-49cm Volume of Form A
14	B_PVOL	20-49cm Volume of Form B
15	C_PVOL	20-49cm Volume of Form C
16	D_PVOL	20-49cm Volume of Form D
17	E_PVOL	20-49cm Volume of Form E
18	F_PVOL	20-49cm Volume of Form F
19	TOTAL_PVOL	Total 20-49cm Volume
20	PVOL_PER_HA	20-49cm Volume per Hectare
21	COMP_PVOL	Percent of 20-49cm Volume
22	PBA	Total 20-49cm Basal Area
23	A_SVOL	50cm+ Volume of Form A
24	B_SVOL	50cm+ Volume of Form B
25	C_SVOL	50cm+ Volume of Form C
26	D_SVOL	50cm+ Volume of Form D
27	E_SVOL	50cm+ Volume of Form E
28	F_SVOL	50cm+ Volume of Form F
29	TOTAL_SVOL	Total 50cm+ Volume
30	SVOL_PER_HA	50cm+ Volume per Hectare
31	COMP_SVOL	Percent of 50cm+ Volume
32	SBA	Total 50cm+ Basal Area
33	SPEC_GROUP	Species Group(= Mep Group)

PART B. THE FIPS SOFTWARE SYSTEM

1. OVERVIEW

FIPS is a simple computer system to process PNG inventory assessments of natural forest. It was written to be implemented on PC using the programming facilities provided by data management system.

The main data input routine follows standard field book entries. Provided field parties identify tree species in field books correctly and blocks, strips and plot are properly numbered, there is little additional overhead in the office before computer processing, apart from species coding and checking forest types.

Log volumes of stems with diameters of 50 cm and over are calculated using the regression on which the lowland rainforest volume table is based. Volumes of stems with diameters between 20 and 50 cm are based on the pulpwood volume table developed for the Madang area. A one-way volume function, V = f(DIAM), is provided as an option.

Survey results are produced as printed output in a variety of ways, which can be selected by the operator. A measure of reliability on estimates of volumes, basal area and stockings is provided by way of statistical analysis (variance, standard errors and confidence limits). The analysis assumes random sampling.

2. SYSTEM REQUIREMENTS

Operating environment of this software are as follows:

	内容	備考
Development Language	･Visual Basic for Applications	
Production Environment	･OS*1 :Windows XP (SP3 or higher), Windows Vista (SP2 or higher), Windows 7 (SP1 or higher) ･CPU :300MHz or higher (recommended) ･Memory : RAM 128MB or higher(recommended) ･Hard disk drive : 100MB or larger	*1 :Windows 2000 is not included in the guaranteed operating range along with the end of service provided by Microsoft.
Others	Printer is set up Microsoft Access 2003 or higher	

3. RELEASE NOTES AND SYSTEM COMPATIBILITY

The FOXPRO edition of FIPS is upgraded to the Microsoft Access edition in 2013. This new edition improves the speed of processing and the convenience for users.
The Microsoft Access edition is not backward compatible for following reasons:
- Database system is migrated to SQL Server.
- Item length of Survey Number is changed from 4 to 5.

Therefore, data conversion by system developer is necessary to import database file generated in the FOXPRO edition (with the extension ".dbf").

4. DISCLAIMERS

No warranty is made or implied about the functioning of FIPS on any given system or computer configuration. The author nor the Papua New Guinea Forest Authority (hereinafter referred to as PNGFA) assume any responsibility and shall have no liability of any kind arising from the use of this product on any computer or the material contained in the documentation.

5. REGISTRATION and SOFTWARE SUPPORT

A register of authorized users of this software is established.

Authorized users may request for alternate or customized versions of FIPS or software support and any such request should be directed to PNGFA.

Please direct correspondence or enquiries to:

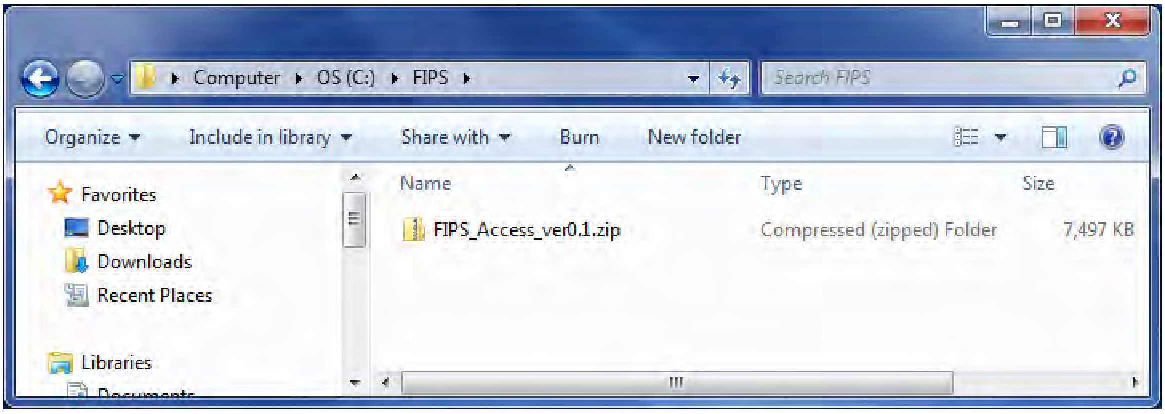
Forest Policy and Planning Directorate
Papua New Guinea Forest Authority
P.O.Box 5055
Boroko - Papua New Guinea

Telephone : (675) 327 7800
Facsimile : (675) 325 4433

PART C. INSTALLATION AND SETUP

1. DISTRIBUTION PACKAGE

The package is distributed with ZIP format.



Unzipping the distribution package, following folders and files are created.

[] means folder

[Distribution package]		
├── FIPS.mdb	(1)	Access file as FIPS main file
├── FIPS_ODBC.dsn	(2)	connection setup file to the SQL Server (DSN file)
└── [macro]		
└── FIPS_ImportDataCreater.xls	(3)	Macro file for editing in Excel

(1) The Access file (FIPS.mdb) includes compiled source code, Form object, Report object and work tables which are used in FIPS and etc. The main table used in FIPS is not included but it is defined in SQL Server.
(2) The DSN file (FIPS_ODBC.dsn) is a config file for establishing connection with SQL Server.
(3) The Macro file (FIPS_ImportDataCreater.xls) has a function to convert forest inventory Excel formatted data into FIPS format.

NOTE:
Starting FIPS with the script file (3) enables you to operate FIPS without obstacle Command Prompt screen, which is always displayed if you run the batch file (5) directly.

2. INSTALLATION

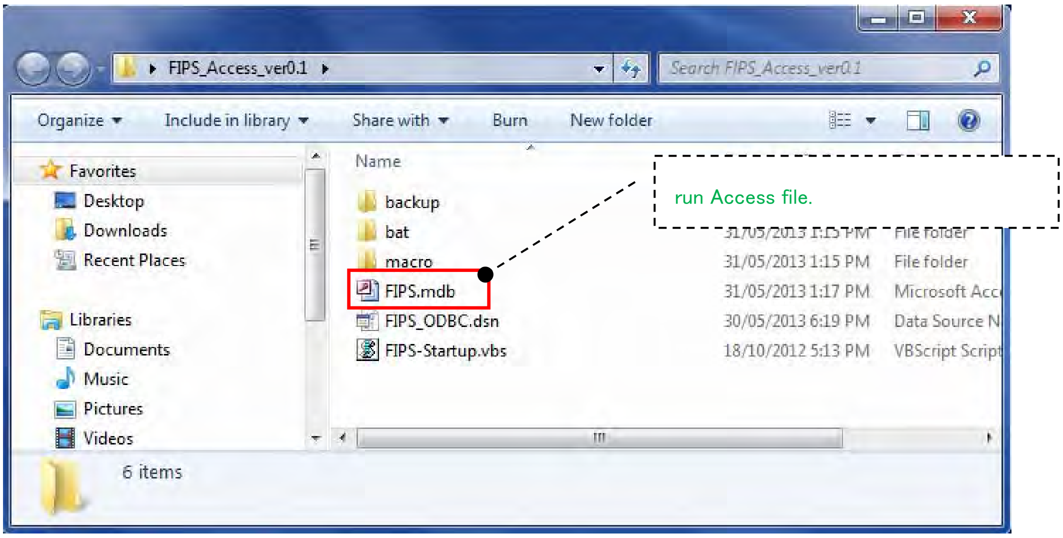
The Microsoft Access 2003 or higher should be installed to start FIPS.

If the Microsoft Access 2003 or higher is already installed, FIPS installation is only to unzip the distribution package into the directory you choose.

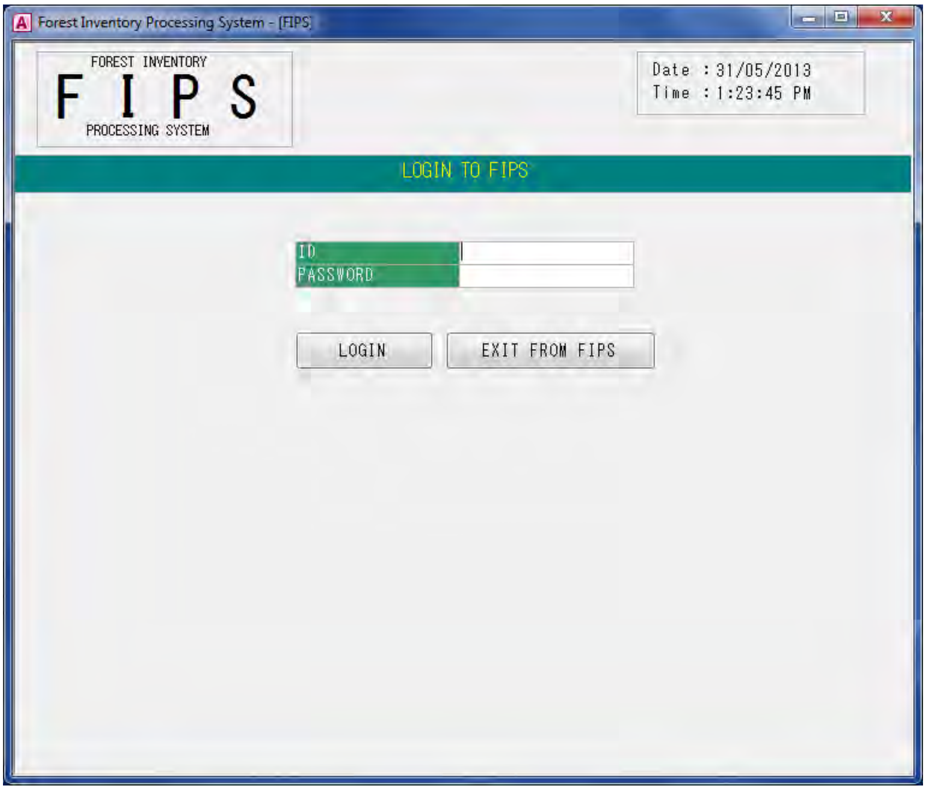
If not installed, you should install the Microsoft Access 2003 or higher. The installation instruction can be found in the Microsoft Support.
Furthermore, database construction on SQL Server and connection setup to the SQL Server are also necessary to FIPS operation. Details can be found in the Installation Manual for FIMS and FIPS

3. STARTING FIPS

run Access file “FIPS.mdb” to start FIPS.



After the program is loaded, the title screen appears:



4． PASSWORD PROTECTION AND USER ACCESS

The Microsoft Access edition of FIPS requires passwords to protect data and software.
There are 3 levels of authority for passwords:

1)	General authority	This level allows users to use the most basic functions such as inputting and viewing data
2)	Administrative authority	In addition to the above, users can use of account management function.
3)	Developer authority	This level allows users to use all functions of FIPS and to use standard functions of Microsoft Access.

Developer authority is necessary for editing the Microsoft Access data directly without FIPS User interfaces, or editing source code to use standard functions of the Microsoft Access.

Please contact the system administrator to confirm passwords.

Login fails when the SQL Server connection is not established normally, and an error message window is opened.
Reconfiguring for connecting with SQL Server is necessary. Configuration process can be found in the Installation Manual for FIMS and FIPS.

PART D. DATA COLLECTION AND RECORDING

1. FIELD PROCEDURES

It is not intended that this section describes field procedures for assessment surveys in detail. The discussion and comments are confined to those aspects which are relevant to the design and implementation of this processing system and the assumptions made in this regard.

Obviously, the approach should not be to write a processing system and than figure out how field procedures should be adapted to conform to the input requirements of the computer system. The starting point must be the design and implementation of the assessment survey, while being mindful of any constraints and requirements which might be imposed by a computer processing system.

Forest assessment surveys lend themselves very well to computer processing. Apart from the obvious advantages such as reducing processing time, removing certain sources or errors etc., there are other 'spinoff' benefits. The nature of computers requires that you are consistent and disciplined in data collection procedures. Furthermore, developing a computer processing system tends to identify weaknesses in field procedures which otherwise might not be readily identified.

a) Forestry College Training Manual, Volume 7, Forest Assessment and Working Plans (Revised Edition 1975) has been taken as the main reference, describing field procedures for assessment surveys. The procedures currently in use by the PNGFA generally conform with this Manual, but with some notable modifications :

    (i) 'Sawlog' and 'Pulpwood' assessments are normally combined into one survey with the sampling unit for pulpwood being a subplot of the sampling unit for sawlogs.

    (ii) The sampling units most commonly chosen are continuous striplines, both for sawlogs and pulpwood, and not circular plots.

    (iii) The minimum diameter of stems recorded in most surveys is 10 cm, and not 15 cm.

b) The data entry routine is modeled on the format of the ASSESSMENT TRAVERSE field books. It requires input of

Survey Number,
Block Number,
Strip Number,
Plot Area,
Start Point (Latitude and Longitude),
End Point, and

for each plot (which is the basic sampling unit, commonly a 50 or 100 meter section, 20 meters wide, along a continuous strip line) :

Forest Type,
Plot Number, and

for each tree within each plot :

Species Code,
Diameter,
Length, and
Form Class

The only modification to the standard field books entries is that the survey number is expanded from 3 to 4 digits.

IMPORTANT: The standard field books allow for entering 12 trees per field book page. In the FIPS database one record represents one field book page. If there are more than 12 stems recorded in a plot, do not scribble them on the bottom or the back of the field book page but record them on the next page.

In the field, species names are recorded rather than codes. Codes are entered in the appropriate column either by the survey staff after returning to camp or in the office after completion of the survey. Unknown or miscellaneous species are given species code 665.

THE COMPUTER EXPECTS THAT NONE OF THE NUMBERING AND CODES CONTAIN LETTERS. ONLY NUMBERS ARE ACCEPTED!

c) To decide how data are handled and stored in the computer will for a large part be determined by the maximum amount of data that can process in one go. As the total area of large assessment surveys are normally subdivided into a number of blocks, A BLOCK HAS BEEN CHOSEN AS THE BASIC UNIT FOR DATA PROCESSING AND STORAGE. It is assumed that a block may be up to, say, 50,000 hectares, and is identified within a forest survey as a geographically or topographically distinct unit, with boundaries which can be recognized on maps or aerial photographs. A block is NOT identified as a single forest type; more than one forest type may be represented within a block.

Smaller surveys may consist of one block only.

The program allows for up to ten blocks for each assessment survey. Sub-blocks are not recognized. If some sort of sub-division and corresponding identification within a block is required, this can only be done by adopting some convention as to the numbering of strip lines, for example

strip line 101 to 199 for 'sub-block' 1,
strip line 201 to 299 for 'sub-block' 2 etc.

In strip line assessments, strips commonly run at regular intervals and at right angles from a base line. Base lines are normally assessed as any 'ordinary' strip line. The computer treats a base line as any other strip and numbering must reflect this. Identification as BL1, BL2 etc. is not accepted (See above comment - no letters allowed).

d) Field assessment results should be accompanied by a map of the area concerned, with location of strip lines clearly marked and numbered. If any renumbering of block or strip numbers needs to be done to conform to the computer's data acceptance, the new numbers need to be transferred to that map.

e) The program presents results which are expressed as per hectare figures. To produce these figures, the total area and areas of individual blocks do not need to be known. However, to perform a statistical analysis of the figures produced and to produce total resource volume estimates etc. the area of each individual block should be determined and entered into the computer. Total area surveyed is computed as the sum of the areas of the individual blocks.

It is conceivable that the total gross area of the resource area exceeds the sum of the areas of individual blocks. There is provision to enter gross area into the database, but in the present version of the program that gross area is not used for any computation.

f) The issue of forest classification by using the forest types adopted for PNG natural forest needs special consideration. Procedures need to be refined so that the forest is typed on the basis of satellite imagery before a survey is undertaken. The forest type recorded against each plot in the field becomes a check for drawing up a final forest type map after completion of the survey.

Unless such classification forms a routine part of the forest inventory assessment, the forest type data recorded during the survey will be of limited value in processing the survey results. In addition, producing separate species/volume listings per forest type would greatly increase processing time and complicate file management. Due to these two reasons, FIPS presently only produces summarized per hectare results by forest type without presenting species composition.

2. PREPARING FIELD DATA FOR COMPUTER PROCESSING

For each field book check that on the front page are recorded:

Survey Number - A five-digit number (01001 - 19999)
Block Number - A two-digit number (01 - 10)
Strip Number - A three-digit number (001 - 999)
Plot Area - recorded in square meters (5 digits) to the nearest square meter
Plot Type - Radius (m) for circular plot or X * Y meters for rectangular plots
Sub-plots - Plot Area and Plot Type as above (if applicable)

Renumber block and strip numbers if required (see previous section).

For each field book page, check that the spaces on the top of the page are filled in for:

Forest Type - A two-digit number
Plot Number - A three-digit number (001 - 999)

It is suggested that if a plot is continued on the next page, you write at the bottom "Cont." This would minimize the chance of data entry errors for plots with more than 12 stems.

For each stem record, check that Species Code, Diameter (m), Length (m) and Form Class (1-6) are recorded.

NAME OF THE SURVEY - The name can only be up to 20 character long and thus may have to be suitably abbreviated.

COMPLETION DATE OF THE SURVEY (Optional)

FILE REFERENCE NUMBER (Optional)

GROSS AREA OF RESOURCE AREA IN HECTARES (Optional)

NUMBER OF BLOCKS

AREA OF EACH BLOCK IN HECTARES

PLAN ID

VIRGIN OR LOI

VEGITATION

TOPOGRAPHY (SLOPE AND ELEVATION)

Adjusted Net Forest Area

START POINT (LATITUDE and LONGITUDE) FOR EACH STRIP

END POINT (LATITUDE and LONGITUDE) FOR EACH STRIP

3. INTERPRETATION OF SURVEY RESULTS

The principal purpose of assessment surveys usually is to arrive at a close estimate of TOTAL NETT merchantable timber, ideally classified by log quality and species classes, which can be economically harvested from a given resource area.

This processing system does not claim to deliver such estimate! It presents results of forest assessments strictly as GROSS volumes and on a PER HECTARE basis only.

Due to the lack of consistent and standardized volume allowances in regard to timber defect, merchantability, terrain classification etc., it has been a very deliberate decision not to attempt to build in allowances or conversion factors, which would only be arbitrary.

It must also be noted that the volume computations use functions which have been derived for lowland rainforest only and consequently may not be applicable for higher altitude forest.

PART E. RUNNING THE MAIN PROGRAM

0. THE MAIN MENU and GENERAL NOTES

The main menu has seven options. Each will bring up a menu for the particular choice.
In addition, the list of registered inventory information is displayed.

FIPS maintains one database file in which general details of each assessment survey in the system are kept. This file is referred to as the system or master control file (F_MASTER TABLE). There is one record for each survey and each record contains:

= SURVEY NUMBER

= NAME OF THE SURVEY

= DATE OF THE SURVEY (Completion date) (optional)

= FILE REFERENCE NUMBER (optional)

= GROSS AREA OF RESOURCE AREA IN HECTARES (optional)

= NUMBER OF BLOCKS

= Plan ID

= Virsin or LOI

= Vegetation

= Topography

= Adjusted Net Forest Area

For each block within the survey:

= AREA IN HECTARES

= WHETHER OR NOT DATA ENTRY HAS BEEN COMPLETED

IMPORTANT: It would be pretty disastrous if somehow this file would become corrupted or lost. Therefore it is a good idea to make a printout from time to time so that the file can be reconstructed, if need be. (Table name: F_MASTER TABLE)

It must be realized that the contents of F_MASTER TABLE is associated only with the database in the user's or user organization's computer system.

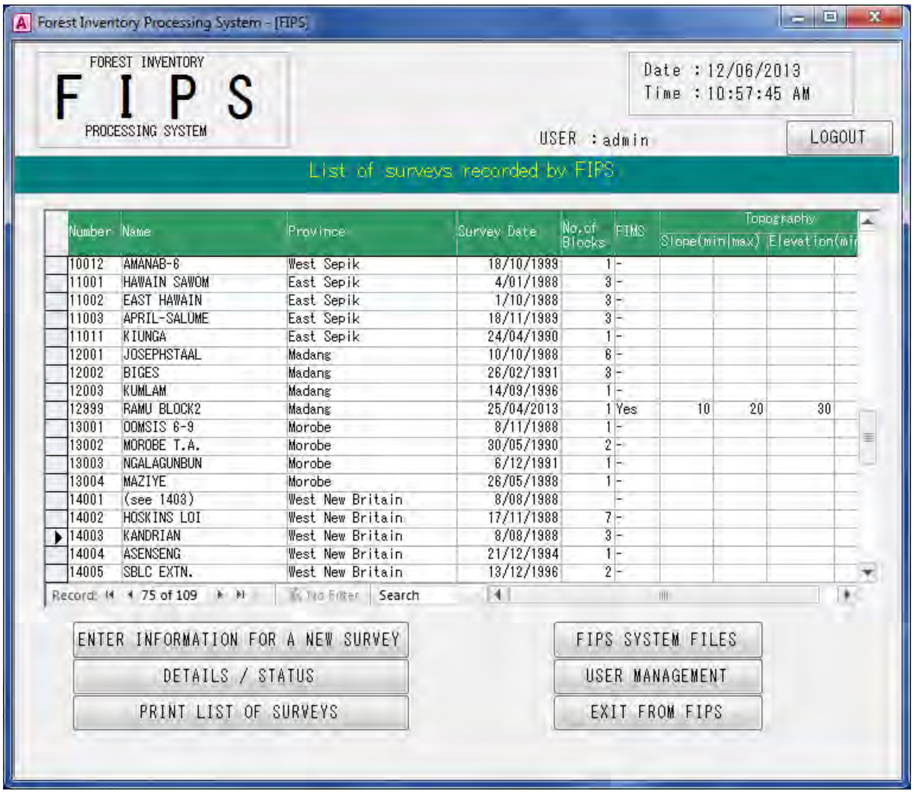


TABLE HEADING:

1. Number
   SURVEY NUMBER

2. Name
   NAME OF THE SURVEY

3. Province
   PROVINCE NAME

4. Survey Date
   DATE OF THE SURVEY (Completion date) (optional)

5. No.of Blocks
   NUMBER OF BLOCKS

6. FIMS
   STATUS OF THE DATA LINKAGE BETWEEN FIMS
   This describes whether the data for FIMS interaction data which is created in FIPS has already imported to FIMS or not.
   Yes : The interaction data is already imported to FIMS.
   No : The interaction data is not imported to FIMS yet.
   \- : The interaction data is not available.

7. Topography
   Slope(min), Slope(max), Elevation(min), Elevation(max)

OPTIONS:

1. LOGOUT
   Log-out processing runs and Login screen is opened.

2. ENTER INFORMATION FOR A NEW SURVEY
   Open screen for enter a new survey information.

3. DETAILS / STATUS
   Open screen for detailed survey information.

4. PRINT LIST OF SURVEYS
   Open print preview screen for the survey list displayed in the main screen. Users can print out after confirmation of preview image.

5. FIPS SYSTEM FILES
   Open detailed information screen where the master data used in FIPS is shown.

6. USER MANAGEMENT
   Open screen for account management of FIPS users. This option is not shown to users with general authority, and is available only for the users with administrative authority or developer authority.

7. EXIT FROM FIPS
   Shut down FIPS.

1. LOGOUT

Pressing “LOGOUT” button starts logout process and opens login screen. Please make sure that all the working processes are finished before pressing “LOGOUT” button not to damage the data.

“LOGOUT” button is shown on all of screens and operations are common among screens.

2. ENTER INFORMATION FOR A NEW SURVEY

Before any field book data can be entered the computer will want to know some basic details of the particular survey.

SURVEY NUMBER

NAME OF THE SURVEY

DATE OF THE SURVEY (Completion date)

FILE REFERENCE NUMBER

GROSS AREA OF RESOURCE AREA IN HECTARES

NUMBER OF BLOCKS

AREA OF EACH BLOCK IN HECTARES

Plan ID

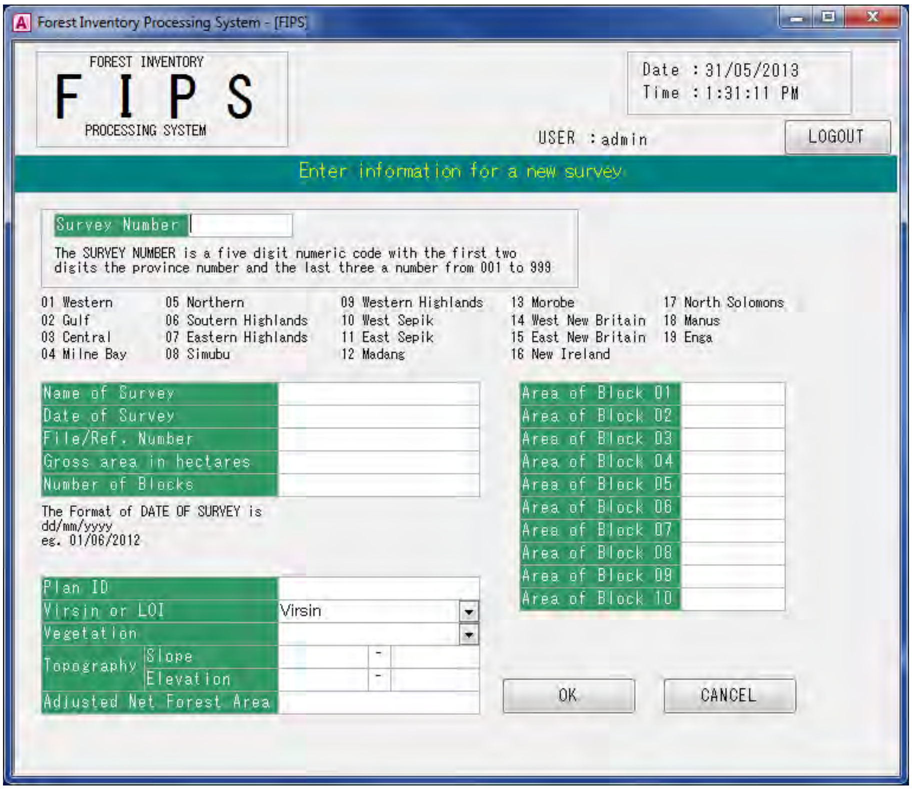
Virsin or LOI

Vegetaion

Topography

Adjusted Net Forest Area

The initial screen will look like this:



These details are stored in the master control file (F_MASTER TABLE).

Survey Number is a mandatory item.
Other items are optional.

The Survey Number is a five digit numeric code with the first two digits the province number (01 to 19) and the last three a number from 001 to 999

Name of Survey can be entered up to 20 characters.

Date of Survey can be entered manually or by selecting date on the calendar.
The Format of Date of Survey is dd/mm/yyyy
eg. 01/06/2012

Number of Blocks is for entering the number of blocks.
Area of Block is for entering the area of each block.
Therefore the entry number of Area of Block is the same with the value of "Number of Blocks"
eg.
If the value of "Number of Blocks" is "1", then "Area of Block 01" should be filled.
If the value of "Number of Blocks" is "2", then "Area of Block 01" and "Area of Block 02" should be filled.
Error message will displayed if "Area of Block" is not input while the "Number of Blocks" is entered, and if "Area of Block" is input while the "Number of Blocks" is not entered.

Plan ID is for Plan ID of Concession Area in FIMS which corresponds to Survey.
If the Plan ID is not entered, then the interaction data with FIMS cannot be created.

Slope and Elevation are input as the topography information.

These data needs both min and max values. Error message is displayed in the case users input either min or max value, or in the case min value is bigger than max value. The values of slope should be within the range of 0 to 90.

The sum of all block areas is referred to in some of the reports as NET AREA of the overall survey and should be less than or equal to the GROSS AREA.

