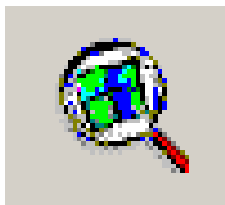


**Japan International Cooperation Agency (JICA)
Department for Forestry Development (DFD),
Ministry of Agriculture and Rural Development (MARD),
Socialist Republic of Viet Nam**

TECHNICAL MANUAL ON OPERATION OF GIS SOFTWARE

**Technical Manual Series on
the Feasibility Study on the Forest Management Plan
in the Central Highland in Socialist Republic of Viet Nam**



December 2002

**Japan Overseas Forestry Consultants Association (JOFCA)
Pasco Corporation**

Acknowledgement

This manual is prepared for the technical staff of Kon Tum province and surrounded provinces for forest management planning. The foresters are expected to use database of a GIS that were prepared by the JICA study team. The base data was constructed during the study and contributed for the analysis of the Master Plan on Kon Plong District Forest Management.

This manual consists two parts. The first part introduce how operate the GIS software Arc View (Esri 3.1/3.2). And the second part explains the procedures how to analyze forest conditions and how to organize map data for drawing up a forest management plan of a forest management unit. Officers for forest Management-Planning can process the GIS data on Kon Plon District for each area of Forest Enterprise following the process explained in this manual.

Items how to interpret base map to GIS digital map data, how to preparing satellite TM data to polygon data are not included in this manual,. These data is processed by GIS Experts **Pasco International Inc** and stored on a CD attached on this manual (an envelope on last page). To create these data is needed special knowledge, technique and instruments; therefore, the study team presented the processed results for applicable use of GIS for Management Planning.

To develop the techniques how to use GIS, please see the official manuals on Arc View, more detail. This manual shows limited functions only for the direct use of tasks on forest management planning for Forest enterprises.

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Appendix Contents of the attached CD

Part I Basic techniques for Arc View operation

1 Preparation for Arc View operation (Install the System)

First, you need to install Arc View software to your computer. Installing procedure is same as other software such as Office (Word, Excel, etc.).

Set the Arc View CD to your CD driver -> Open file list the CD using explorer -> Find a file named "setup.exe" then click the file by left button of your mouse. -> Follow the instructions that are shown by your computer. Key in user's name, and CD key or serial number of the CD.

To use the Arc View software user is requested hardware key to avoid illegal copying. The hard wear key is provided with software when you bought. Therefore you need to set (set the hardware key on printer/parallel port. Printer line can be connect to the hardware Key.

2 Let's see the GIS

2.1 Prepare GIS map data (Transfer the data from attached CD to your computer)

Before starting Arc View (Esri) you need to prepare map data files on your computer. First you need to create folders for map data to store. In this practice section, for example, make a folder "GIS practice" on root directory (usually C:) of your computer, and under the "GIS practice" make sub folders "shap file", "legend", "project", "layout", and "tables". How to use these folders will explain later. Process

of this practice parts you will create many figures, tables, therefore systematic filling system is important to use GIS program for efficient operation. Then copy the files from Data CD attached this manual from same named folders to your computer.

The Data files for this practice is follows

try admini.shp try commune.shp tryfe.shp trylanduse.shp
trystream.shap

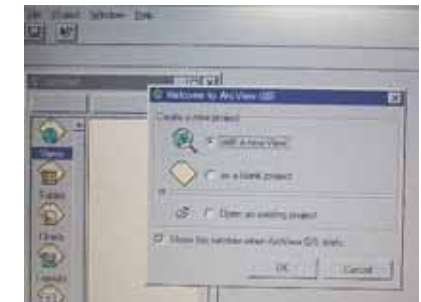
2.2 Start GIS (Esri 3.1/3.2)

Let's start Esri.

Click start button on left side bottom of the windows -> Programs -> Esri -> Arc View -> Arc View 3.2/3.1

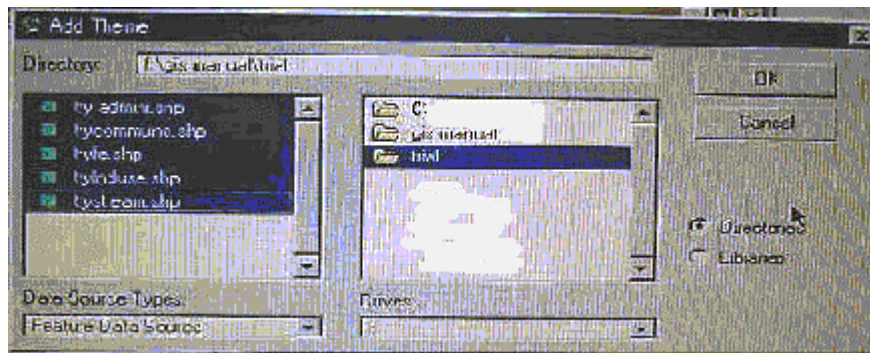
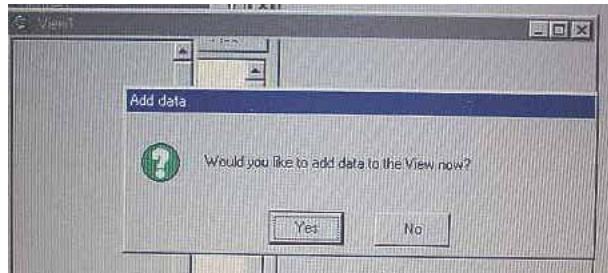