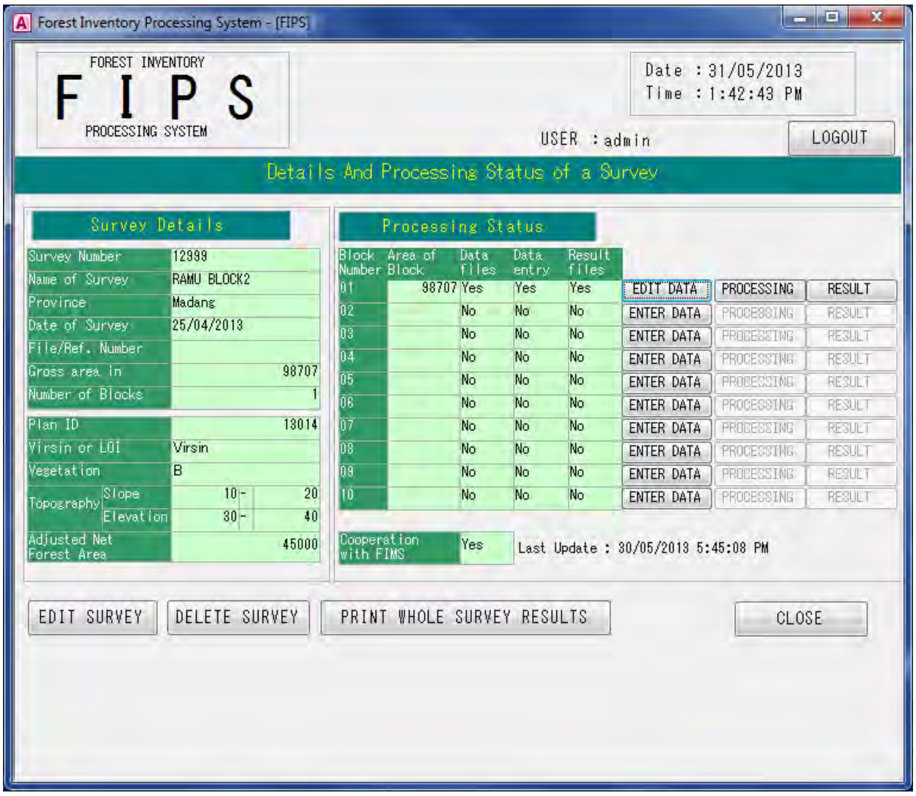
BEFORE FIELD BOOK DATA CAN BE ENTERED, THE SURVEY NUMBER AND THE NUMBER OF BLOCKS MUST BE RECORDED IN THE MASTER CONTROL FILE. BLOCK AREAS MUST BE ENTERED TO PERFORM STATISTICAL ANALYSIS. THE OTHER DETAILS ARE OPTIONAL.

3. DETAILS / STATUS

The survey detailed screen is opened when users select a survey from the list in the main window and press “DETAILS / STATUS” button.

The survey detailed screen contains following information and 7 options:
- Survey information
- Data entry is finished or not
- The calculation result exists or not
- Status of the data linkage between FIMS

Information on number of blocks and whether data entry has been completed is taken from the master control file. Then the data directory is searched to check whether field book data and result files are on SQL Server. YES means that files are found, NO if they are not.



Status			Acton
Data files	Data entry completed	Result files	
No	No	No	Enter field book data

Status			Acton
Yes	No	No	Complete field book data entry
Yes	Yes	No	Process field book data
Yes	Yes	Yes	Produce printed results if not already done so
Yes	No	Yes	Data must have been entered after first confirming data entry completed. No guarantee that results files OK. Reprocess data after making sure that data entry has REALLY been completed.

Cooperation with FIMS describes the status of data linkage between FIMS. “Yes” means interaction data is created and imported to FMIS, “NO” means interaction data is created but not imported to FIMS, and “-” means interaction data is not created because of the lack of Plan ID. The latest update date is shown when the interaction data is created. Notice that this date is the date of interaction data creation and not the date of importing this data to FIMS.
* The interaction data is created using “PROCESSING” described in OPTION 4.

OPTIONS:
1. EDIT SURVEY
   Open the edit screen of Survey information.

2. ENTER DATA
   Open the selection screen for field book data entry.
   This button will not be displayed when the data entry is completed, and the “EDIT DATA” button will be shown instead.

3. EDIT DATA
   Open the list screen of entered field book data.
   The field book data can be edited in this screen.

4. PROCESSING
   Calculate from the entered field book data and create a result file for report publishing.
   If the result file is already created, a confirming message for overwriting is displayed. Press “OK” to overwrite and to continue processing.
   The result file is created and the status of “Result files” is changed into “Yes”. In addition, the interaction data with FIMS is created automatically using this result file. The status of “Cooperation with FIMS” is changed to “Yes” and the latest update date is displayed. The date is automatically overwritten if the interaction data is already created. This function will not work in the block where the Field Book Data is not entered.

5. RESULT
   Open the selection screen to export the result file.
   Export to the Excel format or the CSV format.
   This function will not work in the block where the result file is not created.

6. DELETE SURVEY
   Delete Survey Information.
   Field Book Data, Result files and interaction data with FIMS related to the Survey are also deleted.

7. PRINT WHOLE SURVEY RESULTS
   Open report publishing screen.
   This button will not work when there is no block with the Result files created.

NOTE:
OPTION 2. “ENTER DATA” button and OPTION 3. “EDIT DATA” button are switched automatically depending on the status of data entry on BLOCK; in the case that the data entry is not completed, OPTION 2. “ENTER DATA” button is displayed, and in the case the data entry is completed, then OPTION 3. “EDIT DATA” button is displayed.
In the block where the Data Files (FD Table) do not exist, “PROCESSING” button turns to be invalid.
In the block where the Result Files (FP, FT, FQ Table) do not exist, “RESULT” button turns to be invalid.

3.1 EDIT SURVEY

This option allows you to alter any of the details entered in any record of the master control file, except survey number.

NAME OF THE SURVEY

DATE OF THE SURVEY (Completion date)

FILE REFERENCE NUMBER

GROSS AREA OF RESOURCE AREA IN HECTARES

NUMBER OF BLOCKS

AREA OF EACH BLOCK IN HECTARES

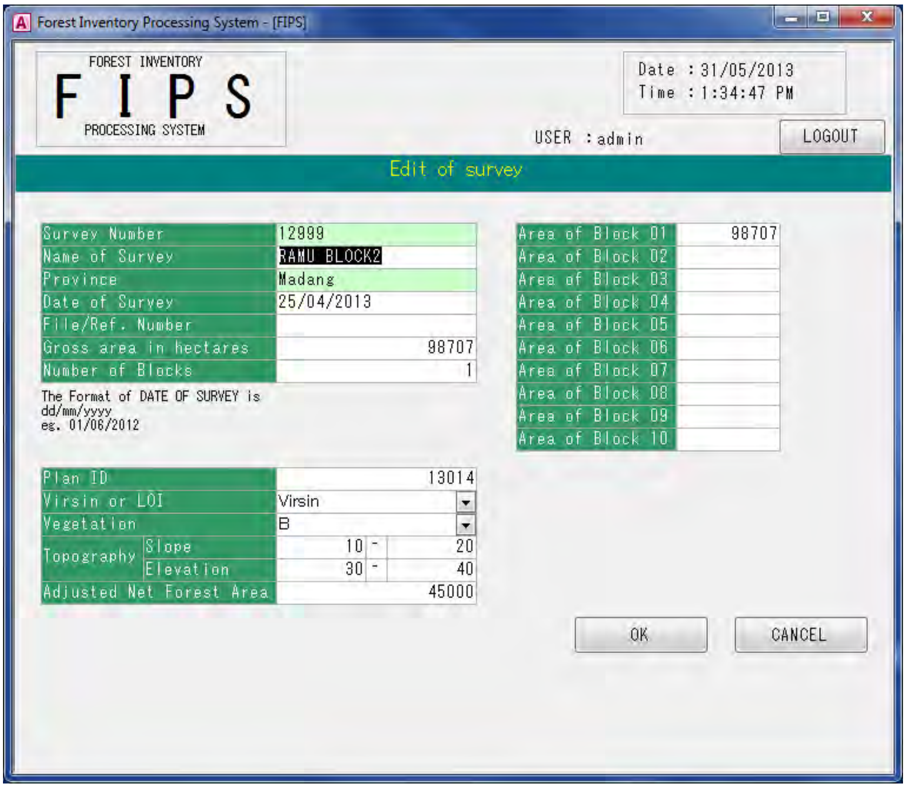
Plan ID

Virsin or LOI

Vegetaion

Topography

Adjusted Net Forest Area



The sum of all block areas is referred to in some of the reports as NET AREA of the overall survey and should be less than or equal to the GROSS AREA.

As details of a particular survey can be changed AFTER the field book data have been processed and reports have been produced, you should be aware of the effect of changes to the Master file on reports subsequently produced:

= Changes to SURVEY NAME, DATE, FILE REFERENCE and GROSS AREA only affect table and report headings.

= Changing the area of a block will affect table and report headings and the results of the statistical analysis.

= Changing Plan ID, Virsin or LOI, Vegetation, Topography or Adjusted Net Forest Area will not affect the content of report.

ALL REPORTS WHICH REQUIRE BLOCK AREA(S) RETRIEVE THESE FROM THE CURRENT MASTER FILE AND NOT FROM THE RESULT FILES WHICH ARE PRODUCED WHEN FIELD BOOK DATA ARE PROCESSED!

The rationale of this is that you do not have to re-process field book data, if you find that area figures need to be changed AFTER you have already processed the field book data.

However, to avoid different report versions, try to have everything correct BEFORE producing tables and reports.

= Changing the number of blocks will affect summary reports.

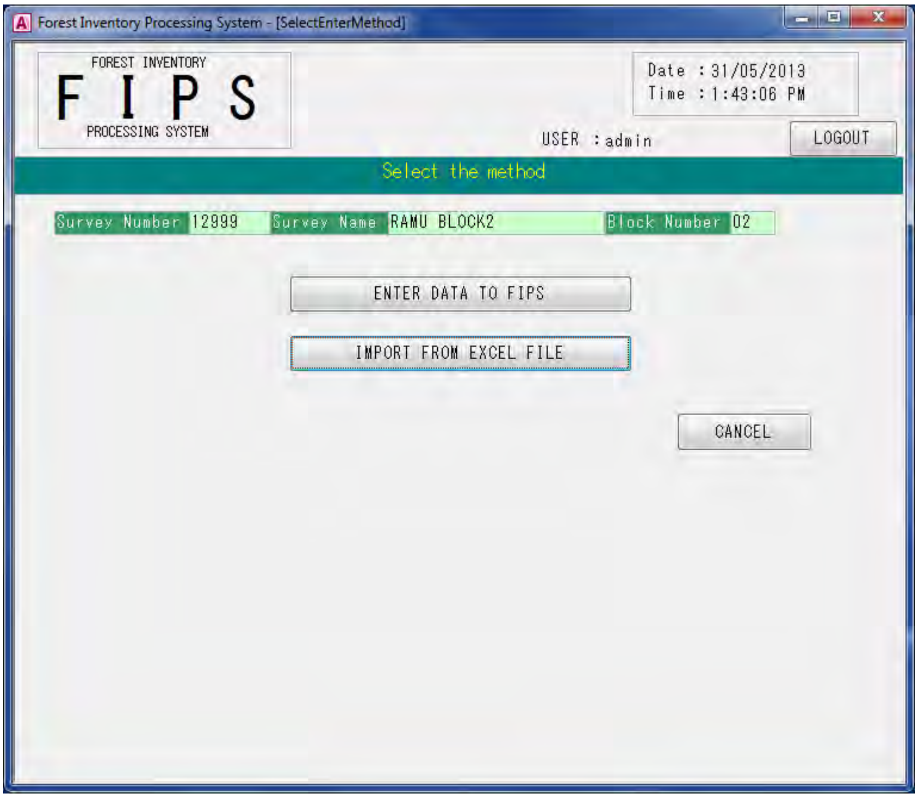
To avoid problems, you should not have to change to number of blocks at all. This means that you need to know how many blocks there are BEFORE YOU START ENTERING ANY FIELD BOOK DATA. However, increasing the number of blocks as you enter new block data is OK, as long as you are aware that blocks must have consecutive numbers from 1 upwards!

REDUCING the number of blocks is a different story! Any data that have already been entered for what becomes a non-existing block are effectively lost to FIPS, although the files are NOT automatically deleted. Check the file status first (3. DETAILS / STATUS).

To delete redundant block file or directly edit data tables, it is necessary to log in with developer authority and to use standard features of the Microsoft Access (See:PART F.1).

3.2 ENTER DATA

This menu provides two options to enter the field book data to the block where the field book data is not entered yet.



OPTIONS:

1. ENTER DATA TO FIPS

   Manual inputting of the field book data

   The Data entry screen is opened by pressing this button.

2. IMPORT FROM EXCEL FILE

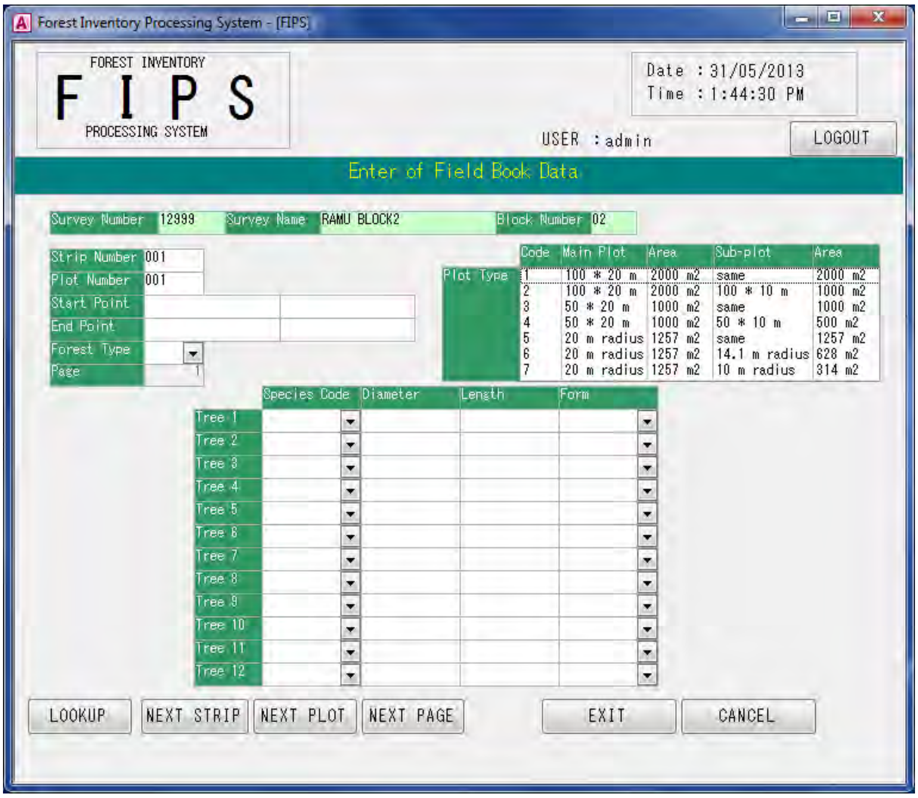
   Import the field book data from the Excel file.

   The file select screen is opened by pressing this button.

   You should select a Excel file which is built with the macro file “FIPS Import Data Creator”.

3.2.1. ENTER DATA TO FIPS

This menu enables you to enter data to the blocks where the Field Book Data is not entered. This menu has 6 options.



OPTIONS:

1. LOOK UP

   Show stored input data

2. NEXT STRIP

   Move to the next stripline data entry. Entered data is stored.

3. NEXT PLOT

   Move to the next plotarea data entry. Entered data is stored.

4. NEXT PAGE

   Move to the next page data entry. Entered data is stored.

5. EXIT

   Exit data entry menu.

6. CANCEL

   Cancel data entry. All entered data at this session is discarded.

The Access edition of FIPS keeps the entered field book data as a Table Object in SQL Server.
First, the empty table for entered data registration is created. The entered data is stored in sequence. Data registration process starts at the moment when either “NEXT STRIP”, “NEXT PLOT”, “NEXT PAGE”, or “EXIT” button is pressed. Entered data is registered if no errors are detected in input check.

Press “EXIT” Button to register entered data into the table and to end data entry.

Or press “CANCEL” button to discard data entry and to quit data entry mode.

Although the program allows entering of field book data for a block in any order, it is strongly recommended that the following steps are followed in order to minimize the chance of errors (especially duplicate/missing plots) during data entry :

1. Prior to entering data for a block, check numbering of striplines and plot numbers and arrange field books in numerical order by stripline.

2. Enter data in sequential order by stripline. Try to finish full striplines in any one data entry session and mark the field books as 'entered' as each is finished.

ONCE A PAGE IS SAVED, THE DATA ENTRY ROUTINE CANNOT MAKE ANY CORRECTIONS TO IT. To edit or correct saved pages, use Option 3.3 “Edit of Data”. As much as possible, you should try not having to use Edit at all as there is always the chance that by editing a page you introduce new errors!

If you have not arranged the field books as suggested, do so now before preceding any further.

Entries for each strip/field book are:

STIP NUMBER : A three digit number (001 to 999), as recorded on the front page of each field book. Letters are not allowed. For example, if strips are numbered in the field as 1A, 1B etc., they must be recoded before entering in the computer.

PLOT AREA : The plotarea is not actually entered. Instead and for each strip line, you select the PLOT TYPE.

START POINT : Input coordinates (longitude and latitude) of Strip Line as a START POINT. END POINT is also necessary when the START POINT is entered. Inputting either one of the two is not acceptable.

END POINT : Input coordinates (longitude and latitude) of Strip Line as a END POINT. START POINT is also necessary when the END POINT is entered. Inputting either one of the two is not acceptable.

START POINT and END POINT can be enterd after importing from Excel file.

Normally all plots are of equal size and of the same type in an entire survey. Entry in the computer for each strip is to conform to the field books and allows for varying plot area from stripline to stripline.

The main purpose of entering Plot area this way is to make sure that the database will contain information on subplot and that and that you don't have to ASSUME sub sampling.

The SUBPLOT refers to that part of the plot that is adopted for recording stems with diameters less than 50 cm.

Plot types 1, 3 and 5 do not have subplots.

Entries for each plot are:

FOREST TYPE : Standard 2 digit code.

PLOT NUMBER : To be entered as a number between 1 and 999 for each strip.

Although it is not essential that strips or plots are entered in numerical order or that they are entered sequentially, it is highly recommended to do so in order to reduce the chance of errors.

```
THE ENTRY ROUTINE WILL NOT DETECT MISSING STRIP NUMBERS AND
MISSING OR DUPLICATE PLOTS ONLY IF ENTERED IN NUMERICAL ORDER!
```

The PAGE NUMBER is the sequential number of the page within each plot. A full page holds 12 trees. Thus only plots with more than 12 trees have more than 1 page. The page number does not need to be entered.

Entries for each tree:

SPECIES : Species names will not need to be entered, only the species code.

To record a NIL plot, eg. A plot with no stems recorded; enter a zero for the species code for tree number 1. Entering a zero for trees other than tree number 1 will not be accepted. Apart from this, the tree number has no special significance. It is merely shown on screen as a sequential number for each tree in a plot and is not actually saved to the database file.

DIAMETER : Diameters (above buttress) are entered in centimeters. Fractions of whole centimeters are not accepted. The allowable range for stem diameter is 1 to 300 CM. This maximum is arbitrarily set and can be altered by altering the program code. The data processing module of the program does ignore any stems with diameter less than 20 CM. so lowering the minimum would have no effect on the output produced.

LOG LENGTH : To be entered in meters. A decimal point is not accepted. The allowable range is set as 0 to 100 Meters. This can only be altered by modifying the program code.

Outside this range and if there is no log length record, you may enter a 0. If you do this, the log length will be shown as 'NR' which stands for Not Recorded or No Record. The value saved to the database is zero. The purpose of this option is to allow records of stems which only have diameter recorded. The processing routine will detect this and use a one-way volume function to calculate stem volume:

```
V = 0.00000515025 x ( Pi x Diam ) ^ 2.4762
```

NB. The current version of FIPS accepts a zero log length and applies this function for ANY diameter stem, but this function was derived for stems with diameter between 12.5 and 50 cm only!

FORM CLASS : The form class is entered as a number from 1 to 6, rather than a letter from A to F. This is done so that data entry only requires use of the numeric keypad on the keyboard.

None of the Tables and Reports produced by FIPS currently use Form or Quality Class EXCEPT the Block and Survey Summary reports.

EXIT – Data entry can be restarted with the Option 3 “EDIT of Data” after closing data entry session. However, you should not quit until a PLOT is completed and, preferably, not until an entire stripline has been entered.

Note also that if a plot holds more than 12 trees, the first page(s) MUST have 12 stems entered. For example, if there are 30 trees in a plot you cannot enter, say, 10 trees in each of 3 plot pages ; you must enter 12 stems on page 1, 12 stems on page 2 and 6 stems on page 3.

If you choose END, the block will be marked DATA ENTRY COMPLETED in the master control file. The field data for an individual block can only is processed (Menu Option 3.4”Processing”) if the block is marked as such.

Volumes are not calculated during the data entry part of the program. Tree volumes are not stored in the field book data base. Individual tree volumes are calculated during data processing (3.4).

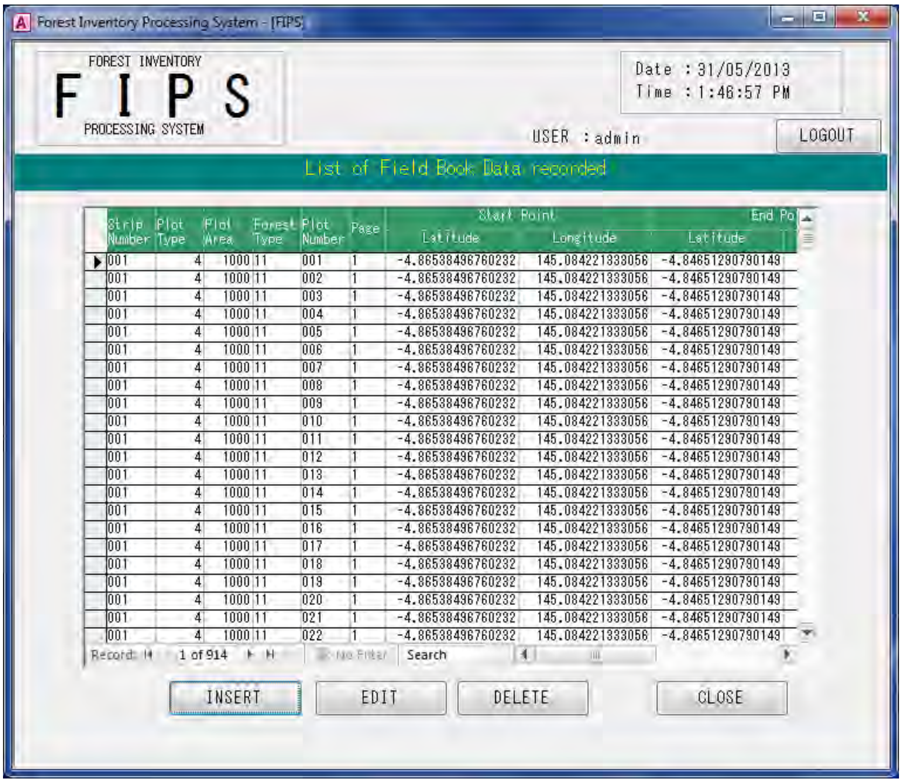
3.2.2. IMPORT FROM EXCEL FILE

This menu allows users to import the Field Book Data from the Microsoft Excel file.
This menu is useful to enter Field Book Data which is recorded with the Microsoft Excel format in the field into FIPS efficiently.
The importable data is the Microsoft Excel files which is converted into the importable format using the macro, FIPS_ImportDataCreater.
Refer to the manual sheet in the macro file about the usage of this macro.

In addition, the coordinates of the Strip Line can be input after importing, unless they are not entered the Microsoft Excel File. Refer to “3.2.1. ENTER DATA TO FIPS” for the coordinates inputting.

3.3 EDIT DATA

This menu enables users to edit data after inputting the field book data. The list of existing data is displayed on the screen. This menu has 4 options.



OPTIONS:

1. INSERT
   Add new Field Book Data into existing data.

2. EDIT
   Edit selected data on the list.

3. DELETE
   Delete selected data on the list.

4. CLOSE
   End editing

The page edit screen is very similar to the data entry screen.

3.4 PROCESSING

This is the heart of the program. It takes a block data file, as entered from field books, calculates stem volumes, groups stems into diameter classes, orders data by species, calculates total volumes and sample area etc.

The module produces a set of database files, which are referred to as 'result files', for each block processed. These result files hold all the information to produce the printed output.

The only input that is required is survey and block number. After validating survey and block number, further prompts depend on whether or not

a) the field data file exists ;
b) the field data file is marked DATA ENTRY COMPLETED ;
c) result files are not yet already on disk.

If result files already exist on disk, you will be asked whether you want to re-process the data. If you respond with Y, the old result files will be erased and processing will commence, else you will be returned to the menu. A block should only need to be processed once after making sure that data entry is complete and verified.

The message “Processing Completed.” is displayed on the screen when the process is completed.
The result of calculation is shown on the report.

In the case of Survey with Plan, creation of the interaction data with FIMS is started, and the message “Cooperation Completed.” is displayed when the process is completed.
Then the status of “Cooperation with FIMS” in “OPTION 3 DETAILS / STATUS screen” is changed from “-” into “No” and the latest update date is displayed.
The interaction data cannot open on the FIPS.

Volume Functions:

The processing routine holds three different volume functions which are selected depending on the individual stem data entered:

D is diameter (above buttress) in centimeters
L is log length in meters
V is log volume in cubic meters

a) 2-way volume function for stems with Diameter of 50 cm + (Lowland Rainforest Volume table) :

```
V = 0.189523 + 0.0000547982 x (D-2.4)² - 0.0089213 x L +
    0.0000528219 x (D-2.4)² x L
```

b) 2-way pulpwood volume function (Diameter 10-49.9 cm) :

```
V = - 0.001508 + 0.000044658 x D² + 0.00005310227 x D² x L -
    0.00000061883 x D² x L²
```

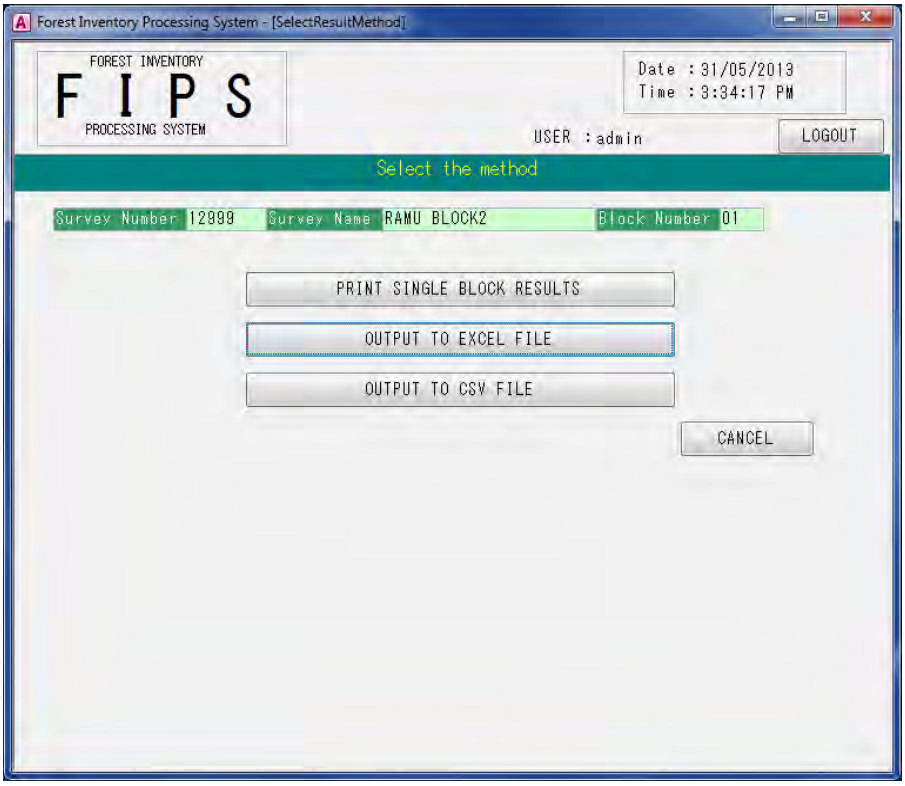
c) 1-way volume table - Pi x D is girth with girth between 40 and 150 centimeters :

```
V = 0.00000515025 x (Pi x D)^2.4762
```

Note that in the current version of FIPS (April 1990) the 1-way volume table is used for ANY stem which has only Diameter recorded against it, irrespective whether girth is less or greater than 150 cm !

3.5 RESULT

This menu provides options for output form of the result file which is created in “PROCESSING”; publishing as a report, exporting with the Microsoft Excel format or the CSV format. This menu has 3 options.



OPTIONS:

1. PRINT SINGLE BLOCK RESULTS
   Publishing the result file of PROCESSING as a report.
   Selection screen of report format is opened when the button is pressed.

2. OUTPUT TO EXCEL FILE
   Exporting the result file of PROCESSING to the Microsoft Excel format.

3. OUTPUT TO CSV FILE
   Exporting the result file of PROCESSING to the CSV format.

The result of calculation can be used for various purposes because of OPTION 2 or OPTION 3.

3.5.1. PRINT SINGLE BLOCK RESULTS

This menu provides preview function and print function for the statistical reports. This menu has 6 options for printing.

OPTIONS:

SPECIES TABLES

FIELD BOOK DATA

PLOT LISTING

FOREST TYPES

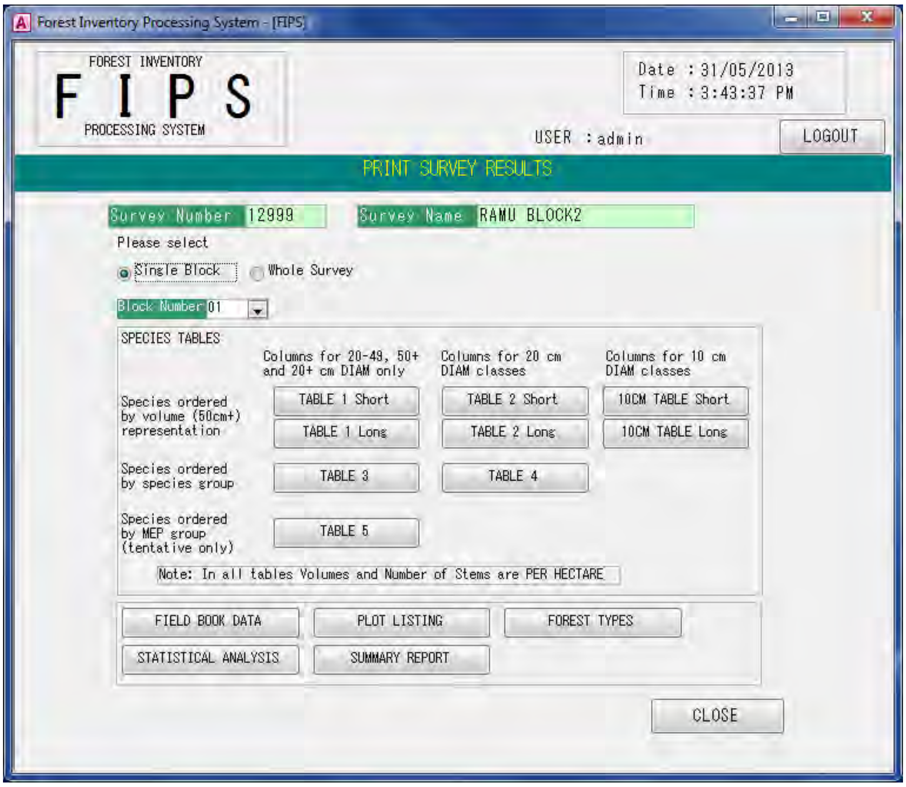
SPECIES TABLES

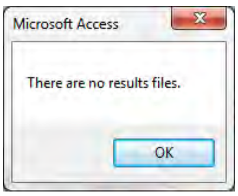
SUMMARY REPORT

Menu is divided in two sections.
The printing extent of the report (Single Block or Whole Survey) can be switched with the “Please select” Radio button.

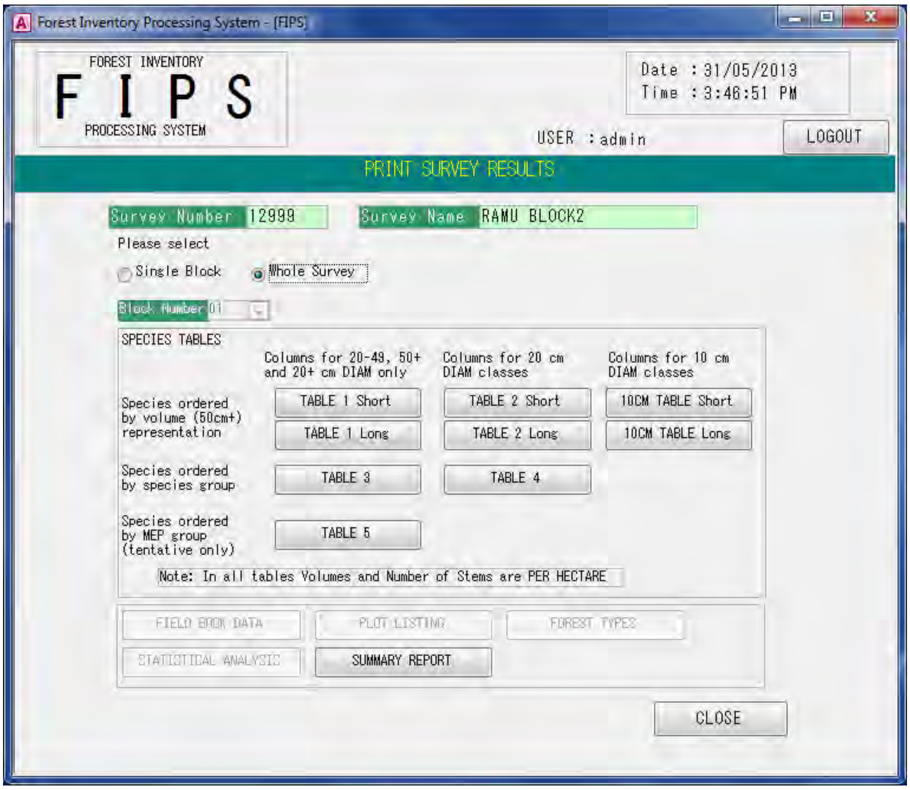
In the case of “Single Block” is selected, the report about one Block can be printed. The target block should be specified from the “Block Number” list. The warning message will be displayed when the block where no result files exist is selected to be printed.

The Block Number of the Survey selected with “Single Block” is displayed as an initial value.





In the case of “Whole Survey” is selected, the reports about whole survey can be printed. The printable report is “SPECIES TABLES” or “SUMMARY REPORT”. Buttons for other reports turns to be inactive.



3.5.1.1. SPECIES TABLES (Single Block)

This option produces species listings for the selected Survey and Block. The following choices are available:

TABLE 1

TABLE 2

TABLE 3

TABLE 4

TABLE 5

10CM TABLE

If TABLE 1 or TABLE 2 is selected, there is a further choice to be made:

Short

Long

Tables 1 and 2 can be printed as a 'LONG LISTING' or 'SHORT LISTING'. In the first case all species recorded in the block are listed individually with corresponding volume/ha etc., while in the second case those species which represent less than 1 percent of volume/ha (50 cm +) are NOT individually listed.
OPTIONS:

Note that in Table 1 and 2, species are listed by volume representation (50 cm +) in descending order, except for MISCELLANEOUS Species, which is printed at the end.

Tables 3 and 4 lists species as per their species group as indicated by the first digit of the species code. Species recorded as Miscellaneous or Unknown (code 665) is given a separate group, named MSC.

Table 5 is labeled as tentative only. The intention is to produce a table with species grouping which reflects merchantability/price classes. The Species code database file (F_CODE TABLE) would need to be updated regularly to reflect any amendments made from time to time to MEP groupings.

10CM TABLE print report with trees of the diameter class 10-19cm.

3.5.1.2. FIELD BOOK DATA (Single Block)

This option produces a printout of the field data entered at any time for a selected Survey and Block. Species names and stem volumes are shown alongside the data entered during data entry, eg. strip/plot number, diam, log length and form class. Total plot volume is printed for each plot.

Follow the instructions to set up printer.

The printout that is produced is basically a printed copy of the field books and for a large survey would take a lot of paper ! If the data entry operator is reasonably proficient, you normally might not need to produce this printout for checking data input plot by plot. Note that the plots are printed sorted in numerical order by Strip and Plot number, which is not necessarily the order in which the data have been entered !

3.5.1.3. PLOT LISTING (Single Block)

This option produces a printed plot listing for the selected block. The table is arranged by Strip line and Plot number and shows for each plot

Strip Number
Plot Number
Plot Area
Forest Type
Number of Stems) separate columns for 20-49 cm,
Plot Volume) 50 cm + and total.

Plot volumes and number of stems are totaled per stripline.

3.5.1.4. Forest Types (Single Block)

Forest Types Report is Volume and Number of Stems/ha by Forest type for a single block.

This option produces a summary table only for the selected Survey and Block Number WITHOUT giving species composition.

Although it is relatively easy to amend the program to produce species listings per forest type, the processing would become rather time consuming and disk intensive as forest type table files would need to be created - from the field data files - each time such tables are required. This applies even more if species tables by forest type are required for all the blocks combined.

It would not really be practical to keep forest type files permanently on disk.

If and when forest typing and stratification form a serious part of the assessment design and assessment data preparation for computer processing, this part would need to be re-examined.

3.5.1.5. STATISTICAL ANALYSIS (Single Block)

The only analysis presently supported is one of volume, basal area and number of stems per hectare for three diameter classes : 20-49 cm , 50 cm + and 20 cm +. The analysis is done PER BLOCK only.

THE ANALYSIS ASSUMES RANDOM SAMPLING and produces standard errors and 95 % confidence limits of the estimates of the means.

The implication of this assumption is that for assessments where plots are NOT selected at random, as is the case with most of our 'standard' forest inventories, the standard errors and confidence limits produced are statistically not strictly correct and may over-estimate the 'true' standard errors and confidence limits. In practice differences are only slight and because systematic sampling statistics are much harder to produce this approach are considered satisfactory.

For the analysis to precede the area of the block (in hectares) must have been entered. The field book data must have been processed and the relevant result file must be on disk.

3.5.1.6. SUMMARY REPORT (Single Block)

This option produces a two page report, with the basic block and survey details shown in the page header. The report has four sub headings:

(A) Stocking per ha.

(B) Basal Area per ha.

(C) Volume per ha.

Figures are presented separately by stem quality (form) classes and two diameter classes (20-49cm, 50 cm+) as well as totals.

(D) List of major species

This list is arranged as per the Species tables.
eg) In order of volume representation of stems with diameter of 50cm+ only.
Percentage representation as well as 20-49cm and 50cm+ volume per hectare is printed for all species listed.

3.5.1.7. SPECIES TABLES (Whole Survey)

This option is very similar to option 1 , except that the tables will show the species listings with corresponding volumes and number of stems per hectare for all the blocks in the survey combined. Tables can only be produced provided all results files for all the blocks recorded in the control file are on disk. You cannot request a summary printout of, say, blocks 1 and 2 (combined), if there are more than 2 blocks in the survey.

If there is only one block in the survey, the summary tables will be identical to the Block tables produced by Option 1, except for the heading of the tables.

3.5.1.8. SUMMARY REPORT (Whole Survey)

This option produces a 2 page report, with survey details shown in the page header. The report has four subheadings:

(A) Stocking per ha.

(B) Basal Area per ha.

(C) Volume per ha.

Figures are presented separately by stem quality (form) classes and two diameter classes (20-49cm, 50 cm+) as well as totals.

(D) List of major species

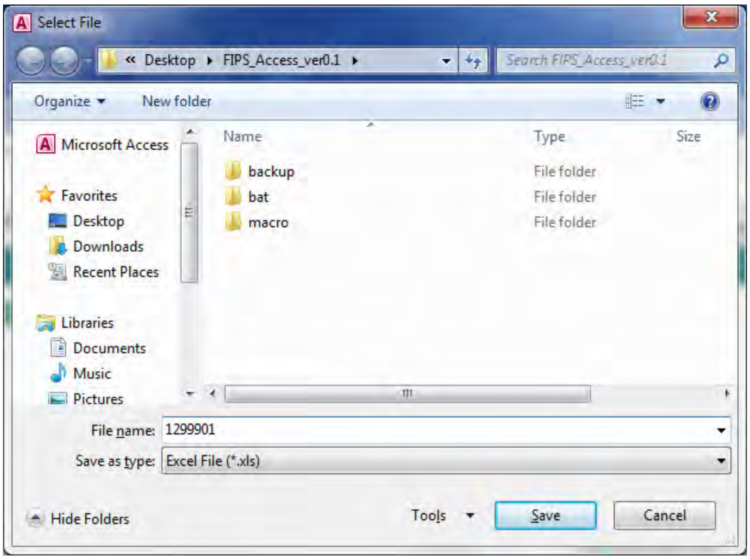
This list is arranged as per the Species tables.
eg) In order of volume representation of stems with diameter of 50cm+ only.
Percentage representation as well as 20-49cm and 50cm+ volume per hectare is printed for all species listed.

3.5.2. OUTPUT TO EXCEL FILE

This menu exports the result file of “PROCESSING” into the Microsoft Excel format.

The file selection Dialog opens by pressing “OUTPUT TO EXCEL FILE” button. Specify where to save the file and its name. The extension is omissible.
The message for overwriting is displayed when a file with the same name already exist.

Press “Save” button to start exporting process.



The contents of the exported Excel file are followings:

Field	Field Name	Contents/Comments
1	SPEC_CODE	Species Code
2	SPEC_NAME	Species Name
3	A_VOL10	10-19cm Volume for Form A
4	B_VOL10	10-19cm Volume for Form B
5	C_VOL10	10-19cm Volume for Form C
6	D_VOL10	10-19cm Volume for Form D
7	E_VOL10	10-19cm Volume for Form E
8	F_VOL10	10-19cm Volume for Form F
9	TOTAL_VOL10	Total 10-19cm Volume
10	VOL10_PER_HA	10-19cm Volume per Hectare
11	COMP_VOL10	Percent of 10-19cm Volume

12	BA10	Total 10-19cm Basal Area
13	A_PVOL	20-49cm Volume for Form A
14	B_PVOL	20-49cm Volume for Form B
15	C_PVOL	20-49cm Volume for Form C
16	D_PVOL	20-49cm Volume for Form D
17	E_PVOL	20-49cm Volume for Form E
18	F_PVOL	20-49cm Volume for Form F
19	TOTAL_PVOL	Total 20-49cm Volume
20	PVOL_PER_HA	20-49cm Volume per Hectare
21	COMP_PVOL	Percent of 20-49cm Volume
22	PBA	Total 20-49cm Basal Area
23	A_SVOL	50cm+ Volume for Form A
24	B_SVOL	50cm+ Volume for Form B
25	C_SVOL	50cm+ Volume for Form C
26	D_SVOL	50cm+ Volume for Form D
27	E_SVOL	50cm+ Volume for Form E
28	F_SVOL	50cm+ Volume for Form F
29	TOTAL_SVOL	Total 50cm+ Volume
30	SVOL_PER_HA	50cm+ Volume per Hectare
31	COMP_SVOL	Percent of 50cm+ Volume
32	SBA	Total 50cm+ Basal Area
33	SPEC_GROUP	Species Group(= Mep Group)

3.5.3. OUTPUT TO CSV FILE

This menu exports the result file of “PROCESSING” into the CSV format.

The file selection Dialog opens by pressing “OUTPUT TO CSV FILE” button. Specify where to save the file and its name. The extension is omissible.
The message for overwriting is displayed when a file with the same name already exist.

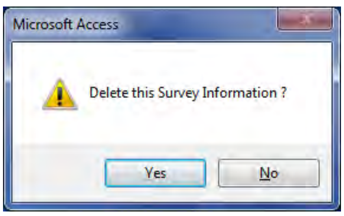
Press “Save” button to start exporting process.

The items exported are the same with those of exported Excel file.

3.6 DELETE SURVEY

This menu deletes selected Survey. The related data of this Survey, which are the Field Book Data, the Result Files created by volume calculation (those are the Table Object in SQL Server), and the interaction data with FIMS, is also deleted simultaneously.

The confirmation dialog is shown.



Select “Yes” to delete. Select “NO” if you want to cancel deleting process.

3.7 PRINT WHOLE SURVEY RESULTS

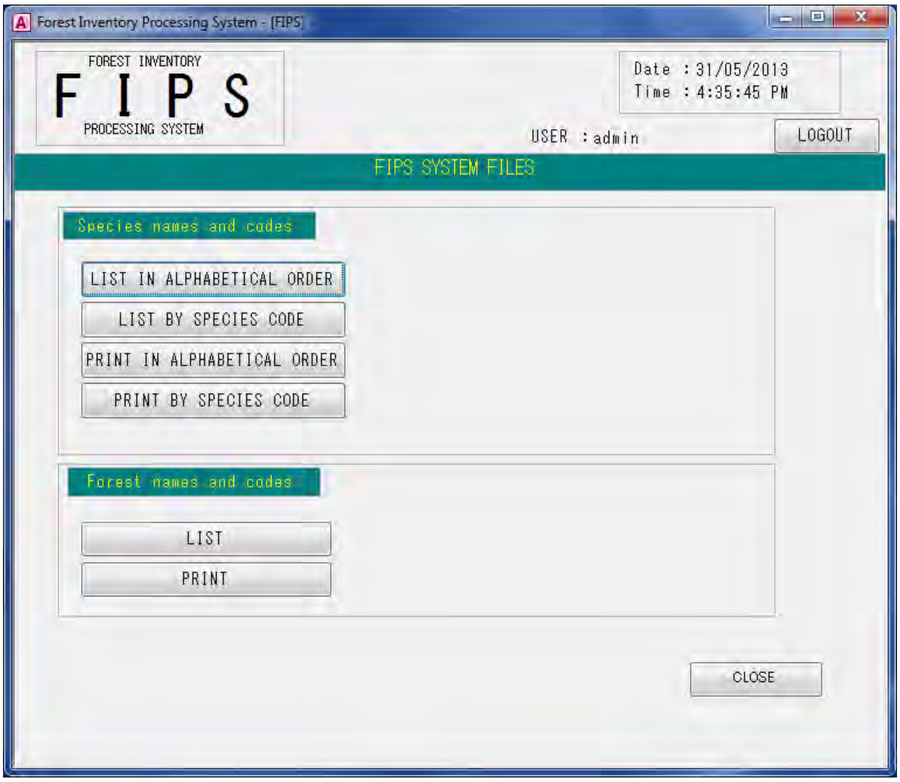
This option provides survey report printing and print preview functions.
When users press this button, the “PRINT SURVEY RESULTS” screen is opened with the “Whole Survey” radio button selected and users can print the Whole Survey report promptly.
Users can switch to “Single Block” after selecting this option.

4. PRINT LIST OF SURVEYS

This option creates a list of the Survey Information.

5. FIPS SYSTEM FILES

This menu enables users to manage (view, add new, edit, and delete) and to publish “Species name and codes (F_CODE TABLE)”and “Forest Types (F_TYPES TABLE)”.This menu has 6 options.



OPTIONS:

Species names and codes
- LIST IN ALPHABETICAL ORDER
- LIST BY SPECIES CODE
- PRINT IN ALPHABETICAL ORDER
- PRINT BY SPECIES CODE

Forest names and codes
- LIST
- PRINT

5.1 Species names and codes

Lists to screen or printer, with species in alphabetical order or sorted on species code, the full list of species names and codes, as used by FIPS. There are currently 288 entries in the list with some species duplication, to maintain compatibility with older surveys.

5.2 Forest Types

This option lists the currently defined forest types with description, codes and altitudinal range to the screen. Optionally the list may be printed.

6. USER MANAGEMENT

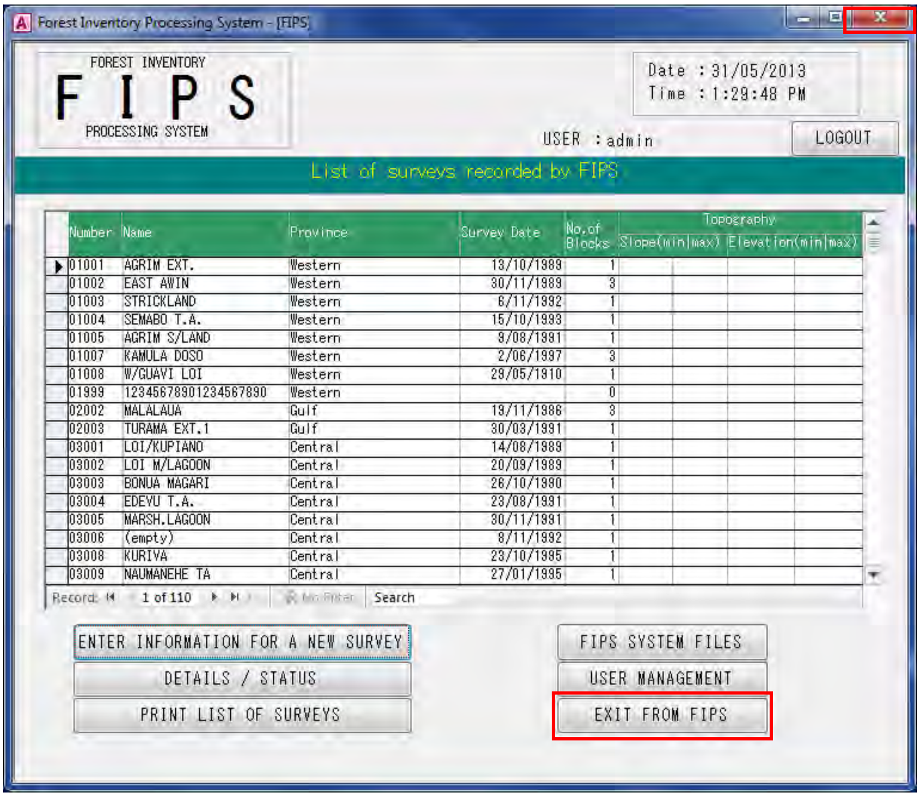
This option enables you to manage the accounts of FIPS users. This option requires the administrative authority or the developer authority to run, and the user with general authority cannot use this option.

The user with administrative authority can manage only the account of users with administrative authority or general authority. The developer authority is superior to the administrative authority; therefore the user with administrative authority cannot add / edit the account of user with developer authority.

The user with developer authority can manage all the accounts of users.

7. EXIT FROM FIPS

FIPS is shut down by clicking the Close button at the upper-right corner of the screen or pressing “EXIT FROM FIPS” button.



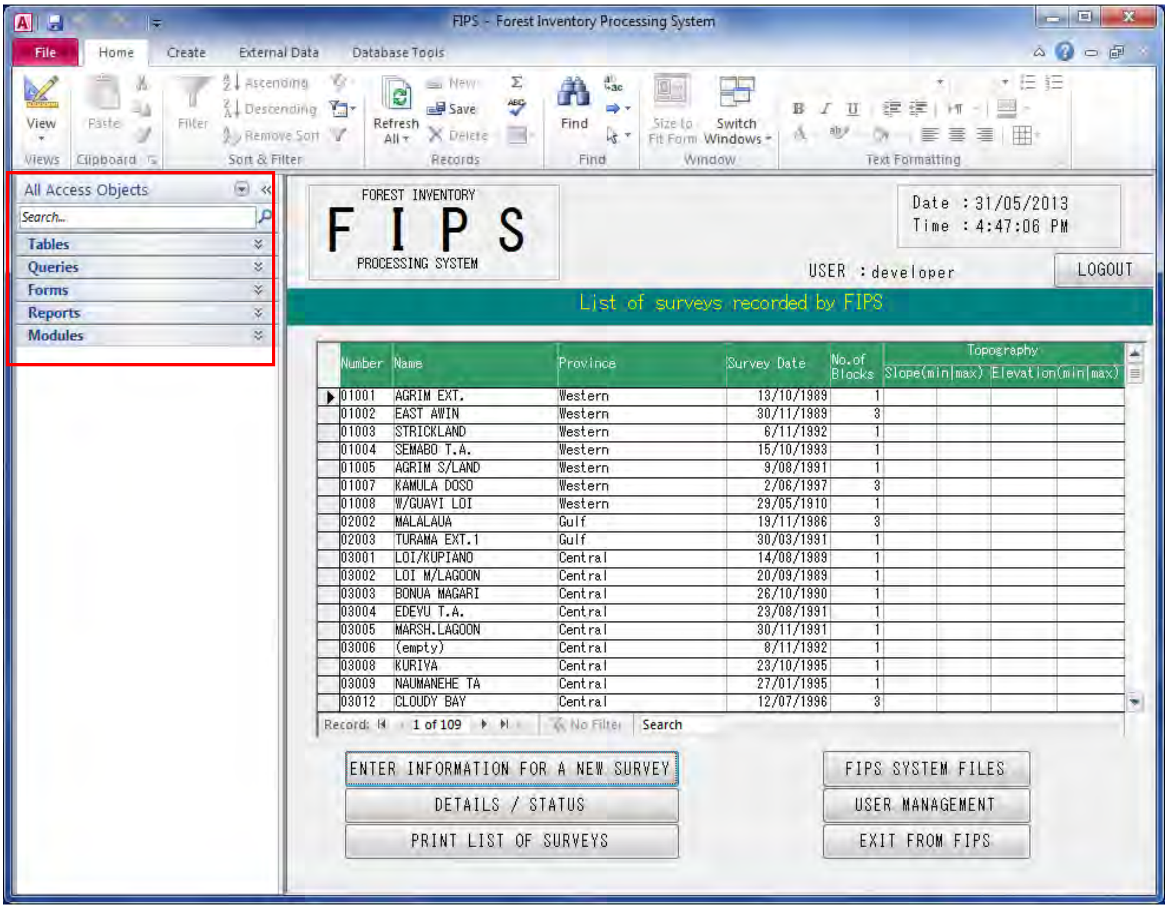
PART F. FILE MAINTENANCE

This part describes the procedures for FIPS management. The FIPS is implemented in Access VBA. Therefore, the standard feature of the Microsoft Access enables users to edit source code of FIPS and report layout.

Users need to log in with developer authority to operate standard feature of the Microsoft Access.

1. FIPS Internal structure

The screen to operate standard features of the Microsoft Access is displayed when the user logs in with developer authority.



Access Objects used in FIPS are listed in the Navigation screen.

FIPS Internal structure is based on Access:

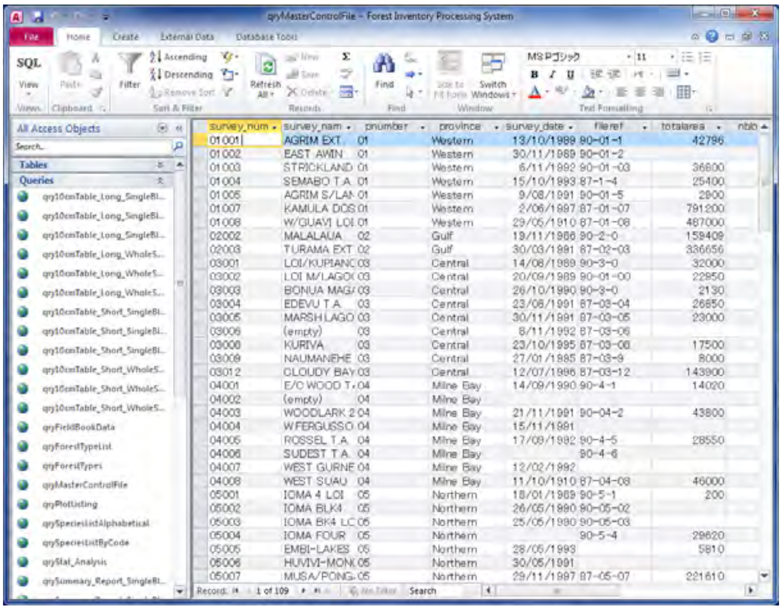
Tables
Queries
Forms
Reports
Modules

1.1 Tables

The Table objects in FIPS application are two work tables used for data importing and data exporting.
The main table where forest inventory data is stored is contained in the SQL Server.

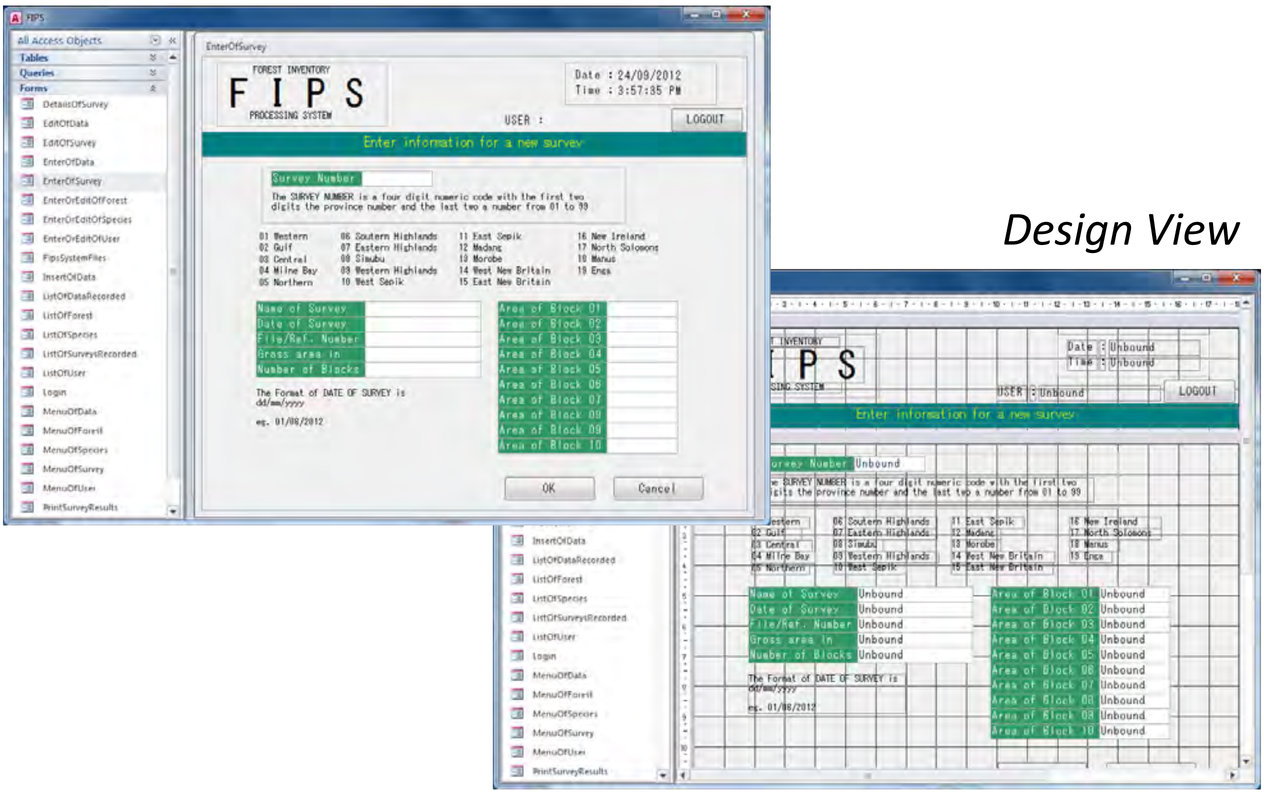
1.2 Queries

Queries are the record source for making reports.   These records are created from Tables or calculations.



1.3 Forms

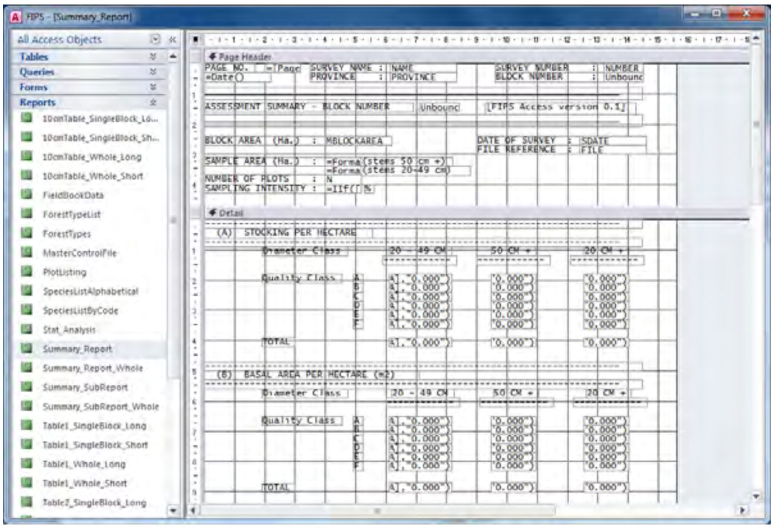
Forms are the interface for users. Users access Forms to enter/view data.



1.4 Reports

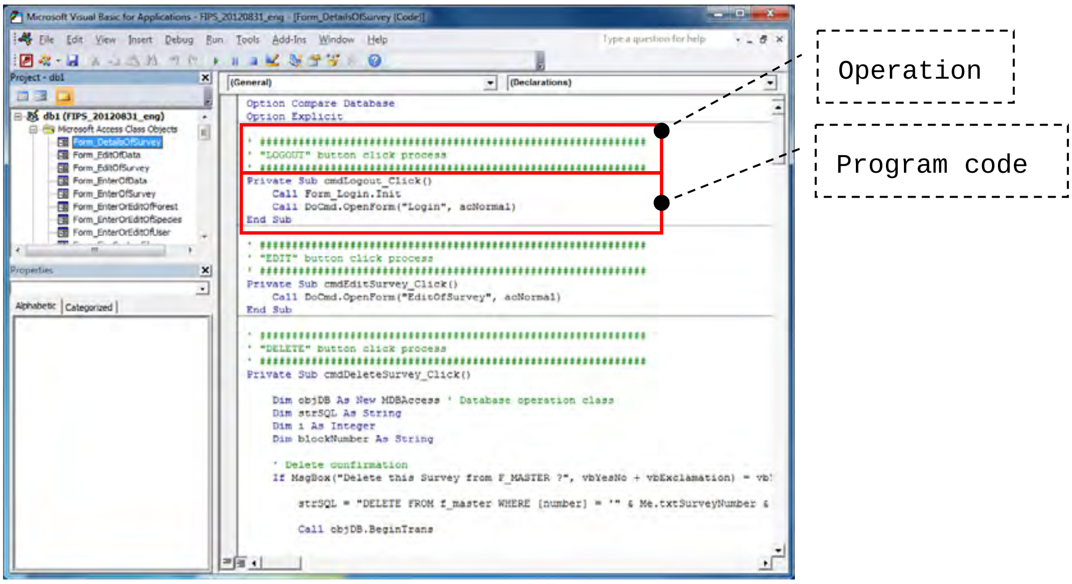
Reports are the view for printing out. You can access Design View only from Reports menu.

Design View



1.5 Modules

Reports are the view for printing out. You can access Design View only from Reports menu. “F_CALC” are the program for Equation. “F_COMMON” are the common program in FIPS.



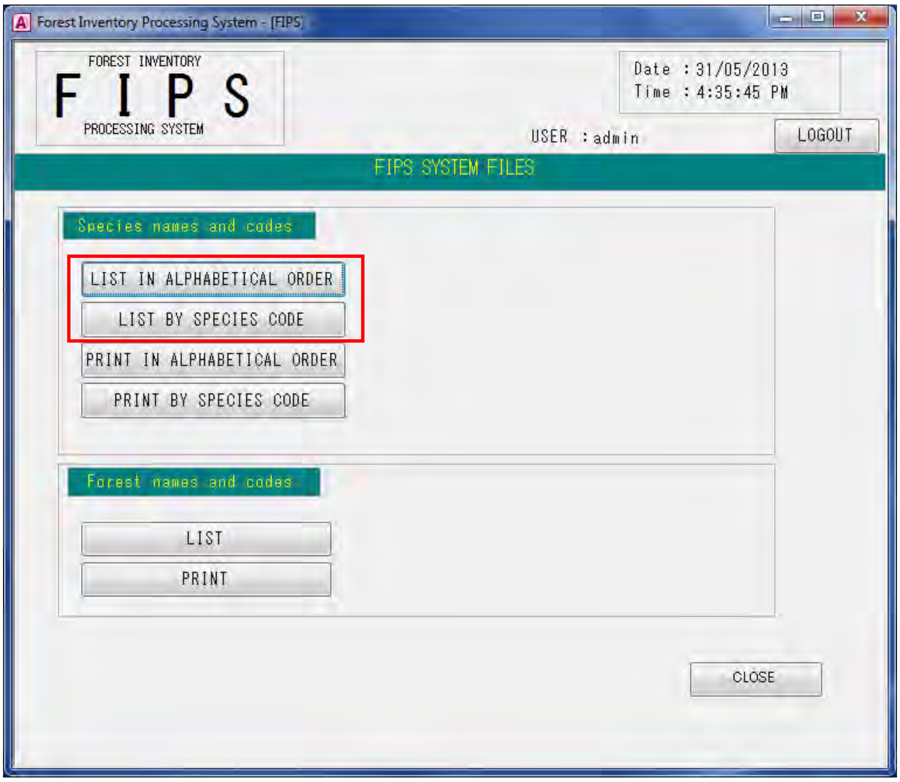
2. Update Mep Group(Price Group)

This section describes procedure of Mep Group Updating.

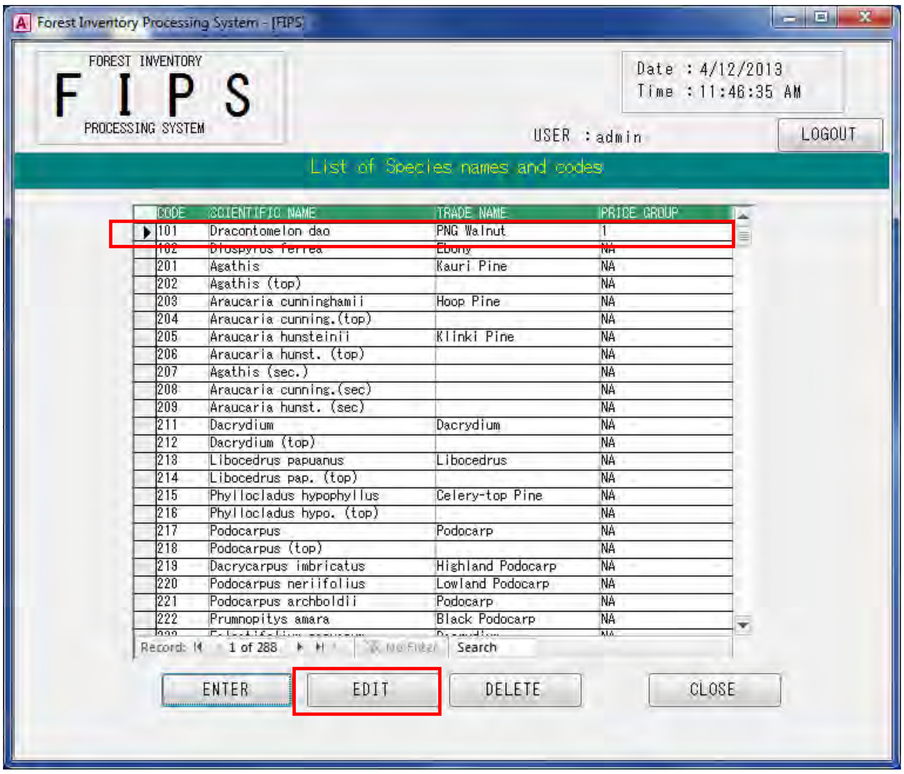
There are two procedures for updating Mep Group:

1) Update from FIPS
2) Update in SQL Server Database

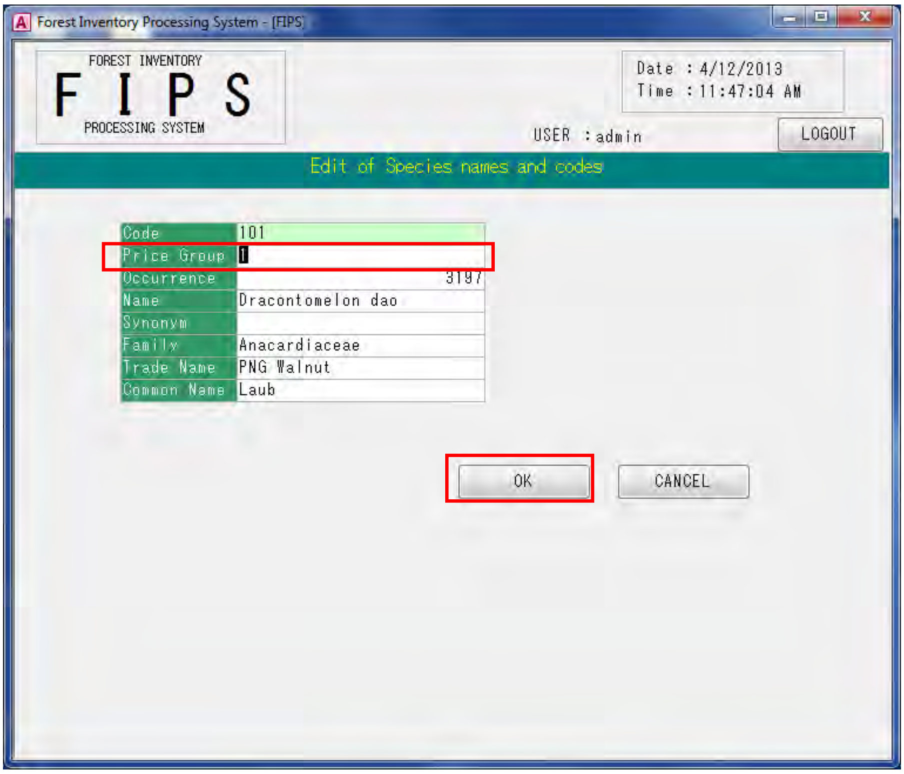
To update from FIPS, refer to PART D “5.1 Species names and codes”. All users can update Mep Group using FIMS.



Select “LIST IN ALPHABETICAL ORDER” or “LIST BY SPECIES CODE” to start updateing Mep Group.



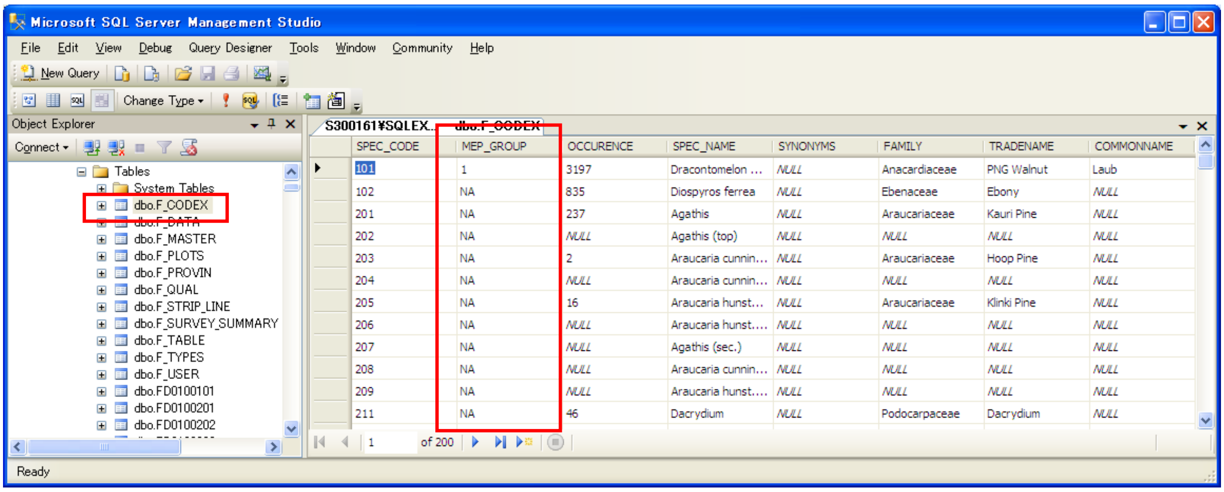
Select a tree species which needs to be updated and press “EDIT” button.



Edit Price Group and press “OK” button to update.

Data administrator can update Mep Group efficiently by editing SQL Server Database.

Connect with SQL Server Database using SQL Server Management Studio, and edit Mep Group in F_CODEX table.



3. Backup

Refer to PNG-FRIMS Guidebook.

PART G. SOFTWARE DEVELOPMENT NOTES

This part is reserved for the more experienced computer user, who is familiar with programming in dBASE or compatible database system.

Notes are available on request on how to manipulate FIPS files in the database interactive environment and how to customize the system.

Please refer to the design documents for more details such as the database structure, report formats and others.

Simple manual on LAN Map on PNGFA's Intranet

July 2019

Papua New Guinea Forest Authority (PNGFA)

Japan International Cooperation Agency (JICA)

Simple manual on
LAN Map on PNGFA's Intranet

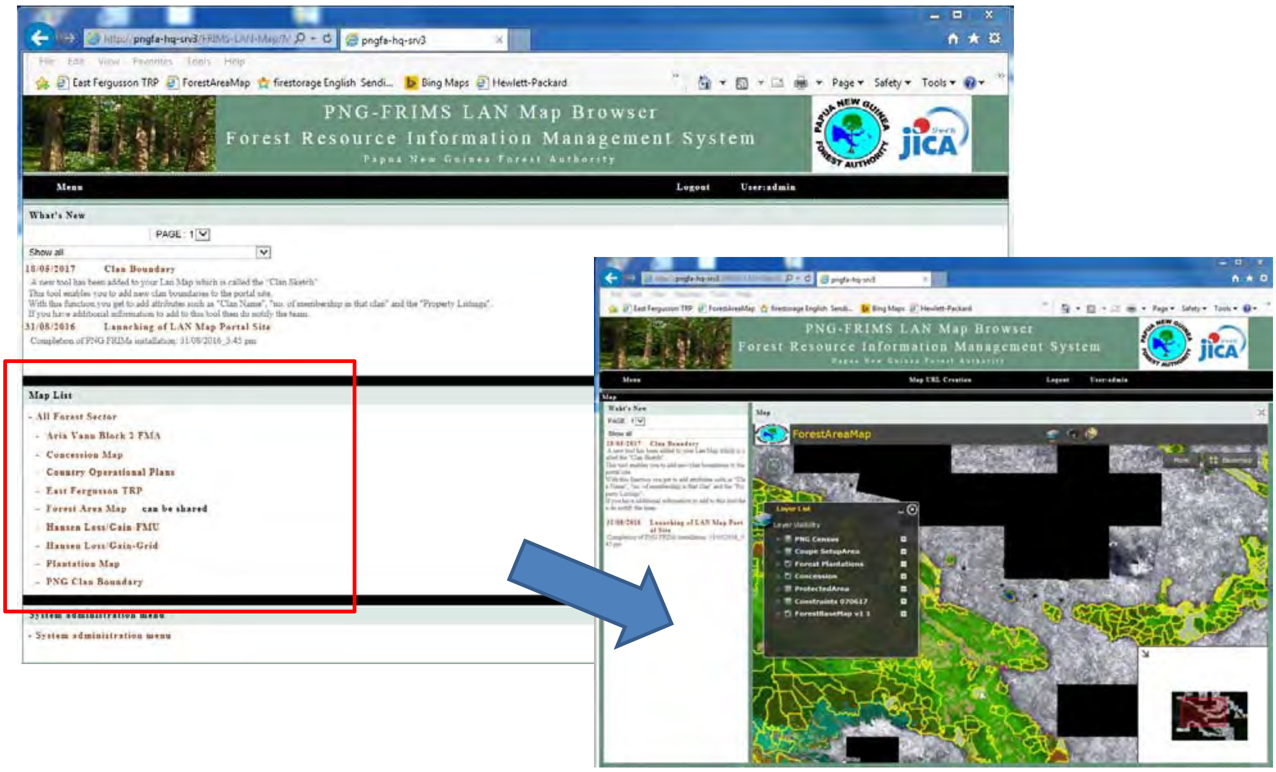
PNGFA
JICA

LAN Map on PNGFA's Intranet

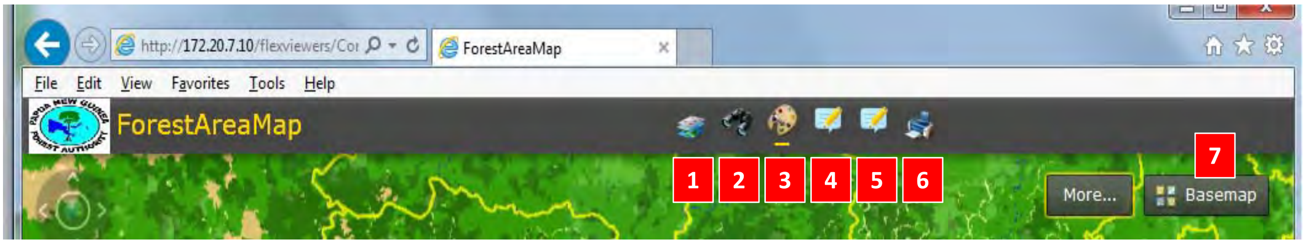
- Purpose: To Share Forest information within PNGFA HQ
- Overview:
  - You can see the map stored in the PNG-FRIMS through a Web Browser without ArcGIS software.
  - No access to the map through Internet from outside. (Access from only inside PNGFA HQ)
  - This map shows Concession Area, Forest Base Map (Vegetation), Project Area and Topography.

Top page of the Portal site

You can see thematic map names which you are authorized to access under "Map List".



Summary of Basic Map Functions



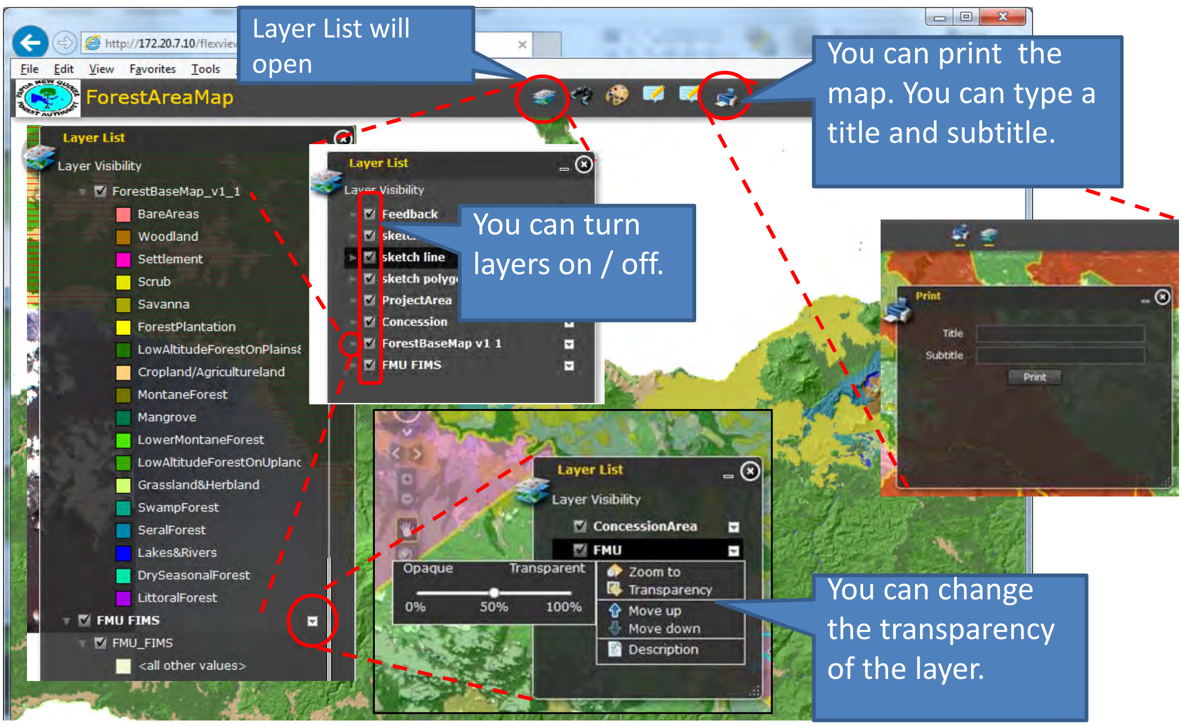
Functions		Remarks
1	Layer List	To turn layers on and off.
2	Search	To search for the attribute “Name” in the concession area layer.
3	Measure	To measure length and area for simple graphics (line or polygon) drawn by users.
4	Sketch	To create simple graphics (point, line and polygon) for planning or monitoring.
5	Feedback	To create feedbacks (e.g. the data error which user noticed, the request for adding information or adding new functions) as new point features on the map.
6	Print	To print all visible map displayed.
7	Switch Basemap	To choose background topography.

Procedure to see the map

Basic operation of map

– You can zoom in / out the map using mouse scroll wheel.

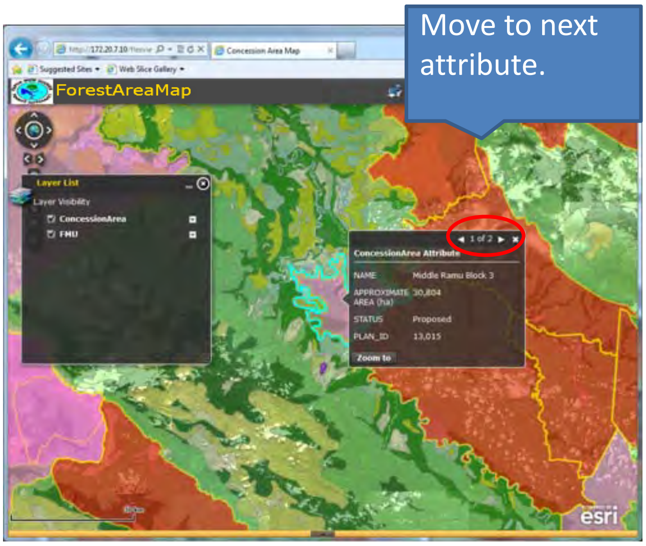
– You can pan the map using the left mouse button.

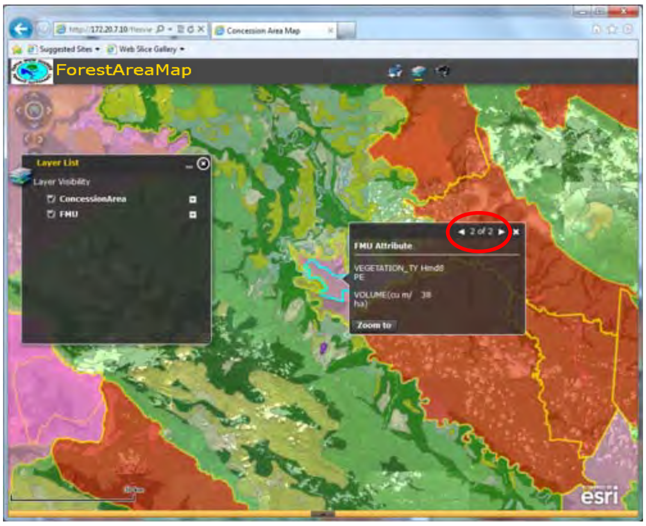


Procedure to see the map

See the attribute of the layer

– You click on the map, then attribute window will open.





Procedure to see the map

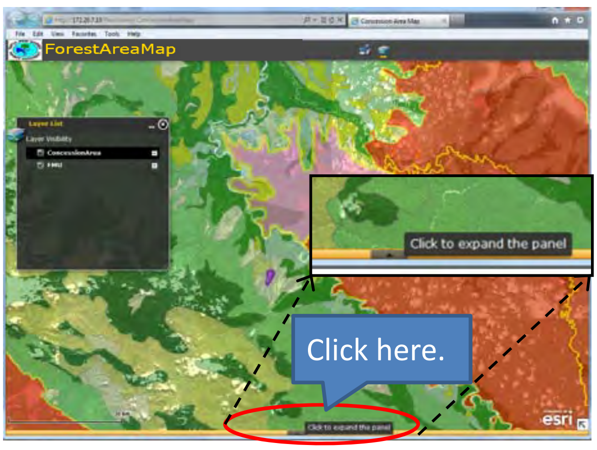
See the Attribute Table

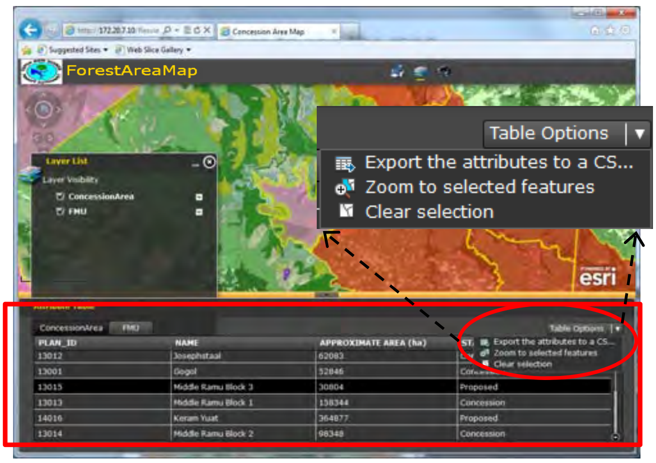
– If you click on the bottom of the map screen, the Attribute Table will open.

– You can see a tabular view of each layer's attribute.

– The attribute table has "Table options" dropdown combo box.

- Export the attributes to a CSV file—Exports the attributes to a separate CSV file
- Zoom to selected features—Zooms to the extent of the selected features on a tabular view
- Clear Selection—Clears the current selection

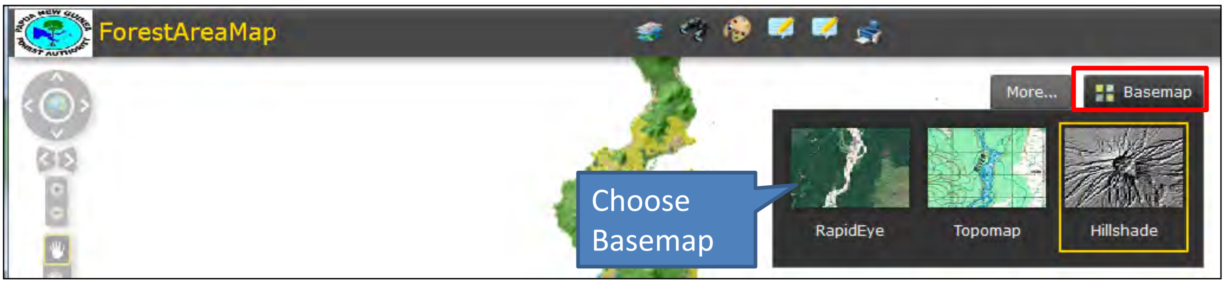


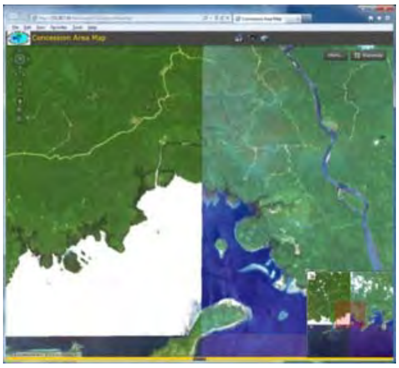


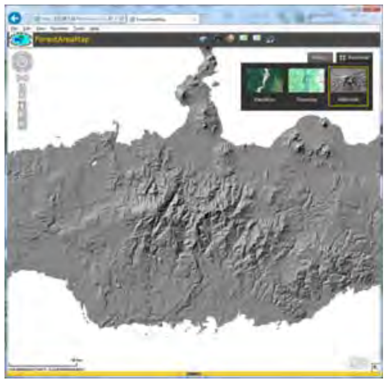
Procedure to see the map

Switch Base map

- You can choose the Basemap from among the satellite image , the topographic map and hillshade.
  - The topomap will appear when you zoom in the map.



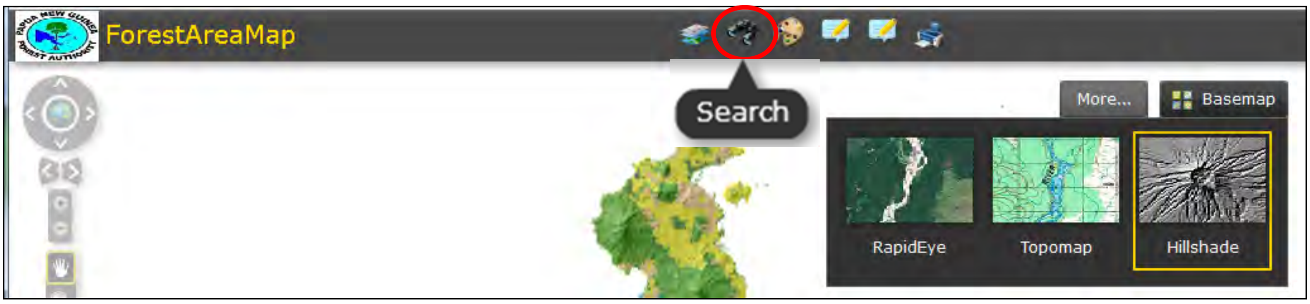


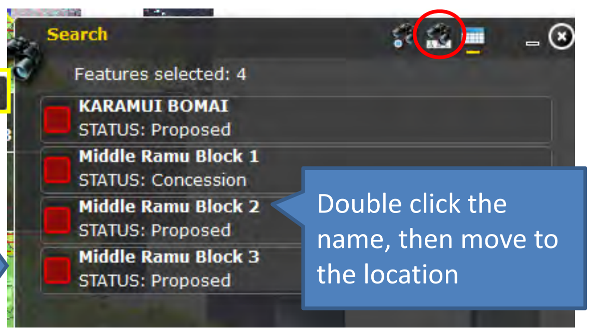


Procedure to see the map

Search by name of the concession area

- You can move to the concession area in which you are interested

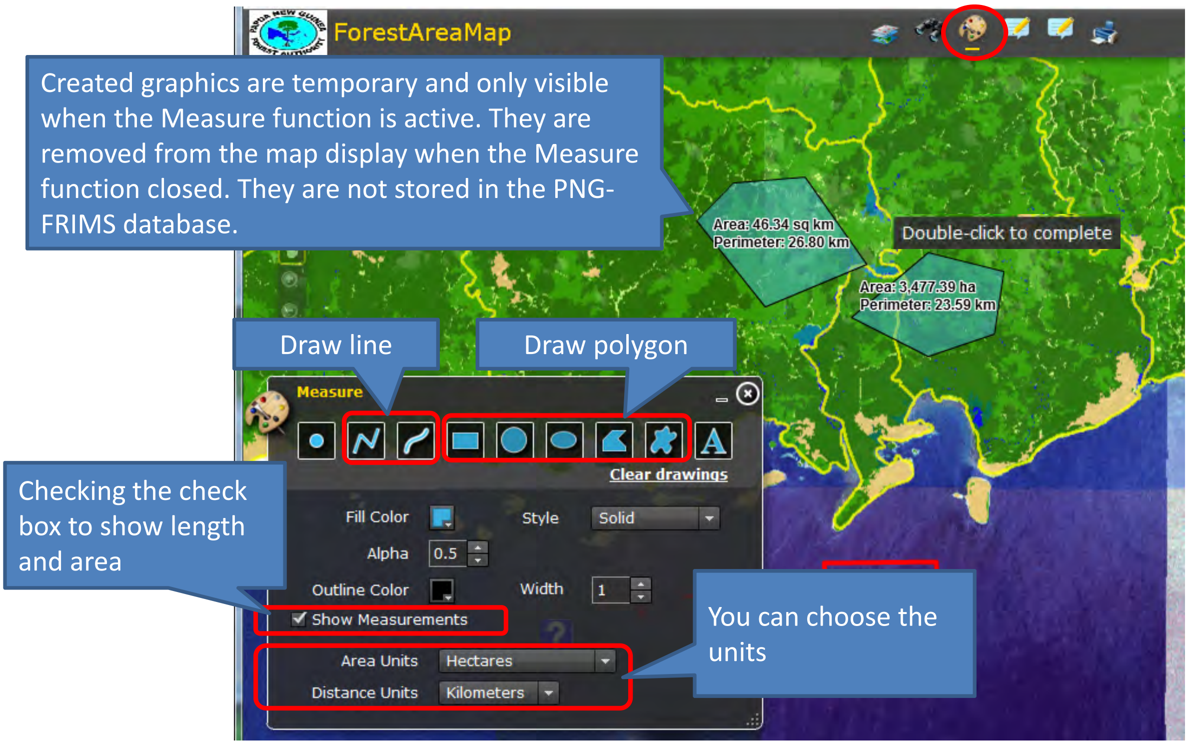




Procedure to see the map

Measure length and area of where you are interested in

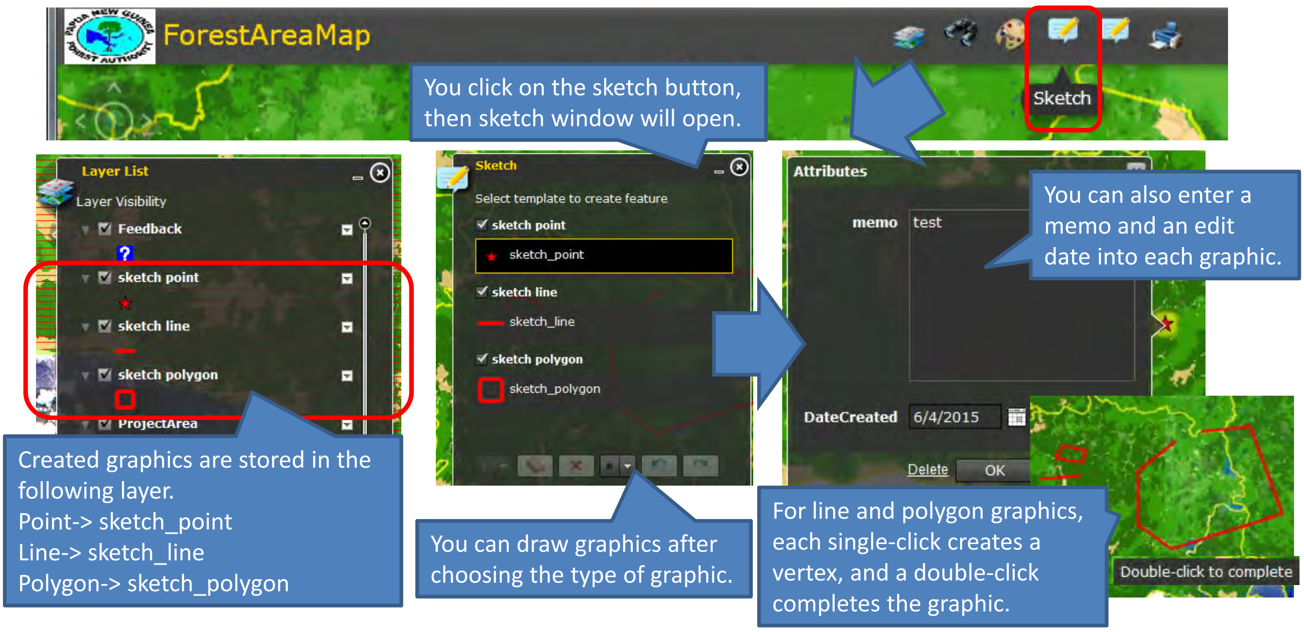
- You can measure lengths or Areas for simple graphics (line or polygon) drawn by users. Creates graphics are temporary, not stored into the FRIMS database.



Procedure to see the map

Sketch forest information for planning or monitoring

- You can draw point, line and polygon on the map. Created graphics are stored into FRIMS database. They are shared on the map among all users.



Intended purpose of sketch layer : To draw stripline or boundary for project planning or monitoring, to record the location of issues we can share on the map such as forest fire, landslide, re-entry logging, etc.

添付資料4

過去の森林炭素蓄積量の変化推計

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

Estimated Change of Forest Carbon Stocks

JICA-PNGFA Project team
April, 2019

PNG's Forest Reference Level (FRL) was submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in January 2017, with technical support from the Food and Agriculture Organization of the United Nations (FAO). The FRL was reported in "Papua New Guinea's National REDD+ Forest Reference Level – Submission for UNFCCC Technical Assessment in 2017". In this report, point sampling that applies Collect Earth was assigned to areas of each forest type to calculate forest carbon stocks.

In this Project, forest cover maps in 2011 and 2015 were developed for entire PNG, and forest cover maps in 2000 and 2005 were also developed for West New Britain (WNB) and West Sepik (WSP) Provinces. Therefore, in the Project, forest carbon stocks for entire PNG were calculated on a trial basis using the Forest Cover Map 2015. Furthermore, as for WNB and WSP, change of forest carbon stocks were calculated by using the Forest Cover Map 2000, 2005, 2011 (revised version) and 2015.

Forest living biomass was calculated assigning the Forest Cover Maps to areas, and values assigned in the "PNG National REDD+ FRL 2017" were used for above-ground living biomass value and below-ground living biomass ratio, which was also the IPCC default value. Forest biomass carbon stocks were calculated by multiplying the forest living biomass by the default value in the IPCC guideline for carbon content.

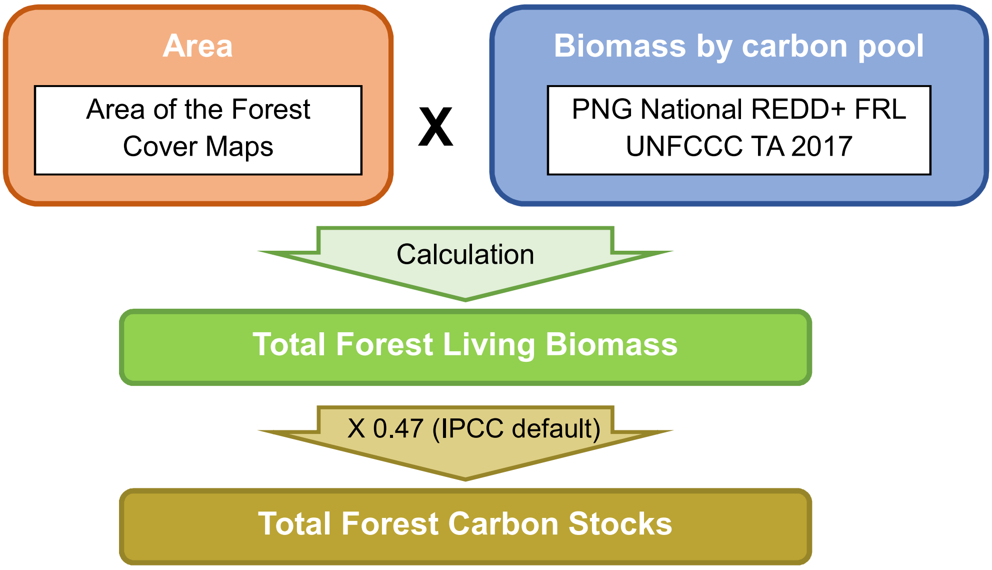


Figure 1. Basic design of Forest Living Biomass / Forest Carbon Stocks calculation method

Forest carbon stocks of PNG in 2015

First, above-ground living biomass was calculated by multiplying the area for each land cover class (forest type) on the Forest Cover Map 2015 by the above-ground living biomass value assigned in the "PNG National REDD+ FRL 2017".

Area of each forest type (Forest Cover Map 2015) X AGLB per ha (PNG National REDD+ FRL = AGLB of each forest type

Forest Cover Map 2015					AGLB value (t/ha)		AGLB of each forest type (Mt)
Forest type		Human impact	Area (ha)				
P	Low Altitude Forest on Plains & Fans	Primary	3,119,231	X	223	=	695.59
		Disturbance	5,014,087		146		732.06
H	Low Altitude Forest on Uplands	Primary	4,475,346		223		998.00
		Disturbance	7,128,517		146		1,040.76
L	Lower Montane Forest	Primary	3,345,477		140		468.37
		Disturbance	4,119,871		92		379.03
Mo	Montane Forest	Primary	257,917		140		36.11
		Disturbance	96,578		92		8.89
D	Dry Seasonal Forest	Primary	758,768		130		98.64
		Disturbance	176,439		85		15.00
B	Littoral Forest	Primary	22,518		223		5.02
		Disturbance	44,098		146		6.44
Fri	Seral Forest	Primary	67,900		223		15.14
		Disturbance	79,731		146		11.64
Fsw	Swamp Forest	Primary	945,622		223		210.87
		Disturbance	1,044,263		146		152.46
M	Mangrove Forest	Primary	163,685		192		31.43
		Disturbance	355,279		126		44.77
W	Woodland	Primary	1,493,062		130		194.10
		Disturbance	1,495,948		85		127.16
Sa	Savanna	Primary	348,076		130		45.25
		Disturbance	287,048		85		24.40
Sc	Scrub	Primary	298,100		70		20.87
		Disturbance	93,609		46		4.31
Qf	Forest Plantation	Primary	55		150		0.01
		Disturbance	67,896		98		6.65

Figure 2. Calculation of Above-Ground Living Biomass based on Forest Cover Map 2015

Next, below-ground living biomass was calculated by multiplying the area for each land cover class on the Forest Cover Map 2015 by the below-ground biomass value. The below-ground biomass value was calculated by multiplying the above-ground biomass value by the below-ground biomass ratio.

Area of each forest type (Forest Cover Map 2015) X BGLB per unit area AGLB per ha x R (ratio of BGB to AGB) = BGLB of each forest type

Forest Cover Map 2015						
Forest type	Human impact	Area (ha)	AGLB value (t/ha)	R	BGLB value (t/ha)	BGLB of each forest type (Mt)
P	Primary	3,119,231	223	0.37	82.51	257.37
	Disturbance	5,014,087	146	0.37	54.02	270.86
H	Primary	4,475,346	223	0.37	82.51	369.26
	Disturbance	7,128,517	146	0.37	54.02	385.08
L	Primary	3,345,477	140	0.27	37.8	126.46
	Disturbance	4,119,871	92	0.27	24.84	102.34
Mo	Primary	257,917	140	0.27	37.8	9.75
	Disturbance	96,578	92	0.27	24.84	2.40
D	Primary	758,768	130	0.28	36.4	27.62
	Disturbance	176,439	85	0.28	23.8	4.20
B	Primary	22,518	223	0.37	82.51	1.86
	Disturbance	44,098	146	0.37	54.02	2.38
Fri	Primary	67,900	223	0.37	82.51	5.60
	Disturbance	79,731	146	0.37	54.02	4.31
Fsw	Primary	945,622	223	0.37	82.51	78.02
	Disturbance	1,044,263	146	0.37	54.02	56.41
M	Primary	163,685	192	0.49	94.08	15.40
	Disturbance	355,279	126	0.49	61.74	21.93
W	Primary	1,493,062	130	0.28	36.4	54.35
	Disturbance	1,495,948	85	0.28	23.8	35.60
Sa	Primary	348,076	130	0.28	36.4	12.67
	Disturbance	287,048	85	0.28	23.8	6.83
Sc	Primary	298,100	70	0.4	28	8.35
	Disturbance	93,609	46	0.4	18.4	1.72
Qf	Primary	55	150	0.37	55.5	0.00
	Disturbance	67,896	98	0.37	36.26	2.46

Figure 3. Calculation of Below-Ground Living Biomass based on Forest Cover Map 2015

Total forest living biomass was calculated by adding the above-ground biomass and the below-ground biomass calculated above.

AGLB + BGLB = Total Living Biomass

Forest Cover Map 2015		AGLB (Mt)	BGLB (Mt)	Total Living Biomass (Mt)
Forest type	Human impact			
P	Primary	695.59	257.37	952.96
	Disturbance	732.06	270.86	1,002.92
H	Primary	998.00	369.26	1,367.26
	Disturbance	1,040.76	385.08	1,425.85
L	Primary	468.37	126.46	594.83
	Disturbance	379.03	102.34	481.37
Mo	Primary	36.11	9.75	45.86
	Disturbance	8.89	2.40	11.28
D	Primary	98.64	27.62	126.26
	Disturbance	15.00	4.20	19.20
B	Primary	5.02	1.86	6.88
	Disturbance	6.44	2.38	8.82
Fri	Primary	15.14	5.60	20.74
	Disturbance	11.64	4.31	15.95
Fsw	Primary	210.87	78.02	288.90
	Disturbance	152.46	56.41	208.87
M	Primary	31.43	15.40	46.83
	Disturbance	44.77	21.93	66.70
W	Primary	194.10	54.35	248.45
	Disturbance	127.16	35.60	162.76
Sa	Primary	45.25	12.67	57.92
	Disturbance	24.40	6.83	31.23
Sc	Primary	20.87	8.35	29.21
	Disturbance	4.31	1.72	6.03
Qf	Primary	0.01	0.00	0.01
	Disturbance	6.65	6.65	13.31
Total		5,372.95	1,867.43	7,240.38

Figure 4. Calculation of Forest Living Biomass based on Forest Cover Map 2015

Forest carbon stocks were calculated by multiplying the total forest living biomass by the default value in the IPCC guideline for carbon content.

Total Living Biomass X Carbon Fraction (CF) = Total forest biomass carbon

Forest Cover Map 2015		Total Living Biomass (Mt)		GF		Total forest biomass carbon (Mt)
Forest type	Human impact					
P	Primary	952.9563181	X	0.47	=	447.89
	Disturbance	1002.917631				471.37
H	Primary	1367.263028				642.61
	Disturbance	1425.846003				670.15
L	Primary	594.8258046				279.57
	Disturbance	481.3657157				226.24
Mo	Primary	45.85772205				21.55
	Disturbance	11.28411544				5.30
D	Primary	126.2590235				59.34
	Disturbance	19.19651072				9.02
B	Primary	6.879507139				3.23
	Disturbance	8.820479314				4.15
Fri	Primary	20.74426026				9.75
	Disturbance	15.94771577				7.50
Fsw	Primary	288.8971038				135.78
	Disturbance	208.873543				98.17
M	Primary	46.82690096				22.01
	Disturbance	66.70010282				31.35
W	Primary	248.4454598				116.77
	Disturbance	162.7591329				76.50
Sa	Primary	57.91992785				27.22
	Disturbance	31.23084014				14.68
Sc	Primary	29.21375285				13.73
	Disturbance	6.028449016				2.83
Qf	Primary	0.011341011				0.01
	Disturbance	13.30766291				6.25
Total		7240.378051				3,402.98

Figure 5. Calculation of forest carbon stocks on Forest Cover Map 2015

In this calculation, total forest carbon stocks of PNG in 2015 was 3,402.98 Mt.

Change of forest carbon stocks of WNB and WSP

As for WNB and WSP, forest carbon stocks for each 2000, 2005 and 2011 were also calculated using the Forest Cover Map 2000, 2005 and 2011 (revised version) following the same method.

Area of each land cover class (forest type), above-ground living biomass, below-ground living biomass, total living biomass and forest carbon stocks for each 2000, 2005, 2011, 2015 of WNB and WSP were calculated as the tables below.

Table 1. Area of each land cover class (forest type), above-ground living biomass, and below-ground living biomass for each 2000, 2005, 2011, 2015 of WNB

Forest type		Human impact	Area (ha)				AGLB (Mt)				BGLB (Mt)			
			2000	2005	2011	2015	2000	2005	2011	2015	2000	2005	2011	2015
P	Low Altitude Forest on Plains & Fans	Primary	108,313	98,428	82,930	74,590	24.15	21.95	18.49	16.63	8.94	8.12	6.84	6.15
		Disturbance	427,456	426,087	428,722	434,781	62.41	62.21	62.59	63.48	23.09	23.02	23.16	23.49
H	Low Altitude Forest on Uplands	Primary	455,523	436,064	379,438	356,424	101.58	97.24	84.61	79.48	37.59	35.98	31.31	29.41
		Disturbance	600,609	617,444	668,602	689,244	87.69	90.15	97.62	100.63	32.44	33.35	36.12	37.23
L	Lower Montane Forest	Primary	59,892	59,892	59,662	59,590	8.38	8.38	8.35	8.34	2.26	2.26	2.26	2.25
		Disturbance	6,491	6,491	6,650	6,723	0.60	0.60	0.61	0.62	0.16	0.16	0.17	0.17
Mo	Montane Forest	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	Dry Seasonal Forest	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	Littoral Forest	Primary	25	25	6	6	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	1,368	1,197	1,105	1,105	0.20	0.17	0.16	0.16	0.07	0.06	0.06	0.06
Fri	Seral Forest	Primary	11,679	7,682	6,271	6,206	2.60	1.71	1.40	1.38	0.96	0.63	0.52	0.51
		Disturbance	13,583	12,923	14,096	13,934	1.98	1.89	2.06	2.03	0.73	0.70	0.76	0.75
Fsw	Swamp Forest	Primary	13,305	8,877	6,320	6,024	2.97	1.98	1.41	1.34	1.10	0.73	0.52	0.50
		Disturbance	12,771	17,151	17,889	17,501	1.86	2.50	2.61	2.56	0.69	0.93	0.97	0.95
M	Mangrove Forest	Primary	1,184	1,162	1,162	1,162	0.23	0.22	0.22	0.22	0.11	0.11	0.11	0.11
		Disturbance	8,483	8,505	8,391	8,391	1.07	1.07	1.06	1.06	0.52	0.53	0.52	0.52
W	Woodland	Primary	19,493	17,569	15,034	13,399	2.53	2.28	1.95	1.74	0.71	0.64	0.55	0.49
		Disturbance	17,663	19,234	21,169	21,321	1.50	1.63	1.80	1.81	0.42	0.46	0.50	0.51
Sa	Savanna	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sc	Scrub	Primary	112	112	112	112	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qf	Forest Plantation	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total			1,757,949	1,738,842	1,717,558	1,710,512	299.78	294.01	284.96	281.51	109.81	107.69	104.36	103.10

Table 2. Total living biomass and forest carbon stocks for each 2000, 2005, 2011, 2015 of WNB

Forest type		Human impact	Total Living Biomass (Mt)				Total forest biomass carbon (Mt)			
			2000	2005	2011	2015	2000	2005	2011	2015
P	Low Altitude Forest on Plains & Fans	Primary	33.09	30.07	25.34	22.79	15.55	14.13	11.91	10.71
		Disturbance	85.50	85.23	85.75	86.96	40.18	40.06	40.30	40.87
H	Low Altitude Forest on Uplands	Primary	139.17	133.22	115.92	108.89	65.41	62.61	54.48	51.18
		Disturbance	120.13	123.50	133.73	137.86	56.46	58.05	62.85	64.80
L	Lower Montane Forest	Primary	10.65	10.65	10.61	10.60	5.00	5.00	4.99	4.98
		Disturbance	0.76	0.76	0.78	0.79	0.36	0.36	0.37	0.37
Mo	Montane Forest	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	Dry Seasonal Forest	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	Littoral Forest	Primary	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.27	0.24	0.22	0.22	0.13	0.11	0.10	0.10
Fri	Seral Forest	Primary	3.57	2.35	1.92	1.90	1.68	1.10	0.90	0.89
		Disturbance	2.72	2.58	2.82	2.79	1.28	1.21	1.33	1.31
Fsw	Swamp Forest	Primary	4.06	2.71	1.93	1.84	1.91	1.27	0.91	0.87
		Disturbance	2.55	3.43	3.58	3.50	1.20	1.61	1.68	1.65
M	Mangrove Forest	Primary	0.34	0.33	0.33	0.33	0.16	0.16	0.16	0.16
		Disturbance	1.59	1.60	1.58	1.58	0.75	0.75	0.74	0.74
W	Woodland	Primary	3.24	2.92	2.50	2.23	1.52	1.37	1.18	1.05
		Disturbance	1.92	2.09	2.30	2.32	0.90	0.98	1.08	1.09
Sa	Savanna	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sc	Scrub	Primary	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qf	Forest Plantation	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total			409.59	401.70	389.32	384.60	192.51	188.80	182.98	180.76

In this calculation, total forest carbon stocks of WNB was 192.51 Mt in 2000, and changed to 180.76 Mt in 2015.

Table 3. Area of each land cover class (forest type), above-ground living biomass, and below-ground living biomass for each 2000, 2005, 2011, 2015 of WSP

Forest type		Human impact	Area (ha)				AGLB (Mt)				BGLB (Mt)			
			2000	2005	2011	2015	2000	2005	2011	2015	2000	2005	2011	2015
P	Low Altitude Forest on Plains & Fans	Primary	254,686	245,283	220,799	209,901	56.79	54.70	49.24	46.81	21.01	20.24	18.22	17.32
		Disturbance	711,439	714,476	721,632	719,326	103.87	104.31	105.36	105.02	38.43	38.60	38.98	38.86
H	Low Altitude Forest on Uplands	Primary	450,310	439,291	405,977	389,268	100.42	97.96	90.53	86.81	37.16	36.25	33.50	32.12
		Disturbance	863,080	863,543	876,877	892,882	126.01	126.08	128.02	130.36	46.62	46.65	47.37	48.23
L	Lower Montane Forest	Primary	359,010	358,648	356,552	355,356	50.26	50.21	49.92	49.75	13.57	13.56	13.48	13.43
		Disturbance	191,776	191,960	193,853	194,986	17.64	17.66	17.83	17.94	4.76	4.77	4.82	4.84
Mo	Montane Forest	Primary	17,960	17,960	17,960	17,960	2.51	2.51	2.51	2.51	0.68	0.68	0.68	0.68
		Disturbance	42	42	42	42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	Dry Seasonal Forest	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	Littoral Forest	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	1,972	1,799	1,611	1,611	0.29	0.26	0.24	0.24	0.11	0.10	0.09	0.09
Fri	Seral Forest	Primary	2,737	2,737	2,737	2,737	0.61	0.61	0.61	0.61	0.23	0.23	0.23	0.23
		Disturbance	239	239	239	239	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01
Fsw	Swamp Forest	Primary	34,942	34,942	34,700	33,991	7.79	7.79	7.74	7.58	2.88	2.88	2.86	2.80
		Disturbance	101,333	101,111	101,297	101,895	14.79	14.76	14.79	14.88	5.47	5.46	5.47	5.50
M	Mangrove Forest	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	667	667	667	667	0.08	0.08	0.08	0.08	0.04	0.04	0.04	0.04
W	Woodland	Primary	12,568	12,568	12,440	12,314	1.63	1.63	1.62	1.60	0.46	0.46	0.45	0.45
		Disturbance	51,952	51,605	51,522	51,647	4.42	4.39	4.38	4.39	1.24	1.23	1.23	1.23
Sa	Savanna	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sc	Scrub	Primary	280	280	280	280	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qf	Forest Plantation	Primary	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total			3,054,993	3,037,150	2,999,183	2,985,102	487.19	483.03	472.93	468.64	172.68	171.15	167.43	165.85

Table 4. Total living biomass and forest carbon stocks for each 2000, 2005, 2011, 2015 of WSP

Forest type		Human impact	Total Living Biomass (Mt)				Total forest biomass carbon (Mt)			
			2000	2005	2011	2015	2000	2005	2011	2015
P	Low Altitude Forest on Plains & Fans	Primary	77.81	74.94	67.46	64.13	36.57	35.22	31.70	30.14
		Disturbance	142.30	142.91	144.34	143.88	66.88	67.17	67.84	67.62
H	Low Altitude Forest on Uplands	Primary	137.57	134.21	124.03	118.93	64.66	63.08	58.29	55.89
		Disturbance	172.63	172.73	175.39	178.59	81.14	81.18	82.43	83.94
L	Lower Montane Forest	Primary	63.83	63.77	63.39	63.18	30.00	29.97	29.80	29.70
		Disturbance	22.41	22.43	22.65	22.78	10.53	10.54	10.65	10.71
Mo	Montane Forest	Primary	3.19	3.19	3.19	3.19	1.50	1.50	1.50	1.50
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D	Dry Seasonal Forest	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	Littoral Forest	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.39	0.36	0.32	0.32	0.19	0.17	0.15	0.15
Fri	Seral Forest	Primary	0.84	0.84	0.84	0.84	0.39	0.39	0.39	0.39
		Disturbance	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.02
Fsw	Swamp Forest	Primary	10.68	10.68	10.60	10.38	5.02	5.02	4.98	4.88
		Disturbance	20.27	20.22	20.26	20.38	9.53	9.51	9.52	9.58
M	Mangrove Forest	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.13	0.13	0.13	0.13	0.06	0.06	0.06	0.06
W	Woodland	Primary	2.09	2.09	2.07	2.05	0.98	0.98	0.97	0.96
		Disturbance	5.65	5.61	5.61	5.62	2.66	2.64	2.63	2.64
Sa	Savanna	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sc	Scrub	Primary	0.03	0.03	0.03	0.03	0.01	0.01	0.01	0.01
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Qf	Forest Plantation	Primary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Disturbance	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total			659.87	654.18	640.36	634.48	310.14	307.46	300.97	298.21

In this calculation, total forest carbon stocks of WSP was 310.14 Mt in 2000, and changed to 298.21 Mt in 2015.

添付資料 5

REDD+の参照排出レベルの試行的推計：

PNG-FRIMS を用いた木材伐採による森林劣化からの

炭素排出量推定の可能性

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

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

PNGFA-JICA project

DRAFT April, 2019

Executive summary

Timber production in Papua New Guinea (PNG) is a key sector of the national economy but also one of the main sources of forest degradation. As PNG is actively involved in sustaining its forest resources, it is important to estimate the impact of activities in forest. Carbon stock is a good indicator of impacts and past emissions were estimated to make projections in PNG's Forest Reference Level (FRL) submitted in 2017. To build FRL, degraded areas were assessed by Remote Sensing analysis. These areas may also include post-logging emissions (from fire, gardening, etc.) and removals from regrowth. Further countries estimated forest degradation in their FRL by measuring the impacts directly and solely linked to harvesting practices which are observable in sites right after operations. Such information is included in routine monitoring conducted by PNG Forest Authority (PNGFA) and one question is how to utilize this potential for carbon monitoring. The main objective of this report is to evaluate the potential in PNG to estimate logging emissions based on field and proxy methods and by using data in PNGFA Forest Resource Information Management System (FRIMS). As such, the project analyzed international methodologies recommended by IPCC and adopted in FRLs, relevant data available in PNGFA, and their consideration for future FRLs and forest management.

Methodologies recommended by IPCC and adopted in FRLs

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

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

Many FRL countries opted for Method 1. This choice was facilitated by open sourced 30 m resolution images. In PNG, land use transitions (deforestation, forest degradation and carbon stock enhancement) were determined by RS. EF of forest degradation was calculated as the difference in carbon stocks between before and after logging. Four countries (the Republic of Congo, Ghana, Guyana and Suriname) chose the Volume Method (VM), elaborated in Pearson et al. (2014), for their FRL to count logging emissions as direct loss associated to extracted timber volumes.

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

In the VM, methodologies recommended to determine AD by using actual harvested volume data as complete, consistent over more than 10 years and originated from reliable sources. To account all emission sources associated to harvest, Total EF is calculated by summing Extracted Log Emissions (ELE), Logging Damage Factor (LDF) and Logging Infrastructure Factor (LIF). To calculate each EF, no need historic data but to sample parameters directly assessable on the field such as the extracted log, wasted log pieces, deadwood from trees surrounding the felled tree, and forest removal for the construction of skid trails, log decks, roads, ponds and camps. Field inventory method is now well documented for example in Standard Operating Procedures (SOP) from Winrock International (2018).

Potential in PNG to estimate logging emissions and utilization in FRL and MRV

Timber extracted volumes are recorded in the Field Services Directorate (FSD) database for all provinces, projects and since 2000 (digitized from 2010). Information on collateral damage is recorded in setup logbooks (but not in database) except for skid track areas and felling deadwood.

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

Complementary supports are expected in the future for monitoring from improve spatial information in PNG-FRIMS and drone usage (to capture skidding and felling gap areas in particular), but also from DSS (Decision Support System) for volume data management, and NFI (National Forest Inventory) for updates in carbon content of different forest strata and providing some information on deadwood.

FSD volume data can be used to determine PNG's logging AD because they fill most of requirements regarding consistency, completeness, accuracy and reliability. A country-specific logging EF can be developed based on PNGFA information available from routine forest monitoring (see table above) and a full sampling plan. The sampling plan is recommended to be designed in several concessions (representing as much as possible the range of extraction rates) and to cover all indicators of impact directly assessable on the field. In four relevant FRL countries, FRL was based on two methods: the VM to assess emissions from forest degradation and the RS method to estimate emissions from deforestation. Total logging emissions in PNG were simulated based on volume data from FSD (by excluding volumes generated in Forest Clearance Authority concessions) and the value of EF as calculated in the Republic of Congo.

Year	AD (Mm3)	Total EF (tC/m3)	Total logging carbon loss (MtC)	Total logging emissions (MtCO2e)
2010	3.1	1	3.1	11.2
2011	2.7	1	2.7	9.5
2012	2.6	1	2.6	9.4
2013	2.8	1	2.8	10.0
2014	3.3	1	3.3	11.8
2015	3.6	1	3.6	13.1
2016	2.3	1	2.3	8.2
2017	3.5	1	3.5	12.4

Besides, considering specific methods of carbon monitoring into routine assessment conducted by project supervisors for setup clearance (way of log measurement, waste assessment, etc.) can input the development of the national carbon Measurement, Reporting and Verification (MRV) system.

Way forward

Developing the VM produces outcomes that can be useful for forest management: (i) historic and projected emissions from logging, (ii) historic volume dataset, and (iii) a specific EF for logging in PNG. First, the potential to estimate logging emissions can be a critical element for Emission Reduction Programs (in the context of REDD+), carbon projects (in the context of voluntary carbon offset) and in a relative measure for Sustainable Forest management standards (climate components). Second, trends in timber production can be used for general purpose of forest management including adjustment of AAC (Annual Allowable Cuts) and comparison of provincial extraction rates. Third, logging EF (ton of carbon loss per m3 extracted) is a good indicator of environmental / carbon efficiency of harvesting practices. So it can allow comparing practices between or within concessions. Besides, the development of EF provides methodological experience in PNGFA and can facilitate the calculation of two EFs which is critical for differentiating conventional and improved practices.

Key findings are that the VM is specific to logging; an in-house method; most of required data is available in PNGFA; development of AD requires historic dataset while EF needs a sampling approach; guidance for conducting the VM and field inventory is well developed. Remaining needs are limited experts and scientific publications on Pearson's method, and limited financial options to support or reward the development of logging EF. Next steps would be to compare benefits from both RS and RS+VM approaches, develop Research to produce EF, promote carbon initiatives focused on sustainable practices, develop DSS system and new monitoring methods such as drone, and design a Roadmap for developing a logging EF (including by identifying relevant fund options).

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Introduction

Papua New Guinea's total area is 46.3 million hectares (FAO, 2015). Almost 80% of the land is covered by forest (PNG, 2017). Forest resources are the basis of livelihood for rural population and timber is a key asset for economy with more than 8 million hectares designated for production. But commercial logging is the major source of forest degradation and represents more than 80% of land emissions. So the estimation of forest degradation and associated emissions becomes particularly important to regulate environmental impact and sustain forest resources.

In this context, PNG Forest Authority is engaged to improve the compliance of activities with the Logging Code of Practice (LCoP). Different supports from JICA aim at facilitating the monitoring of field operations such as the improvement of spatial information in PNG-FRIMS and the development of capacities for using satellite images, GIS software, GPS and drones. Among LCoP items, many parameters are linked with carbon levels such as the extent of roads, infrastructures, collateral damage on surrounding trees and wasted logs. So improve capacities to monitor LCoP can facilitate monitoring of carbon emissions.

Emissions from forest degradation were assessed in the PNG's Forest Reference Level (FRL). Remote Sensing images were analyzed to determine deforestation areas (forest to non-forest), degradation areas (primary to degraded forest) and carbon stock enhancement (non-forest to forest). EF of forest degradation corresponds to the carbon stock difference between before and after logging so it also includes post-logging degradation (ex.: gardening, fire, fuel wood collect) and natural regeneration.

So it is interesting to study alternative approaches such as field estimation of direct impact from harvesting activities. But to use method based on field parameters, historic data of harvested volumes must be associated for at least last 10 years and EF determined for each source of emissions. Providing such information may be challenging for some countries and hinder proper estimation.

So this paper proposes to consider additional methods to contribute to PNG's FRL centrally, but also for further purposes linked with forest management. As such, the paper aims to describe main methodologies recommended by IPCC and applied in Forest Reference Levels, indicating calculation steps of emissions in the 'Volume' method, analyses PNG potential including from on-going initiatives, and proposes possible way of integrating additional methods and evaluates possible utilization of outcomes from developing the Volume method for forest management purposes.

1. Methodologies that estimate carbon emissions from logging

According to the driver of forest degradation, different methods exist to estimate emissions. Emissions that occur in harvesting sites are particularly challenging to measure because sources of emission are diverse and field parameters complex to monitor. This part summarizes main methodologies that specifically account carbon emissions from forest degradation caused by commercial logging. General methodologies recommended in IPCC framework and methods adopted in the past by REDD+ countries in their Forest reference Level are indicated.

1.1. Methods recommended in IPCC

Emissions from Forestry sector are calculated by deriving activity data (magnitude of human activity resulting in emissions or removals) and emission factors representing the change in carbon stocks as a result of the activity (IPCC's AFOLU guidelines, 2006). See Equation 1.

Net emissions (Em) = Activity Data (AD) x Emission Factor (EF) (Eq. 1)

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

1. The Remote sensing (RS) method using medium-resolution imagery to estimate degraded areas (AD) and Stock-Change method for EF,
2. A combination of timber extraction rates (volume method), management plans, and/or high-resolution imagery for AD and Gain-Loss for EF.

Method 1 is also applicable to deforestation and forest degradation from drivers other than logging. EF is the carbon stock difference (SD) between primary and secondary forest areas. Method 2 is specific to logging emissions and AD is based on harvested volumes ("Timber extraction rates") or on areas of managed forestland (“Management plans”) if volume data are not reliable (ex.: no FLEGT, high illegal logging or overpassed AACs). EF is calculated by the Gain-Loss method with a focus on biomass loss. The method is designed to provide EFs for all emission sources during operations.

1.2. Methods adopted in Forest Reference Levels

Forest Reference Levels (FRL) offers a good example of application of IPCC guidance. FRL is a benchmark for assessing each country’s performance in implementing REDD+ activities (UNFCCC Decision 12/CP.17). Estimation methods used by countries should be explained in FRL reports. Fourteen over 38 FRLs include forest degradation, and the distinction of degradation drivers vary according to the importance of logging and existing capacities/data in the country. See table 1.

Table 1: Methodologies proposed in FREL/FRL submissions for assessing forest degradation

Countries	**Activity Data (Methods)**	**Emission Factor (Methods)**
Include all drivers		
Cambodia, Chile, Indonesia, Mongolia, Panama, **PNG**, Uganda, Viet Nam	Land use transitions (RS method)	Carbon content variation (Stock-difference)
Lao	Land use transitions (RS method)	Biomass variation (Stock-difference also based on counting of stumps)
Specific to commercial logging		
Congo, Ghana, Guyana, Suriname	**Timber extraction (Official statistics)**	**Carbon losses (Gain-Loss)**
Ghana	Monitored log numbers (Official statistics)	Carbon losses (Gain-Loss)
Specific to drivers other than logging		
Ghana, Nepal	Fuel wood collect (Model supply-demand balance)	Carbon losses (Gain-Loss)
Ghana, Chile	Fire (MODIS method: MODerate resolution Imaging Spectro-radiation)	Carbon losses (Gain-Loss)

Based on FAO. 2018. From reference levels to results reporting: REDD+ under UNFCCC. 2018 update. Rome.

The RS method is the most commonly used. Its utilization is facilitated by free satellite images at medium resolution (30m) mainly from LANDSAT 7 and 8. PNG opted for this method in FRL (tab. 2).

Table 2: Calculation of total emissions in the RS method (ex.: PNG)

REDD+ activities	**Sources of emission**	**AD (method)**	**EF (method)**
Deforestation	Forest land => Other land use tCO2e	Land use transitions ha	Biomass difference tCO2e/ha
Forest degradation	Forest land => Forest land (emissions) tCO2e	Land use transitions ha	Biomass difference tCO2e/ha

Similar approach (Remote Sensing method for AD and Stock-Difference method for EF) is conducted for deforestation, forest degradation and carbon stock enhancement. EF for forest degradation is calculated in logged areas so it may include post-logging degradation from other drivers (small-scale logging, fire, gardening, etc.) and natural regeneration. Figure 1 summarizes the approach in PNG.

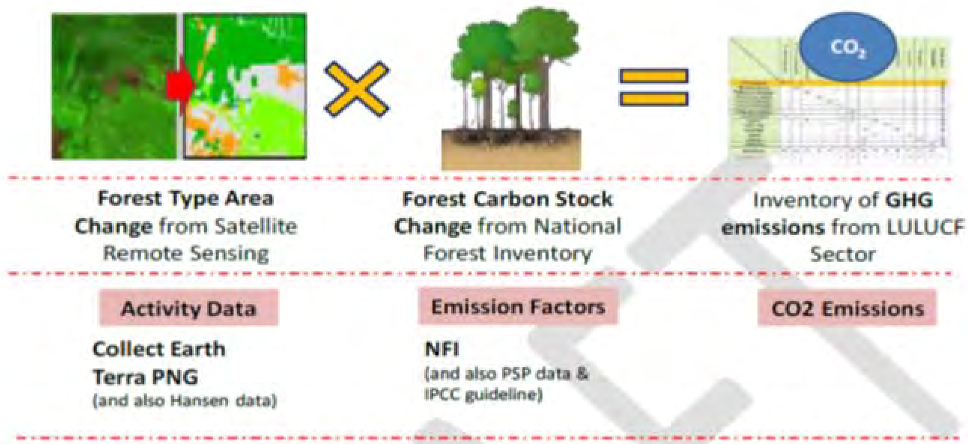

Figure 1: Calculation of emissions in the Forest reference Level of Papua New Guinea

Amongst improvement fields identified by PNG in its FRL (2017), several points are directly linked with the issue of estimation of logging emissions:

1. Develop specific method for forest degradation and specific EF for logging and other drivers
2. Provide a breakdown of emission at the level of provinces or districts
3. Include SFM in the scope of REDD+ activities by providing data at concession level for quantifying emissions from conventional forest management as opposed to SFM.
4. Provide values of deadwood (critical to assess logging impact).

According to Pearson et al. (2014), it is more appropriate to assess direct emissions in harvesting sites. The 'Volume' method based on extracted/harvested timber volumes is the only method applied so far in FRL that is specific to logging as method for AD and EF cannot be used for other drivers. Guyana (2015), Congo (2017), Ghana (2017) and Suriname (2018) opted for this methodology, see table 3.

Table 3: Calculation of total emissions in the 'Volume' method (4 FRL countries)

REDD+ activities	Emission sources	AD	EF

Deforestation	Forest land => Other land use tCO2e	Land use transitions ha	Biomass difference tCO2e/ha
Forest degradation	Industrial timber production tCO2e	Extracted volumes m3	Biomass loss associated to extraction tCO2e/m3

The method for forest degradation from logging is different than for deforestation and degradation from other drivers. The Volume method provides an interesting approach here as it involves proxy and field parameters. It will be detailed throughout this report.

Another method recommended by IPCC (2006) is based on 'areas of managed forest land'. According to table 1, none FRL used this method so far. The challenge to delimit active and logged over areas is common to many forest countries. Improve mapping may facilitate this method. And to be exhaustive, one more 'Volume' method exist; it estimates extraction based on exported figures. None FRL used this method yet. It was tested in PNG by PNGFA Forest Resource Institute (2015, unpublished). Collateral damage was estimated from national values and assumptions. Interesting recommendations are made concerning volume data:

1. Official records of harvested volumes should be compared with logging operational plans
2. Possible time lag between actual extraction of logs and issuance of export data
3. Consider logged areas in deforestation or degradation emissions according to the harvesting method (clear cutting or selective cutting)
4. Consider IPCC and other FRL approaches to develop EF in PNG
5. Compare benefits from Remote Sensing and Proxy approaches with the help from consultancies and workshops.

Methodologies based on field assessment and proxy such as harvested volumes exists and brings interesting benefits. However, field methods of vegetation analysis are usually time-consuming, extended and complex.

2. Procedures of field monitoring and methods of calculation of logging emissions

The volume method provides an interesting approach to estimate the carbon impact of logging operations as it is based on in-house figures of harvested volumes and field parameters usually monitored by field services. But to measure logging collateral damage may be very challenging. This part provides detailed information on procedures to determine Activity Data and calculate Emission

Factors. Main emission sources to consider and methods to monitor field parameters are presented.

2.1. Recommended procedures to determine AD

For Activity data, IPCC (2006) recommends providing data and information that are transparent, complete, consistent over time and accurate. To develop a robust method by using harvested volumes, relevant FRLs (four countries cited above) provided AD corresponding to the total extraction, annual, in all concessions, recorded at regional and summed at national scale, and resulting in any log products such as round wood, sawn wood or plywood. Volume data come from annual reports and statistics from the State, log tracking systems, forest concession planning or operational log books. Existing FRLs presented a representative trend by providing AD for more than 10 years: 13 years in Congo, 15 in Ghana, 12 in Guyana and 16 in Suriname.

2.2. Definition of EFs

The Volume method is designed to provide emission factor for all sources of emission as a function of the unit of timber production (ton of carbon per cubic meter extracted) as indicated Equation 2.

Total Emission Factor (TEF) = ELE + LDF + LIF (Eq. 2)

Definitions below are compiled from IPCC (2006) and relevant FRLs. TEF is the total loss of live biomass caused by immediate damage that occurs during operations. ELE (Extracted Log Emission) corresponds to extraction of the selected merchantable trees. LDF (Logging Damage Factor) accounts log biomass left behind in felling gaps and incidental damage to surrounding trees. LIF (Logging Infrastructure Factor) accounts dead biomass caused by infrastructures built for removing logs out of the forest. LIF includes skidding trails caused by the use of bulldozers or other equipment to transport logs from felling areas to roads; logging decks (or landings) where logs skidded out from forest are piled waiting transport; and logging roads used by vehicles to transport logs out of the forest. We propose a representation of different sources of emission Figure 2.

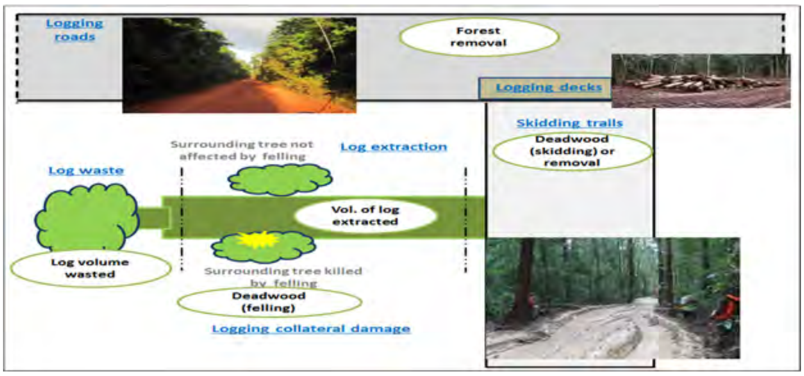

Figure 2: Main sources of emission from commercial logging

To calculate each EF (and estimate each emission source), It is recommended to use parameters directly assessable on the ground and good indicator of carbon impact. See table 4.

Table 4: Utilization of field parameters to calculate logging EFs

EFs	Sources of emission	Monitoring parameters
ELE (extraction)	Removal of biomass of the whole tree felled	Extracted/harvested log
LDF (collateral damage)	Log left behind as trimmed or abandoned	Wasted logs
	Damage on trees surrounding the felled tree	Deadwood (DW) caused by felling
LIF (road & infrastructure)	Skidding trails	Skidding deadwood or carbon loss
	Logging roads	Road carbon loss
	Logging landings/decks, ponds and camps	Infra carbon loss

Methodology implementers are actually free of following their own choice unless all sources of possible emission are recorded and the entire procedure remains logic and conform to IPCC (tab.5).

Table 5: Correspondence between EFs and Field parameters in IPCC and FRL countries

Parameters assessable on field	IPCC/Pearson	Congo	Ghana	Guyana	Suriname
Extracted log	ELE	ELE	ELE	ELE	ELE
Wasted logs	LDF	ELE	LDF	ELE	LDF
Felling DW	LDF	DF	LDF	LDF	LDF
Skidding carbon loss	LIF	DF	Skid EF	LIF	Skid EF
Road carbon loss	LIF	DEF	Road EF	DEF	DEF
Infra carbon loss	LIF	DEF	Infra EF	DEF	DEF

DF: Damage Factor; DEF: Deforestation.

In three over four FRL countries, emissions from logging roads and infrastructure are accounted as deforestation (DEF) so monitored by RS. Congo and Guyana included log landings in roads as they are often an extension of road areas. The Republic of Congo simplified categories from three (ELE, LDF, LIF) to two (ELE and Damage Factor). ELE regroups extracted and wasted logs and DF regroups felling and skidding deadwood. This approach has for benefit to ease field measurements and facilitate development of two Damage Factors: one for "certified" and one for "non-certified" concessions.

2.3. Methods to monitor carbon parameters and calculate EFs

Extracted Log Emissions

Volumes of both log and entire tree are estimated from log diameter measured on the ground or obtained from records. It is recommended not to fix a sample area (just adapt to the felling gap) and to use fresh gaps. Mean-ELE is the sum of gap-ELEs divided by the number of gaps sampled. For converting log diameters into emissions, methodologies refer to Chave et al. (2005). See table 6.

Table 6: Conversion steps from log diameter to CO2e emissions

Steps	Initial	Converting factors	Final
1	**Diameter** & length (m)	f(DBH,H) allometric eq.	Log volume (m3)
2	Log volume (m3)	Density (tdm/m3)	Log biomass (tdm)
3	Log biomass (tdm)	Biomass Expansion Factor	AGB (tdm)
4	AGB (tdm)	1+ Ratio aerial/roots	Tree biomass (tdm)
5	Tree biomass (tdm)	Carbon Fraction (tC/tdm)	Tree carbon (tC)
6	Tree carbon (tC)	Conversion Fac. tCO2e/tC	**Emission** (tCO2e)

Three of the four FRL countries opted not to consider long term carbon sequestration in wood products assuming that all carbon extracted is emitted at harvest time. Additional methods exist to consider sequestration with the application of a set of equations and national values.

Logging Damage Factor

LDF includes wasted log pieces and surrounding trees killed by the fall of the felled tree.

1- Wasted logs i.e. trimmed, defected and abandoned logs can be estimated by several methods:

- Assumed as 20% of gross tree volume (10% from trimming; 10% from abandon), cf. Congo FRL

- Subtract the registered log volume to gross tree volume
- Inventory diameter of stump (or bottom of the log if no stumps) (4), stump height (5), length of pieces (6), diameter of bottom (7) and top of pieces (8). See figure 3.
-

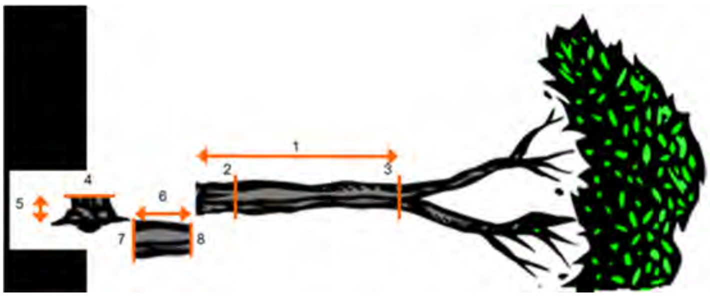

Figure 3: Inventory method to estimate extracted and wasted volumes

2- Felling deadwood: diameter of deadwood* creating during felling is measured in felling gaps so that the correspondence with extracted volume is possible. Deadwood refers to two categories of damage: trees snapped (main branches broken) or uprooted (lying on the floor). There is unanimity within 4 FRL countries for measuring deadwood by field inventory. Deadwood from waste, felling and skidding can overlap the same area. So felling deadwood is sometimes accounted with other parameters such as wasted logs (in Ghana and Suriname) or skidding deadwood (in Congo). Assess together deadwood in skidding and felling gaps can be a good option to simplify inventory and use very high resolution imagery to assess the sum of all gaps (GOFC-GOLD, 2016).

** Trees surrounding felled trees that are killed by felling together with waste logs is sometimes referred as the sensu stricto definition of collateral damage. The sensu extenso definition includes in supplement road and infrastructure. The definition widely varies in the literature, here we use the large definition unless we bring precision.*

LIF for skid tracks

Emission Factor of skid trails is calculated by associating emissions due to track creation with the volume of logs extracted by using this skid track (eq. 4). Note log extracted volume does not refer only to volume of merchantable trees from track clearing but also includes logs extracted from felling gaps and from the clearing of log decks.

LIF [skid] (tC/m3) = Skidding Emissions (tC) / Log extracted volume (m3) (Eq. 4)

The four relevant FRLs calculated Skid Emissions by using a Skid factor. See Equation 5.

SE (tC) = Skid Factor (tC/ha) x Skid Area (ha) (Eq. 5)

Skid Factor (SF) or carbon content in skid trail areas can be estimated by 3 methods:

1. SF = Carbon stock of unlogged (or pre-logged) forest. This is applied in the case skidding tracks are wide and completely cleared of vegetation (GOFC-GOLD, 2016)
2. SF = 88% of carbon stock of the forest strata. This is applied when vegetation is not completely removed and assuming dozers avoid trees with diameter > 20 cm (Kongsager et al., 2011). Ghana FRL showed that trees with diameter < 20cm correspond to 12% of vegetation. Applying this assumption, one country can realize its own study
3. Inventory of all deadwood (diameter > 10cm) lying or fatally snapped in skid tracks plus a buffer zone of 2 m each side to appraise trees damaged by skidding. Deadwood can be sampled in sampling plots installed on skid trails.

Skid area is calculated based on width and length. A mean width can be obtained from several measurements. Although not mentioned in FRLs, width can be assumed at least equivalent to mean size of dozer blades (3-4 m). Skid length is measured but there is no mention of tools used. We assume GPS, tape meter or human steps are utilized. The whole sampling approach is schematized Figure 4. Also, area can directly be assessed by high resolution RS (GOFC-GOLD, 2016).

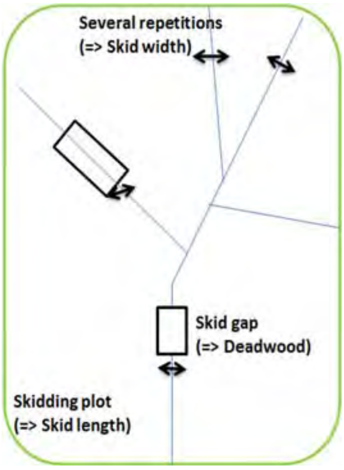

Figure 4: Sampling of skid trails

LIF for logging roads and log landings

Under some accounting schemes, roads and decks (but also ponds and camps) are counted as deforestation because they show up in moderate resolution imagery analysis (e.g. Landsat), and their emissions can be addressed through Stock-Difference approach (see Part 1). However, the direct correlation with logging makes it logical to include all sources of emissions under timber management (Suriname FRL). In that case, Gain-Loss method and EF per cubic meter extracted are applied, same than for skid trails. Emissions from roads and decks can be calculated as below:

1. Road and Deck Factor corresponds to the carbon stock of forest strata (GOFC-GOLD, 2016)
2. Road area is estimated either directly by RS or based on a mean width (repetitions using GPS or RS) and road length (using GPS and a vehicle, or RS)
3. Deck area is estimated in each deck or only in one or two decks to get mean value. Mean area is then multiplied by the number of decks in the active area.

Total Emission Factor (TEF)

Summary of options to determine/measure field parameters: a summary of different options recommended to measure parameters necessary to calculate EFs is presented Table 7. The IPCC has classified the methodological approaches in three different Tiers, according to the quantity of information required, and the degree of analytical complexity (IPCC, 2003, 2006). EF is generally determined by default in Tier 1, nationally in Tier 2 and by higher order methods in Tier 3.

Table 7: Measurement options and corresponding IPCC Tier

Emissions	Measurement options		
	Tier 1	Tier 2	Tier 3
ELE			
Extracted logs			Inventory
LDF			
Wasted logs	20% of tree biomass	= volume of tree – volume of log	Inventory
Felling Deadwood			Inventory
Felling gap area			High resolution RS images (drone photo)
LIF [Skid]			
Skid Factor		- Carbon stock of trees > 20cm - Carbon stock unlogged	Inventory
Skid width and length		Average dozer blade	Tape meter, GPS
Skidding gap area			High resolution RS
LIF [Road and Deck]			
Road Factor / Deck Factor			Carbon stock unlogged
Road area		LCoP threshold width (40m)	RS, Tape meter, GPS-Car
Deck number			Counting, RS
Deck area			Tape meter, RS

Calculation: table 8 summarizes the method to calculate each component of the Total Emission Factor. This table highlights required correspondence between emissions and associated log volumes.

Table 8: Correspondence between emissions and associated extraction (to calculate EF)

Sampling plot	**Emissions** (tC)	**Corresponding vol.** (m3)	**EF** (tC/m3)
1 felling gap	Extracted log	Vol. of the log extracted in the felling gap	ELE
1 felling gap	Wasted logs + Killed trees		LDF
1 felling gap	Extracted + Wasted + Killed		ELE + LDF
1 skidding gap	Deadwood or Removal	Vol. extracted via this trail	LIF [skid]
1 road section	Forest removal	Vol. extracted by this road	LIF [road]
1 log deck	Forest removal	Vol. stored in this deck	LIF [landing]

2.4. Sampling approach to determine logging EF

Exhaustive measurement of carbon parameters in concession area is too constraining. All countries adopt a sampling approach with different sampling methods and units. See examples in table 9.

Table 9: Sampling method developed in FRLs for calculating logging EFs

Sampling items	**Sampling units**	**Sampling repetitions (FRL and Pearson)**
Extracted log (diameter and length when possible)	Felling gap	46-105 per concession (Pearson et al.) 25 per concession (Suriname FRL) 31 per concession (Gabon and Medjibe, 2011)
Wasted logs (same)		
Felling DW (same)		
Biomass loss from skid trails	Skidding gap	164 per concession (Ghana FRL) 39 per concession (Gabon; Medjibe et al., 2011)
Biomass loss from roads	Road section	11 per concession (Ghana FRL)
All above items	Concession	1 to 4 (Pearson, Ghana, Congo) and 10 (Suriname) concessions on a wide range of terrain conditions, extraction intensities and management types

In conclusion, specific methods exist to estimate logging emissions. An interesting point is that they are generally “in-house” method i.e. based on data ordinarily produced within Forest Services.

However, the Volume method does not capture emissions from post-harvest gardening, small-scale logging, etc. Further review is necessary on how these issues are considered in international methodologies and FRLs. Anyhow recent developments in technical guidance for inventory are key sources of information for tropical forest country governments to apply such methods.

3. Potential in PNG to estimate logging emissions

In order to estimate direct emissions from logging, PNG needs to acquire historic data of timber volumes produced and develop a sampling plan to calculate logging EFs. Actually routine activities of forest management conducted in PNG Forest Authority generate a lot of relevant data. This Part describes information collected from ordinary forest monitoring and examines possible utilization for determining AD and EF. Statements reported in this Part can be subject to further investigations.

3.1. Activity Data

Information collected on harvested volumes

All logs produced by individual felling or by extraction of merchantable species during the clearing of skid tracks and decks are stored and scaled in log decks. Log scaler is an agent of the logging company who has a license issued by PNGFA and PNGFA controls about 10% of records. For each log, there is a record of diameters, lengths, and the corresponding Setup number. Logs from merchantable species extracted during clearing of ponds and camps are attributed to Setup following Annual Logging Plans. For roads it is a bit more complex as roads cross several Setups, and they are set before operations. For royalty reason, volumes from road clearing are spread out along the road to attribute logs equally between Setups (and corresponding landowner groups) deserved by the road.

Diameter data are reported in 'Log scaling record sheets' and volume data in 'Setup scaling sheets'. Setup scaling sheets are sent by project to province and regional (or Area) offices which store data in regional database. Area data are transferred to the central database of Forest Services Directorate (FSD) located in PNGFA headquarter and are used for policy design (part of FSD Annual Report), verification of exported volumes and royalty calculation (fig. 5).

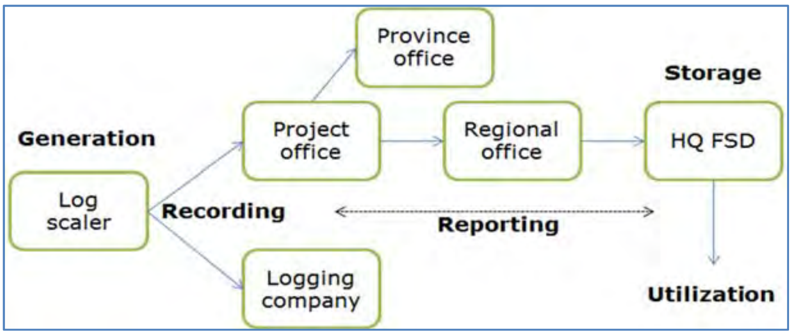

Figure 5: Flow of harvested volume data in PNGFA from scaler to central database

Total volumes in closed Setups are reported as result in next Annual Logging Plan (ALP). The production of ALP and thus the issuance of volume data do not follow fiscal calendar. However, 'FSD Annual reports' showing yearly production by province and project are submitted in the beginning of each year. So all timber produced the previous year in Setup already closed is available. The national database is physically corresponding to an Excel matrix stored in FSD (fig. 6).

Volume By Province By Project 2010 to 2017											
		YEAR	2010	2011	2012	2013	2014	2015	2016	2017	FCA Totals
PROVINCE	TP/TL/LFA/FCA/FM	PROJECT	VOUME(M3)	VOLUME(M3)	VOLUME(m3)	VOLUME(M3)	VOLUME(M3	VOLUME(M3)	VOLUME(M3)	Volume(m3)	Volume(m3)
Western	tp-1-7	Wawoi Guavi	232747.307	222570.043	198255.760	171974.345	305729.733	280279.295	144392.602	213124.112	
	TP 1-8	Makapa	140164.717	193186.458	182555.337	159193.595	233312.401	148087.249	151819.45	131449.546	
	TP1-10	Wpim Tapila				42334.565	6680.803	54651.185	49750.388	45000.673	
	TA 01-51	Ziezu TA	306.510								
Gulf	TP 2-12	Turama	77913.992	149325.462	159407.660	161191.704	150806.184	215777.466	165521.723	125558.284	
	TP 2-12 A	Turama Extension	64803.801	92318.548	104134.970	108014.763	144703.184	185001.056	79963.138	115626.302	
	TP 2-14	Vailala Block 1	67066.237	74163.068	63636.038	50028.877	53415.522	84855.962	87029.241	70744.914	
	TP 2-15	East Kikori	0	13103.348	25068.445	11971.148	16466.171			0	
	TP 2-16	Vailala Block 2 &3	114337.272	110474.244	85347.283	65904.831	45613.798	73028.000	49862.548	37812.894	
	TA 02-09	Eia River	340.618	264.810							

Figure 6: View of the Excel matrix in PNGFA-FSD storing Volume data

The matrix contains key information for calculating emissions such as provinces with active concession, cutting authorization types [Timber Permit (TP/TRP), Timber Authorization (TA), Forest Clearance Authority (FCA), Forest Management Agreement (FMA)], project concession name, and annual timber extraction (m3) here for 2010-17 but data are available from 2000 (except for 2004).

Potential for determining Activity Data

PNG dataset of actual harvested volumes needs to fill certain requirements to produce reliable AD for emission calculation (see Part 2). Findings for the dataset available in PNG are summed Table 10.

Table 10: Conditions of the volume dataset to calculate emissions are filled in PNG

Conditions	PNG potential	Explanation
All concessions	Yes	All projects are monitored
National scale	Yes	Provincial & regional production reported to central DB
Annual data	Yes	Issued each February in FSD Annual Reports
Period of > 10 yr.	Yes	2000 -2018 (data digitized from 2010)
Reliable sources	Yes	PNGFA official records
Accuracy	Yes	Review by PNGFA supervisors, operators and landowners. Possible errors of 5% (pers. com.)

It is noteworthy that PNG has a specific method to measure log dimension on the field. This method is based on the measurement of a certain part of the log. This aspect should be investigated more in details in order to fit with international guidance for conversion from log diameter to log and whole tree volume. Concerning reliability aspect, harvested volumes are reviewed by PNGFA, forest companies (which record diameters and calculate volumes), landowners (for royalty reasons) and export data auditors. It seems that ILG groups are more and more proactive in the control of scaling and acquire means for that (accounting capacities, light material such as calculators, etc.). However, FSD evaluates possible errors in recording, reporting and diverse artifacts at more or less 5% (FSD, pers. discussion). Also, 10% of the scaling is checked by PNGFA supervisors in log ponds. For quality control of carbon estimation, an exhaustive verification is recommended ideally. In FRI study on exported volumes (2015), records of harvested volumes were found to be incomplete and inconsistent but data can be easily collected hence. Recommendations were made for comparing central FSD data with data in logging companies and export databases (SGS).

3.2. Emission Factors

Information collected about field parameters

Figures of biomass loss caused by extraction, felling, skidding and hauling activities are required. Two types of management activities in PNGFA generate information on such field parameters:

① Recording of log volumes extracted during the construction of infrastructures (see Section 3.1)

② Monitoring of operations to evaluate the compliance of operations with 1996 Logging Code of Practice (LCoP) by supervisors. Table 11 highlights correspondence between field parameters assessed in routine monitoring and the ones to be assessed for carbon monitoring.

Table 11: Threshold values checked for carbon parameters in routine monitoring

Thresholds checked for operations' control	Indications for carbon monitoring
Width < 40 m	Forest removal from roads
Area < 0.25 ha per setup	Forest removal from log landings
Width < dozer blade (current LCoP) Area < 10% of total setup area (proposed LCoP)	Area of skid tracks
Directional felling application	Deadwood due to felling
Total log wasted/abandoned < 5%; Stumps < 50cm	Wasted logs (stump, top and abandoned logs)

Results of LCoP monitoring are reported in 'Field assessment sheets' but not as quantitative values. Apart of that, the size of infrastructures is recorded in Setup logbooks together with Setup scaling sheets. See Table 12 for a summary of field information that is effectively and regularly gathered.

Table 12: Carbon-related information available from PNGFA routine control of logging operations

Sources of degradation		Data (unit)	Source documents
Logging infrastructure	Forest Clearance for Camp sites	Length & width or Area [ha]	Camp plan
		Merchantable timber volume [m3]	Setup scaling sheet
	Forest Clearance for permanent roads	Length & width or Area [ha]	Road line Setup log book
		Merchantable timber volume [m3]	Setup scaling sheet
	Forest clearance for feeder and spur roads	Length & width or Area [ha]	Setup logbook
		Merchantable timber volume [m3]	Setup scaling sheet
	Forest clearance for log landings	Length & width or Area [ha]	Setup logbook
		Merchantable timber volume [m3]	Setup scaling sheet
	Forest clearance for skid trails	Length & width or Area [ha]	**No records**
		Merchantable timber volume [m3]	Setup scaling sheet
Logging damage	Disturbance from felling.to surrounding trees	Deadwood in felling gaps [m3]	**No records**
	Log wasted volume	Wasted log pieces (stump, top, buttress) [m3]	Post-harvest assessment sheet (in theory)
Log extraction	Log extracted volume	Merchantable timber volume [m3]	Setup scaling sheet but also in DB (see Volume info)

Skid trails and collateral damage are assessed on the ground from supervisor's eyes. Only 10% of total skid tracks are checked. There is no record of the area of skid trail (although timber extraction is recorded) or deadwood in felling gaps. Also, there is no scaling done for wasted log pieces. Post-harvest assessment would be done when project supervisors recognize the volume of waste logs overpasses 5% of total extracted volume in the Setup. But it seems that the assessment is rarely realized. To sum, Setup logbooks provide much information but not gathered into database, information is at the project side in the hands of field officers and logging companies.

Potential for calculating EFs

+ Extracted Log Emission (ELE): Setup scaling sheets provide volumes of log extracted which can be extrapolated into emissions (full tree) then reported to the log volume extracted in the felling gap.

+ Logging Damage Factor (LDF): for the inventory of deadwood caused by felling, challenges in PNGFA are reported as to be less at the capacity level (inventory method well known) than ability level (manpower, car and fuel). Then the emissions are reported to the log volume extracted in the felling gap to calculate LDF (tC/m3).

+ Logging Infrastructure Factor (LIF): for estimating carbon impact from roads and infrastructures (including skid tracks) by sampling, the challenge is to associate infrastructure areas with a known value of extracted volume. Setup logbooks provide infrastructure area for the entire roads, camps or decks, at the time they are built. But to obtain the length of a specific road section (ex.: road section associated to one setup), different methods can be applied:

- *Direct measurement*
- *Utilization of info from setup logbooks* when the area that is sought for sampling is directly available in Setup logbook. In the case where only length is available, an assumed width of roads of 40m and skid tracks of 4 m can be used.
- *Utilization of concession maps*: map is usually attached to logging plans, designed by operators and stored in PNGFA. Actual area of roads can be calculated based on Eq. 6.

  Road area (ha) = Road length on the map (m) x Scale of the map x Average width (m) (Eq. 6)
- *Proxy method based on extracted volumes*: the area of a road corresponding to one or several setups can also be calculated based on the volume of merchantable species that was extracted during the clearance of this road, and by using timber average density of 15 m3/ha. This method can be very useful for skid tracks. See Equation 7.

  Road area (ha) = Extracted volume (m3) / Average density (m3/ha) (Eq. 7)
- *Remote sensing* can be used for logging roads and landings with medium resolution and for skid tracks with high resolution. The purpose of this report is to examine potential of field methods but new technologies providing very high resolution can be interesting complements (Part 4).

+ Total Emission Factor

EF are expressed in ton of carbon (or CO2 equivalent) per cubic meter of timber volume. So each source of emission should be associated to a level of production (extracted volume). But, harvested volumes are known and data available only for the following areas: felling gaps, setups and concessions (as shown Part 3.1). Emissions due to felling (from extracted logs, wasted logs and deadwood) should be associated to the log volume extracted in one gap (1 to 3 trees) to calculate emission factors ELE and LDF. To calculate EF for skid trail, we need to know skid emissions and associated extracted volume. Skid emission is generally calculated based on forest removal as shown Part 2. The value of log extracted from one skid trail is not known because not usually recorded in PNGFA records. But the volume extracted in one setup is known/recorded so the skid EF should be calculated based on the sum of emissions from all skid tracks of one setup (ex.: 5 tracks) as Skid Emission and based on the volume extracted in this setup (which is known). Same approach can be used for decks, roads and ponds. Table 13 regroups the sampling strategy to get the right correspondence between extracted volume and sampled emissions. Associated volumes mentioned in red are generally not available, the option right below offers a possible alternative.

Table 13: Sampling strategy to calculate emissions (in red data generally not available)

Sampling options	Sources of emission (tC)	Associated volumes (m3)
1 Felling gap 1 Felling gap 1 Felling gap	Extracted tree Wasted logs Deadwood caused by felling	Log volume extracted from 1 gap
1 skid trail	Skid Emission (SE)	Extracted volume from 1 skid track not available
No of trails in 1 setup (ex.: 5)	Sum of SE for 5 skid tracks	Log volume recorded in the setup
Canopy openings	All gaps created by felling and skidding	Log volume recorded in the setup
1 log deck/landing	Deck Emission (DE)	Extracted volume from 1 log landing not available
No of decks in 1 setup (ex.: 3)	Sum of 3 DE	Log volume recorded in the setup
1 road section deserving 3 setups	Road Emission	Log volume recorded in 3 setups
1 pond	Pond Emission (PE)	Extracted volume from 1 log pond
No of ponds in 1 project (ex.: 2)	Sum of 2 PE	Log volume recorded in the concession

So basically every source of emissions can be accessed based on PNGFA ordinary information. But sampling methods to determine EF can become very time consuming as several repetitions are necessary. Complementary methods, tools or approach would be supportive such as shown Part 4.

4. Future potential based on on-going initiatives in PNG

PNG is engaged in sustainable forest management. As such many efforts are on-going to improve the management of data related to Forestry and the Logging sector. So to complete the comprehension of PNG potential in calculating logging emissions, we need also to analyze future potential created from initiatives in development in PNG Forest Authority under JICA project and further initiatives.

4.1. PNG-FRIMS data and functions

PNGFA is working on the enhancement of the Forest Resource Information Management System with the support from JICA. PNG-FRIMS principal types of information are presented figure 7.

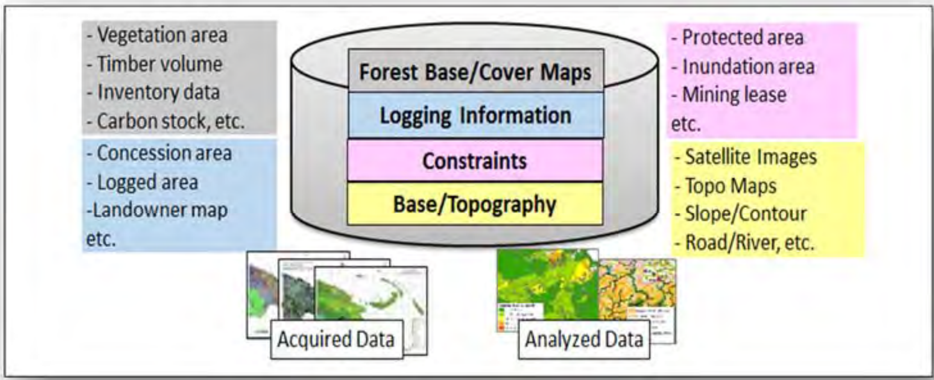

Figure 7: Principal types of information in PNG-FRIMS

Estimation of AD and EFs can be supported by the Forest Base Map and Forest Cover Maps as well as by improve spatial data relating logging, constraints and topography. Besides, several functions have been added to the development of PNG-FRIMS. Below we (1) describe relevant PNG-FRIMS components or functions, and (2) explain their possible utility in the calculation of emissions.

<u>1. Logging information.</u> Forest Information Mapping System (one of PNG-FRIMS components) stores data on logging concessions in the country notably project area, timber permit, associated landowners and moreover the potential in timber. Before land area open to concession, an inventory is conducted and timber tree species recorded in FIMS. Timber data are used to calculate project as well as national Annual Allowable Cuts. To consider regrowth, PNGFA-JICA project tries to improve FIMS by adding regrowth calculation function based on the assumption that timber volume will restore completely 35 years after harvesting started. In pilot provinces, actual logged area acquired from ALP maps is used for regrowth calculation. The regrowth function is expected to be used as a tool to evaluate evolution of historical emissions/removals calculated by other approach such as FRL.

<u>2. Remote Sensing and GIS</u> capacities in PNGFA have been improved through JICA project activities.

These capacities are key assets to estimate emissions from roads, camps and all elements visible in mid resolution images. Recently, net carbon emissions in two pilot provinces (West Sepik and West New Britain) have been calculated for the period 2000-2015. Forest Cover Maps 2000, 2010 and 2015 enabled determining land use transition areas. So the areas of deforestation (forest to non-forest) and forest degradation (primary to secondary forest) were determined. Annual degradation (obtained here from RS) can be compared with annual timber extraction. For comparing areas with volumes, an average timber density of 15 m3/ha can be used. This comparison allows (1) verifying the reliability of results from both RS and Volume methods, and (2) understanding share of logging in total degradation. But one big issue is to distinguish volumes from clear cutting and selective cutting systems. An option is proposed Part 5 related to FRL.

3. Digitalization by PNGFA cartographers of maps attached to Annual Logging Plans is supported in JICA project. ALP maps allow delimitating logged over areas but also picturing different sources of emissions. Roads are represented as lines and log decks and camps as points. Road line lengths can be utilized for calculating emissions as shown before. Camp and deck points facilitate locating sites for ground measurement. However, ALP map scale is too small (1/25000 or smaller) to provide reliable estimation of skid length. Maps are sometimes attached to Setup plans but not under numeric format (as the clearance system does not directly involve HQ). So although systematic recording is not possible, maps from Setup plans could help for calculations.

4. GPS and Drones: in 2016, the project conducted trainings and material provision on the utilization of GPS and ArcGIS software in six Areas and HQ of PNGFA. Since 2018, several training activities on drone technology (Unmanned Aerial Vehicles) were conducted in two provinces namely Central and West Sepik and in HQ with field officers from 6 provinces/Areas. Besides strong potential for forest monitoring, drones can be useful to monitor carbon parameters. See Section 4.2.

4.2. Potential of drones

This Section analyzes practical utilization of very high resolution images to monitor logging impact. Methods based on drones have to be deepened as this technology is still new and utilization still rare amongst forest countries (including industrialized countries). Drone associated functions can bring two main elements to support the estimation of carbon emissions: calculation of the size of roads and infrastructures and calculation of canopy gap areas.

1) Visualization of logging impacts

Drone images allow visualizing logging roads and infrastructures as shown figure 8.

Figure 8: Visualization of forest canopy openings due to logging roads or decks

Skidding tracks and felling gaps are also visible from high resolution imagery unlike from medium resolution. But canopy opening is sometimes not obvious to detect; clearing small areas of vegetation does not necessarily create forest gap. See example in figure 9.

Figure 9: Visualization of skidding trails from drone is not always continuous

2) Measurement of logging impacts (in m2)

Step 1: image ortho-rectification. To use drone photos for measurement purpose, spatially successive photos from drones have to be ortho-rectified by using software as GS Pro or Pix4D Mapper (fig. 10).

Figure 10: Ortho-rectified image of logged forest

Road and infrastructure size can directly be estimated by GIS software such as Goggle Earth and ArcGIS. Support is particularly useful for following parameters:

- Road sections specifically used in one-year production (where timber extracted volume is known)
- Log decks too small for RS detection or too overlapping logging roads
- Total skid track length which can be extrapolated from visible length and ramifications/forks.

But emissions from wasted logs, deadwood caused by felling and deadwood (or forest removal) due to skidding cannot be obtained. They could actually be estimated based on openings in forest canopy. To avoid manual approach that may be not practical, time consuming and imprecise, additional steps should be conducted for automatic analysis (steps 2 and 3 below).

Step 2: image segmentation. Ortho-images are segmented (or normalized) by a software, for example 'ArcGIS mean shift tool'. Example of segmented image is shown figure 11.

Figure 11: Segmented image of a logged forest

Step 3: image classification. Segmented images are classified with ISO classifier. The 20 color classes are reclassified manually in two categories, for example: vegetation (in green) and canopy gaps including roads, trails and felling gaps (in beige). See figure 12.

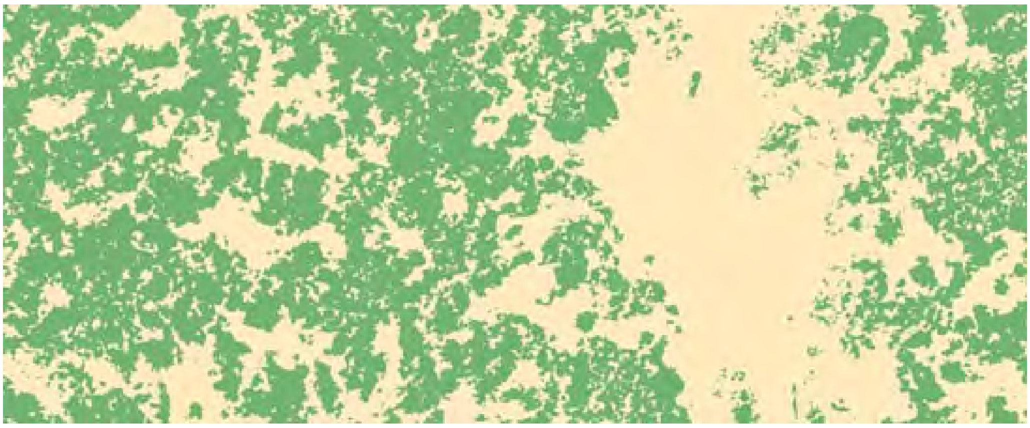

Figure 12: Classified image of logged forest

As minimal polygon area is small (20cm x 20cm), different backgrounds (vegetation vs. soil) can confidently be separated. For illustration, the image figure 12 shows a vegetation area of 11.63 ha and gap area of 10.60 ha. In this forest patch, the gap ratio is 47.68%. For the purpose of measuring only felling and skidding gaps, polygons corresponding to roads have to be removed.

3) Estimation of the gap factor (tC/m2) and emissions (tC)

Using drones, logging emissions (tC) can be calculated by associating to removed areas (m2) a gap factor expressed in tC/m2. For a broad estimation of the Gap Factor, the carbon content of the forest strata can be used (this assumes a final stage after logging of zero biomass). For an improved estimate, an emission factor of canopy gaps can be acquired by ground inventory. Deadwood per hectare in skidding/felling gaps can be measured by field sampling. This is a way to calibrate carbon content in areas recognized as gap. This method actually corresponds to a GOFC-GOLD (2015) recommendation.

4.3. Other initiatives

This study is conducted in the framework of the JICA-PNGFA project. As information on further initiatives may need details and updates we provide here outlines. The objective is to show potential contribution of such initiatives for PNGFA in calculating logging emissions in near future.

1) Decision Support System (DSS)

DSS is developed in PNGFA to be a centralized web based application that is envisioned to collect, store and process forest information, and can be accessed on a 24/7 basis by the owners and stakeholders. Amongst expected modules, the 'Harvest management' module will regroup data on log scaling, scaling check, logs and defect volume calculation (PNGFA, 2012). Harvest figures are planned to be integrated once basic information (project agreements, ILGs…) is completed. The objective is to support the calculation of royalties for communities and levies. For this reason, DSS is expected to be a reliable dataset of harvested volumes. DSS rapid operationalization is critical to implement the Volume method by providing an effective tool to ensure acquiring data more rapidly and accurately.

2) SGS (*Societe Generale de Surveillance* = General Monitoring Company)

SGS is a Swiss private company involved with PNGFA in the control of transparency and accountability in the Forestry sector. SGS possesses a solid database on export and payments (PNGFA, 2012). SGS dataset can be used in different ways:

- Utilization of SGS dataset on harvested volume (if available) already cleansed or analyzed
- Evaluation of the consistency of FSD data by comparing 10% tracked log records in SGS with data in logging companies and PNGFA field offices. Data should be similar as SGS data are expected from FSD records.

3) Timber Legality Verification systems (TLS/TLVS)

PNG is currently establishing national Timber Legality Standards (TLS) and Timber Legality Verification System (TLVS) with the support from FAO and the European Union. The certification will allow a development of the trade of sustainable timber from PNG (EU-FLEGT website). One of TLS components surveys the chain of custody from production to export. So TLVS may be able to improve the reliability of harvested volume data. Also, general support should be provided from this initiative to the Volume method mas it is a good engine for improving volume data and management systems.

4) Multipurpose National Forest Inventory (NFI)

NFI led by PNGFA with the support from FAO and the EU is currently collecting information on biodiversity, timber volume, non-timber forest products, carbon stocks, soil, etc. (FAO, 2019). Results from the second phase (field inventory) could be useful to deliver key information for the calculation of logging emissions such as:

1. Update and precision of Above Ground Biomass (AGB) for different forest strata will provide better estimation of emissions from parameters accessible through Remote Sensing
2. Sample measurement of deadwood reported to concession area can be used in a simplistic approach to estimate emissions from felling and skidding gaps.

5) Summary

Most of future initiatives have the potential to facilitate volume data management. The originality of JICA project is that it may facilitate calculating EF by improving field monitoring methods. Contribution from PNG-FRIMS and further relevant initiatives are summed Table 14.

Table 14: Future supports from PNG-FRIMS and NFI in the estimation of logging EF

On-going Initiatives	**Methods/systems**	**Parameters that can be estimated**
Collect Earth FAO) and pilot (JICA)	**RS** (30m) / GIS	- Deforestation and Degradation areas - Roads areas
PNG-FRIMS (JICA)	Digitizing of **ALP**	- Road areas - Infra. location
	GPS / **Drone**	- Canopy gaps (felling / skidding DW) - Infrastructure
NFI (EU, FAO)	**AGB** updates	Road or Infra Factor
	Deadwood info	DW in Fell/Skid gaps
Other	**Decision Support System** / SGS database	Volumes (acquisition and storing in a central database)
	Timber Legality Standards (**TLS**)	Volumes (improve data quality and management)

5. Integration of the Volume method in PNG’s FRL

The estimation of the logging impact can allow determining a large part of emissions from forest degradation in countries like PNG where timber production is the major source of degradation. This

Part describes procedures to integrate the Volume method in current PNG's FRL methodology, strategic choices associated with this option, and a sampling plan to develop a logging EF.

5.1. Methodological choices

Several countries developed methods that are specific to one driver of forest degradation. They are set out table 15.

Table 15: Methods specific to degradation drivers developed in FRLs

Countries	Degradation drivers accounted by specific methods
Guyana	Logging
Suriname	Logging
Congo	Logging, fuel wood collect
Ghana	Logging, illegal logging, fire, fuel wood collect
Nepal	Fuel wood collect
Chile	Fire

In PNG, almost all forest degradation is caused by commercial logging (PNG, 2017). Most of the small scale logging is considered in TA which are few significant in terms of volumes and emissions. The collect of fuel wood seems significant but no reliable records exist. For forest fire, no records exist but only 6% seems to occur in closed canopy areas. So PNG can justify calculating historic emissions based on two distinct and complementary methods (like in Suriname and Guyana): the 'Remote Sensing - Stock Difference' method to estimate emissions from deforestation and the 'Volume - Gain/Loss' method for forest degradation from logging (fig. 13).

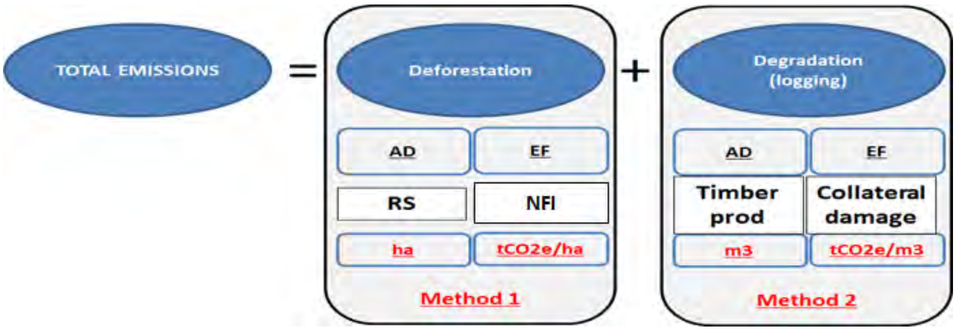

Figure 13: Estimation of emissions based on 2 distinct and complementary methods

The country process would follow a wise step approach. The first step corresponded (in 2017 FRL) to the utilization of available data from RS to estimate land use transitions (all types). The second step could provide a method specific to logging because logging is the major source of forest degradation and because volumes are available and information on collateral impacts more and more accessible. And the final step could provide details of degradation drivers other than logging which are less significant and more difficult to access. This step wise approach is summarized figure 14.

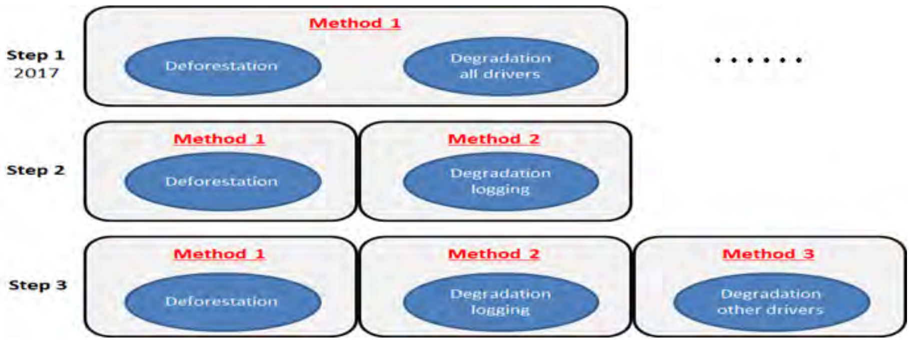

Figure 14: Possible step wise approach in FRL construction in PNG

5.2. Possible benefits from the previous FRL

Table 16 provides a summary of improvement fields that were identified by PNG in its current FRL and possible benefits from the Volume method.

Table 16: FRL improvement fields (PNG, 2017) and possible contribution from the Volume method

FRL improvement fields	Possible inputs from the Volume method
Method specific to Logging (AD and EF)	Volume method accounts emissions associated to timber production
Develop EF for each degradation driver	Vol. method accounts impacts on forest carbon from commercial logging only. EF for additional drivers of forest degradation can be developed in the future by introducing additional method
Include SFM (REDD+ activity) by developing 2 EFs one for improved and one for conventional practice	This method allows by the development of two EF, made possible from acquired methodologic experience, to compare carbon “efficiency” in two types of logging concessions (ex.: certified vs. not certified)
Consider other carbon pools	Deadwood needs to be inventoried in felling and skidding gaps.
Breakdown AD, EF and emissions at province level	Harvested volumes data available for each concession allows calculating emissions for district, province and national level

It is noteworthy that province estimation of historic net emissions is a good basis to develop provincial REDD+ activities. Better evaluation of logging impact, ER potential and associated financial benefits can be useful to decide suitable policies, actions and measures (PAM). Based on improvement for example in PNGFA-JICA project pilot provinces (West New Britain and West Sepik), these provinces will be good candidates for a provincial ER program (targeting reduce impact logging). Test in provinces can bring lessons for the nation-wide REDD+ Strategy. Different activities can be tested with stakeholders of the Logging sector such as PNGFA field supervisors and operators. Concepts and technologies brought by JICA project can support this initiative.

5.3. Simulation of the national FRL

To determine AD, timber volumes must be accounted as either degradation or deforestation according to the origin of timber (type of permit). Below is a proposition of sharing:

- Forest degradation for productions from TRP/TP, LFA and FMA
- Deforestation for productions from FCA by assuming all FCA areas will be clear cut by the end of projects. Many examples showed the utilization of FCA (which is basically a lease for developing agriculture activities) for Forestry purposes i.e. for timber. These examples will be accounted neither in deforestation (because not visible from RS) nor in degradation (because FCA decided to be integrated in deforestation). So total extracted timber, and total carbon emission, will be underestimated because it will not include FCA degradation. But at least this approach does not lead to overestimation and so it is considered as a conservative approach of carbon estimation
- Deforestation or degradation for timber issued from TA, the question remains because here also clearance is allowed although restricted to 50 ha. Anyhow TA represents less than 0.5% of total volume extracted so it could be conservatively neglected.

Based on this description, table 17 gives an example of Activity Data for PNG (nationwide).

Table 17: AD for the Volume method (total extraction FCA excluded). Source: FSD

Simulated AD based on extraction 2010-17 (FCA excluded). Source: FSD	
Year	**Activity Data (Mm3)**
2010	3.11
2011	2.65
2012	2.6
2013	2.79
2014	3.29
2015	3.64
2016	2.28
2017	3.45

PNGFA-FSD data can be compared with harvested volumes recorded in logging companies; with exported volumes (considering FCA and time lag); or with areas of degradation determined by Remote Sensing, as established in the first FRL (Collect Earth software using Hansen data).

To develop a logging EF, field parameters can be measured from two methods: information from Setup logbook (when available) or from sampling approach. A sampling plan should clarify sample plots, items, and number of repetitions. Table 18 proposes a simulation of such a sampling plan.

Table 18: Indicative sampling plan to develop a logging EF (based on examples from other FRLs)

Sampling units	Repetition	Examples of choice
Concessions	4	- 2 intensive: WNB, WS, W or Gulf - 1 moderate: NI, ENB, MA, MO, CE - 1 low: MA, Northern or MB
Felling gaps	200	50/concession
Skidding gaps	100	25/concession
Log landings	40	10/concession
Roads	Exhaustive	All roads of active setups (about 40 km)
Ponds	Exhaustive	All super deck of active setups (about 3)

Obviously, the zones with data already available are preferred. For instance, it could be advantageous to use PNGFA Permanent Sampling Plots and project pilot areas. On the examples of Suriname and Congo, concessions can be selected according to extraction rates. Because in PNG there are no certified concessions, this approach could provide a good option to differentiate concessions. An example of activities to sample field parameters is shown figure 15.

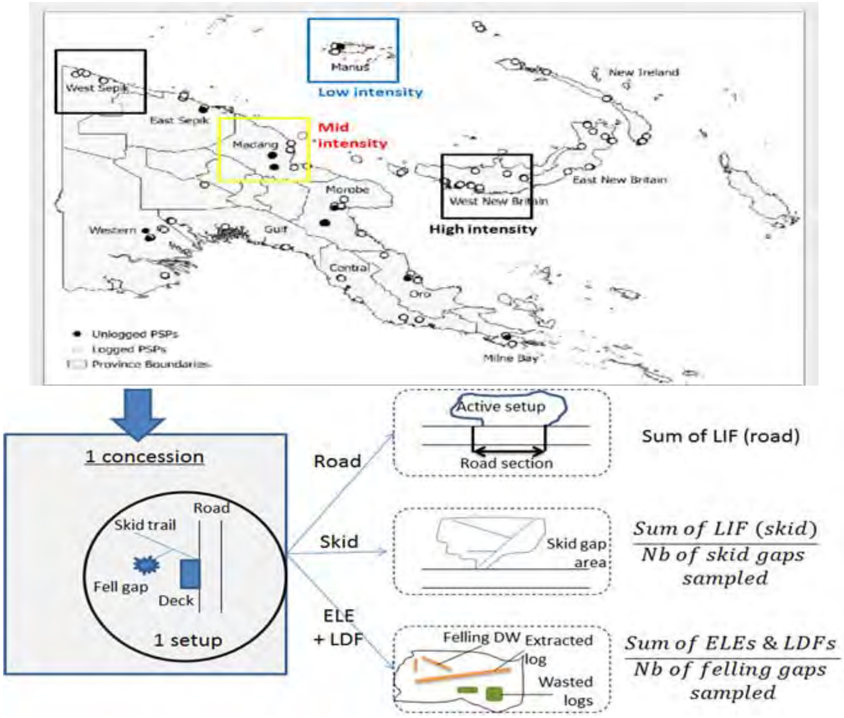

Figure 15: Proposition of plan for sampling field parameters to calculate total EF

TEF calculated based on existing data in FSD and based on this sampling plan can be compared with the Damage Factor of Congo (considering that it does not include road and infrastructure) or with the EF of PNG as found in FRI study on export volume (PNGFA, 2015).

To calculate total emissions, mean values of ELE, LDF and LIF are summed to get a value of total EF. EF is a constant. TEF is then multiplied by annual timber production to calculate total emissions. Table 19 shows a simulation by using EF from Congo and 3.6 to convert tC into tCO2e.

Table 19: Matrix simulating total emissions from logging in PNG. EF assumed = 1 tC/m3 (Congo Rep.)

Year	AD (Mm3)	Total EF (tC/m3)	Total logging carbon loss (MtC)	Total logging emissions (MtCO2e)
2010	3.1	1	3.1	11.2
2011	2.7	1	2.7	9.5
2012	2.6	1	2.6	9.4
2013	2.8	1	2.8	10.0
2014	3.3	1	3.3	11.8
2015	3.6	1	3.6	13.1
2016	2.3	1	2.3	8.2
2017	3.5	1	3.5	12.4

Total country emission in the Forestry sector is the logging emission added to emission from deforestation. Total emission obtained from two methods (RS for deforestation and Volume for degradation) can be compared with the RS method for deforestation and degradation (current FRL).

5.4. Input to carbon MRV system

Technical framework

Improvement of existing monitoring activities and innovations can be integrated into ordinary activities of forest monitoring to monitor carbon. See an option of carbon monitoring plan (fig. 16).

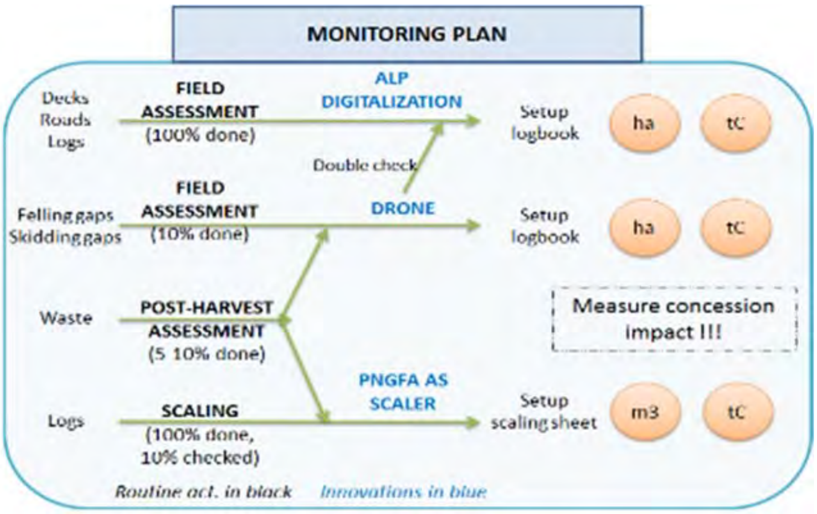

Figure 16: Carbon monitoring plan building on routine monitoring activities

Monitoring the indicators of carbon impact during routine assessment will foster following activities:

- Realization of log scaling by PNGFA officers

- Activation of post-harvest waste assessment
- Integration of field measurement of felling and skidding gaps in Setup logbooks
- Improvement of the accuracy of logging road and infrastructure areas.

Stakeholders

Logs could be scaled by PNGFA project supervisors and diameters double-checked by logging companies. This can increase reliability of volume data. Paper ALPs from operators could be digitized by cartographers in the Inventory and Mapping branch of FPPD. This could inform on Road and Infrastructure position in complement of the info on size already available. Knowing the position facilitates associating to a road section (or a log deck) a value of timber extraction. The objective is also to record their dimensions in numeric format to facilitate storage and reporting to regional and national databases. Annual emissions resulting from these different sources could be calculated by the REDD and Climate Change branch of FPPD. Emissions in each project every year would be available and could be reported to UNFCCC as requested in Biennial Update Report (BUR). See fig. 17.

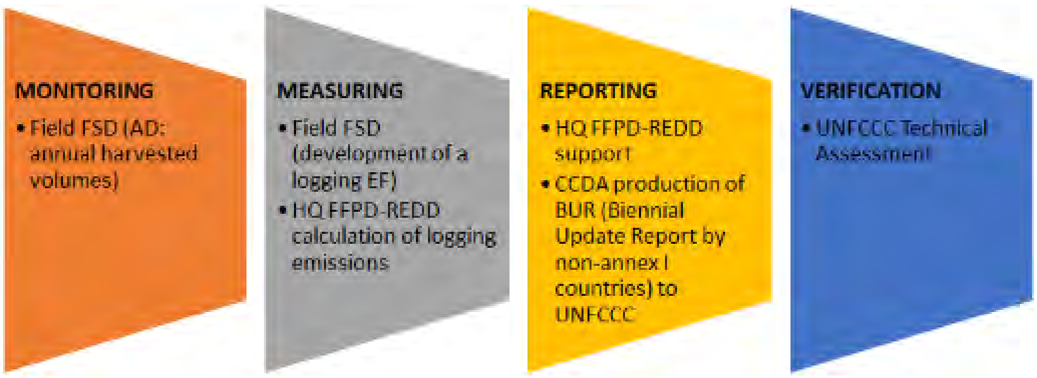

Figure 17: Possible Carbon Monitoring, Measuring, Reporting and Verification of logging emissions

6. Utilization of outcomes from the Volume method for Forest management purposes

The Volume method allows providing a value of emissions corresponding to the climate impact of field operations. This estimation is the central objective but in addition procedures necessary to develop this method produce different outcomes which can be key indicators for decisions on forest policy. The best example is the acquisition of a strong dataset of extracted volumes. Also, Emission Factor, as it corresponds to a quantification of environmental impact of operations, can be useful to compare the quality of harvesting practices in different countries, or within a country in different logging projects. Figure 18 gives a representation of main outcomes.

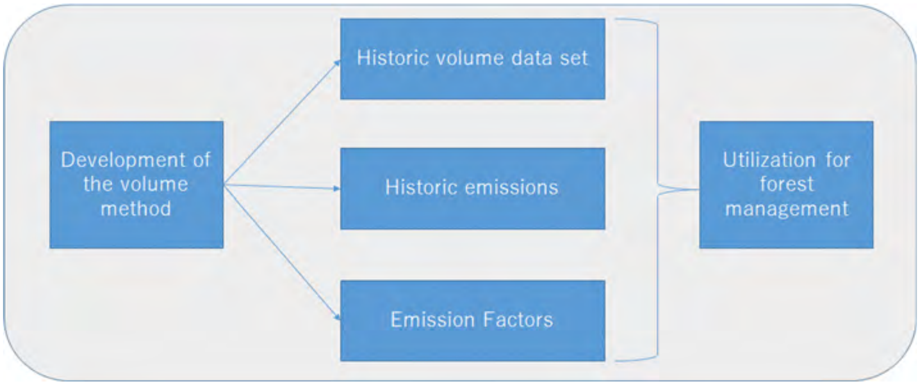

Figure 18: Main outcomes produced from the development of the Volume method

6.1. Utilization of the values of Emission

Applying the Volume Method requires a lot of resources. We can wonder what are the benefits associated to realize such efforts. This section studies the main contexts where VM can directly be utilized. For example, this method provides good proxy of forest degradation such as harvested volumes, practical examples of method for measuring impacts on the field, or again adapted equation and calculation procedures for initiatives that need to assess historic degradation (ex-ante emissions) and measure improvement after policies/measures application (ex-post emissions). So this method can be useful in initiatives based on ER performances at country level (REDD+) as well as at project-level (carbon initiatives) and, in a certain measure, for sustainable Forestry standards. This section details these three areas of possible utilization which are first summarized figure 19.

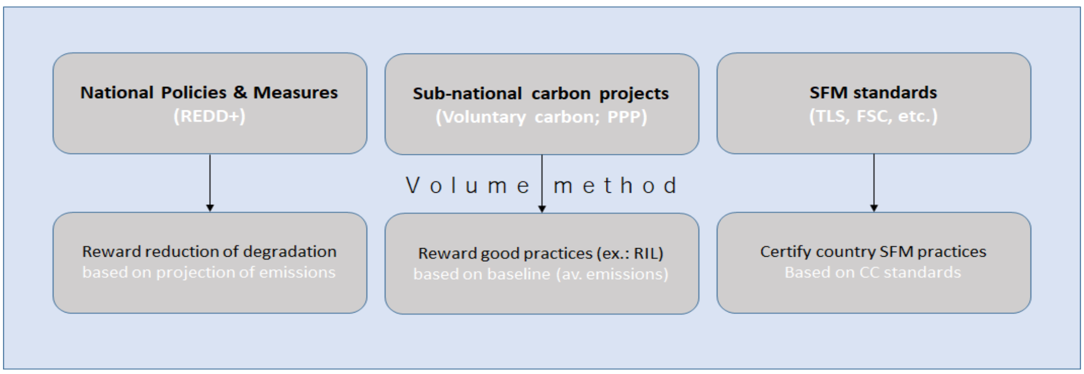

Figure 19: Contexts where and reasons why it is needed to evaluate carbon impact of logging

1- In the context of REDD+, the Volume method allows rewarding specific efforts in reducing forest degradation caused by logging. Efforts developed by REDD+ countries are mainly involving the preparation and implementation of different Policies, Actions and Measures aligned on the same objective of sustaining forest resources in production sites. The volume method allows producing figures required in ER Result Based Payment systems: make a baseline of past emissions (historic trend), a projection of future emissions (Forest Reference Level) and a measurement of annual actual emissions (MRV). This potential is particularly important in PNG because logging is a central element of the National REDD+ Strategy and in this timing because PNG enters in REDD+ Implementation Phase. Besides, the determination of logging emissions is a good way to show the weight/share of the sector among total forest degradation and total emissions (degradation plus deforestation). This can show or confirm priorities to abate emissions from the Land and Logging sectors.

2- In carbon projects developed by private operators or PPP (Public Private Partnerships), the Volume method can be useful to calculate the baseline of emissions and measure ex-post emissions. While developing a carbon project, operators need to choose a registered methodology for example in Verified Carbon Standards (VCS). Ideally, the project scale corresponds to one logging concession and project activities an improvement of practices such as Reduced Impact Logging (directional felling, introduction of improve chainsaws, etc.). PNG is engaged in the REDD+ process and as such the national or province level is privileged for actions. However, specific opportunities such as led by political pressure from landowners for developing activities relevant with land use based climate change mitigation may be considered by the government of PNG, maybe through nesting carbon projects to a whole province or national strategy.

3- Sustainable Forest Management (SFM) standards are more and more including a Climate Change component. SFM certification generally needs to show that timber production is mainstreamed with different objectives notably related to land tenure, social welfare or environment conditions (soil, watershed, biodiversity). Because of the tight link existing between the storage of carbon stocks in forest and climate change, levels of carbon emissions associated to productions are also part of main standards. In this sense, SFM standards and criteria can be associated with verifier parameters corresponding to elements that can indicate biomass loss occurring during logging. The Volume method is a method based on proxy and field parameters directly assessable on the field. So relevant examples of carbon verifiers can be provided by the Volume method.

6.2. Interpretation of timber volume figures

The unique outcome of having improved volume dataset is already a critical asset for forest management in itself. Examples of utilization of volume figures are shown below for a period of 8 years (2010-17) but as mentioned data can be accessed from 2000. Pre-requisite for analysis is to transform FSD raw database into format easy to manipulate in statistical software. Based on such a matrix, different analyses can be conducted. Note this section has for objective to show the potential i.e. what is possible to do from this method, it does not intend to include neither policy analysis nor propositions. First, complete dataset allows following total timber production over the time (fig. 20).

Figure 20: PNG total Forestry production from 2010 to 2017 (Million m3). Volumes from FCA excluded

Actual harvested volumes (from FSD) can be compared with key policy figures such as AAC Permitted Cut (issued in Project Allocation Directorate) or AAC calculated by PNG-FRIMS. And this comparison can be realized at different levels namely project, province and/or national.

It can also be interesting to view the evolution of timber extraction according to cutting authorizations as shown figure 21.

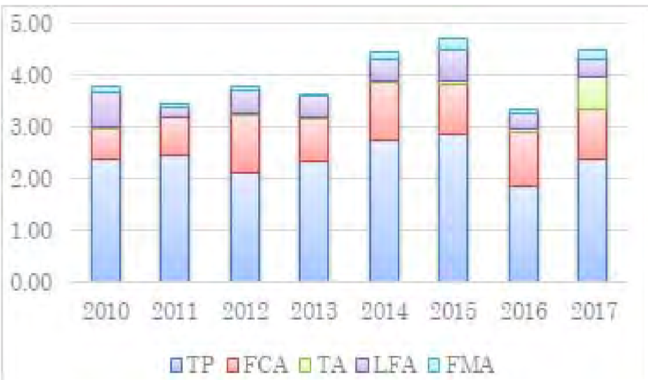

Figure 21: Evolution of timber production per cutting permit for the period 2010-17 (Mm3)

These figures can be used for adjusting policies or regulations according to main trends identified. For example, the trend shows here a dominance of permits existing before 1991 (TP and LFA) and FCA. At contrary, productions in TA are insignificant (less than 0.5%). TA includes many types delivered for clearing specific zones such as road. Such elements can be considered for future decisions.

Then, productions in each type of permit can be reported to the number of projects. This provides an average value of extraction in projects for each permit type (fig. 22).

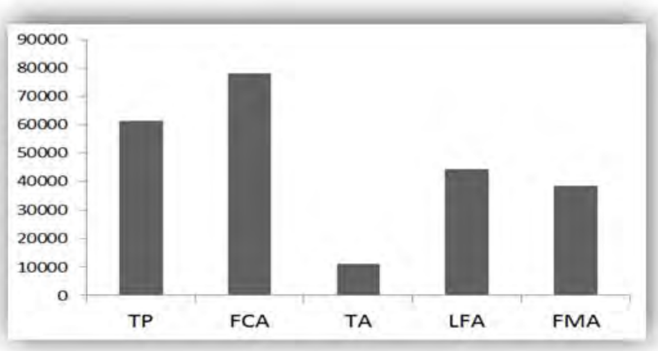

Figure 22: Mean project production for each permit type (m3/project)

In addition, national data can be broken down to infra-national levels. For instance, timber produced every year in average can be calculated for each province. See figure 23.

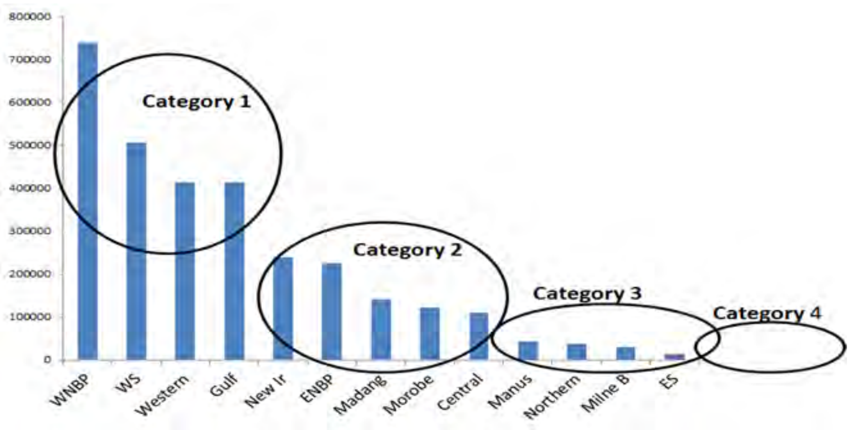

Figure 23: Mean annual (2010-17) production per province in m3

This figure allows categorizing provinces according to their production rate: 1- intensive, 2- moderate, 3- low, and 4- no extraction. Specific policies could be discussed accordingly.

6.3. Utilizations of values of Emission Factor

Relative magnitude of each emission source indicates where are priorities to curve damage collaterally produced during harvesting. For example, Pearson et al. (2014) found in several countries that LDF is greater than LIF which is greater than ELE.

LDF (felling) > LIF (Road/Infra) > ELE (log extraction)

Based on that, priorities can be chosen to reduce the damage specifically associated with felling. Examples of measure are to increase the number of felled tree in one felling gap, promote/develop directional felling techniques or other techniques of Reduced Impact Logging.

PNG's logging EF can be used to compare average sustainability of practices in PNG concessions with other countries. More sustainable practices are, lower is EF. In Congo DR whose timber production is comparable with PNG (around 4 million m3), EF is equivalent to Congo Rep. (1 tC/m3) while EF in Indonesia and Brazil is 1.5 tC/m3 and Guyana 2.3 tC/m3 (Pearson et al., 2014).

Logging Emission Factor

RoC/DRC > Indonesia/Brazil > Guyana
(1 tC/m3) (1.5 tC/m3) (2.3 tC/m3)

Similarly, EF can be developed then compared within PNG between provinces or concessions. But limitations associated to methodology implementation need to be taken into account.

Development of one EF can facilitate the development of further EFs because methodologies are well comprehended and developers (institutions) trained. The need to develop EF for both conventional and improved logging will be particularly important for rewarding countries efforts to implement sustainable forest management under REDD+ (Pearson et al., 2014). Only one EF would not be able to differentiate the policies that reduced extracted volumes to the policies that improved carbon efficiency of the extraction. In some studies, EF for conventional logging was estimated as double than certified concessions (FAO, 2003 and Billand et al., 2008). This shows that the work of sampling (to calculate EF) does not need to be realized twice. EF can be developed in only one type of concession (CVN or SFM) and the EF corresponding to the other type is estimated by using this assumption. Nevertheless, this assumption is only possible for countries which have a reliable way to differentiate concessions such as provided by certification schemes (ex.: FSC). If there is no objective way to differentiate concessions, like in PNG (no selective logging project under certification), EF need to be developed for different concessions and different times in one concession. This comparison within and between projects is shown figure 24.

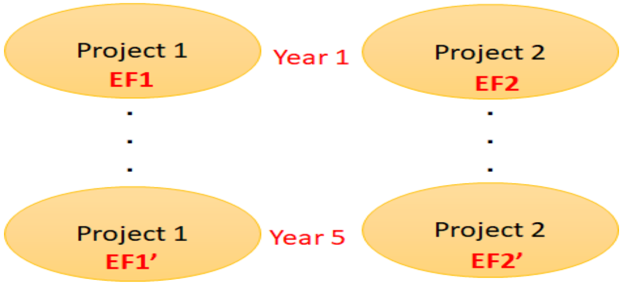

Figure 24: EFs and carbon efficiency compared within and between projects

EF becomes a tool to (quantitatively) appreciate the sustainability of practices. In this sense, logging EFs can be helpful in the development of systems to push operators for improving practices. Usual regulations set low levies for certified concessions and high ones for non-certified (the case of all concessions in PNG). One original system could set a levy (named Carbon or Environmental tax) and release it for concessions once they got certified (ex.: 50% release during the process of certification and 100% once fully certified). Taxing project operators as well as landowners could be considered. Anyhow, it can be interesting to index levy amount to the cost of certification by FSC for example. Practically, it will be like project developers have the choice in paying 10 000 USD to be certified by FSC or paying 10 000 USD over 10 or 20 years as PNG Carbon tax. The first option will certainly be preferred by most of operators because of new market opportunities created and by landowners because of a possible quicker recovery of their cutting rights (as regeneration period is reduced). New levy currently in discussion within PNGFA to be operable in 2019 could consider this system. It can be interesting to promote new tax as a system for PNG production sites to attract more foreign buyers. Current operators may accept more easily the idea of a new levy if their awareness is raised on such potential benefits.

Conclusion

Key findings

- The Volume Method (VM) is specific to forest degradation (method different than for deforestation) and specific to logging (not including other drivers in logged areas)
- VM is an in-house method as the determination of Activity Data is based on data and EF on information ordinarily collected by Forest services
- Most of data required to use VM is available in PNG Forest Authority (at least not less than in the four FRL countries cited along this report)
- The determination of AD requires historic dataset of volumes while the calculation of EF needs a sampling approach to inventory impact parameters
- Harvested volume data in PNG are stored in central database since 2000 and information on field parameters is available but not stored in database
- Challenging information types are deadwood from felling and skid track areas. They could be apprehended through field inventory or new technologies such as drones
- VM can directly be used in FRL calculation but also in carbon projects (baseline) and Forestry standards (indicators of impact)
- Outcomes from developing VM (values of Emission, EFs and volume datasets) can be useful for forest management
- Existing guidance are well developed for conducting the Volume method (IPCC and Pearson) and field inventories (Standard Operating Procedures, Winrock International).

Key advantages

- Logging emissions as calculated from VM can input current PNG Forest reference Level
- Emissions can be broken down at province and district levels
- Information on deadwood (in concession areas) needs to be provided. This helps promoting the consideration of carbon pools other than AGB and BGB
- Possibility in the future to integrate SFM in the scope of REDD+ activities (by developing two EFs)
- Efforts to improve volume dataset and information on impact parameters can lever a long-term improvement in forest monitoring
- Awareness raised on requirements for carbon monitoring can be considered for adjusting routine activities of forest monitoring (log measurement, road assessment, etc.)
- The development of VM allows building experience and capacities to estimate logging emissions and calculate logging EF using the VM

Main constraints

- The Volume method does not cover important sources of GHG emissions and removals such as regrowth, post-logging degradation (illegal logging, gardening, fire…) and degradation from other drivers
- Capacity and availability of technical experts for using VM for logging EF may be limited
- Technical support may be restrained in reason of limited scientific background (articles, guidelines, etc.) to evaluate carbon losses from felling, skidding and hauling
- Options to financially support the development of an additional method for FRL may be limited by uncertain schedule of activities of main REDD+ donors in the country
- Rewards for creating additional methods are uncertain in future REDD+ RBP schemes.

Next steps

- Complementary review of international guidance and FRLs to evaluate methods to consider regrowth, post-logging degradation, and degradation from other drivers
- Compare total emissions and accuracy using both 'Remote Sensing' and 'RS-Volume' methods for strategic decisions in the construction of future FRLs
- Develop opportunities of technical support by promoting Research studies in PNG (links with Pearson's team notably)
- Develop opportunities of financial support by highlighting future initiatives that will benefit from field estimation of logging emissions such as national/sub-national ER-Programmes, carbon projects or standards of Sustainable Forest Management
- Develop methods of measurement and monitoring especially for missing emission sources (felling and skidding gaps) that can help in the short-term for calculating EF and in the long-term for daily forest monitoring (notably drones)
- Rapid operationalization of DSS to improve management of actual harvested volume.

References

- Billand, A. Gourlet-Fleury, S. Sarrailh, J-M. 2008. Variation des paramètres carbone selon différentes contextes d'exploitation. Atelier COMIFAC, Paris.
- CCDA. 2018. GCF concept note. Implementation of PNG's REDD+ Finance and Investment Plan.
- Chave, J. Andalo, C. Brown, S. et al. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia, 145, 87–99.
- Congo. 2017. FCCC/TAR/2016/COG, NERF de la Republique du Congo. Improved version.
- FAO. 2003. Code régional d'exploitation forestière à faible impact dans les forêts denses tropicales humides d'Afrique centrale et de l'Ouest.
- FAO. 2015. Global Forest Resources Assessment 2015, Desk reference.
- FAO. 2018. From reference levels to results reporting: REDD+ under UNFCCC. 2018 update. Rome.
- FAO. 2019. NFI. http://www.fao.org/in-action/png-multipurpose-national-forest-inventory/en/
- Ghana. 2017. FCCC/TAR/2017/GHA, Ghana's National Forest Reference Level.
- GOFC-GOLD. 2016. A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals caused by deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation Report Version COP19-1. www.gofcgold.wur.nl/redd/sourcebook /GOFC-GOLD Sourcebook.pdf
- Guyana. 2015. FCCC/TAR/2015/GUY, The Reference Level for Guyana's REDD+ program.
- IPCC. 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use; Prepared by the National Greenhouse Gas Inventories Programme ed H S Eggleston, L Buendia, K Miwa, T Ngara and K Tanabe (Japan: IGES)
- Kongsager, R. Napier, J. Mertz, O. 2011. The breakeven price of REDD-credits: a case study from Kade, Ghana. Environmental Management
- Medjibe, V. P. Putz, F. E. Starkey, M. P. Ndouna, A. A. and Memiaghe, H. R. 2011. Impacts of selective logging on above-ground forest biomass in the Monts de Cristal in Gabon. For. Ecol. Manag.
- Pearson, T. R. H. Brown, S. and Casarim, F. M. 2014. Carbon emissions from tropical forest degradation caused by logging. Winrock International. Environ. Res. Lett. 9 (2014) 034017 (11pp).
- PNG. 2017. FCCC/TAR/2017/PNG. PNG's national REDD+ Forest Reference Level.
- PNGFA. 2012. Business analysis of PNGFA's existing information systems.
- PNGFA. 2015. Progress of work on Estimating Degradation from Selective Timber Harvesting in PNG using historical data on Log Extraction: Proxy Approach. FAO and FRI.
- PNGFA/JICA project. 2018. GPS/GIS training report under PNGFA/JICA project. Intern document.
- Suriname. 2018. FREL for Suriname REDD+'s programme.
- TLVS website. http://www.euflegt.efi.int/what-is-flegt