Then arc view first window will come

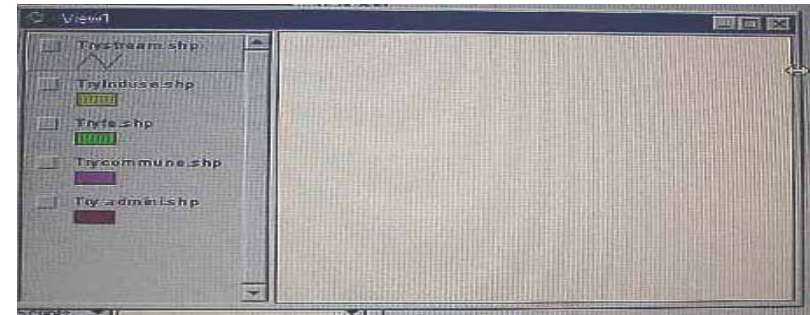


Add mark on "with a new view" to "Welcome to Arc View GIS" box, then

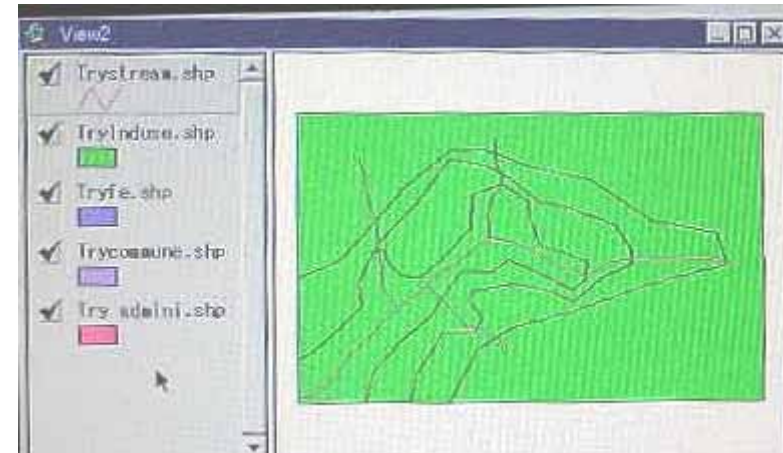
click “ok” button. Arc View asks whether you want to add data or not. Click “yes” button. Then Arc View asks what data should be added.



Change drives to the folder where the practice files (shape file) stored. In this practice the target folder is located on root directory on drive C:, under the name of “GIS practice” sub folders “shape file”. Then shape files list will arise on left side of the “Add Theme” box. Click the file names you want to use (If you want to select plural files, push shift key and click needed files.), then selected file name(s) will change blue color. Then click “OK” button. The first Arc View window will come on your computer screen as bellow figure. This window is called as “View window”. On right side map will drawn when you mark “L” on left side legend part of small squares.

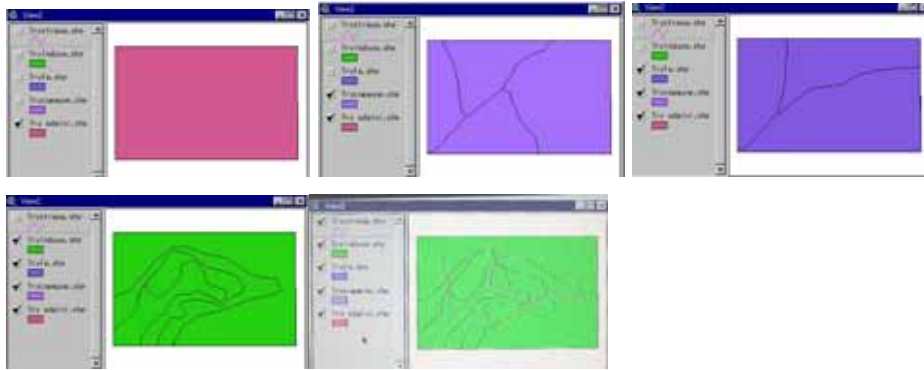


Give check mark on every legend items/shape files. Then Arc View draw map/polygons from bottom item to top item. The screen will change following figure.



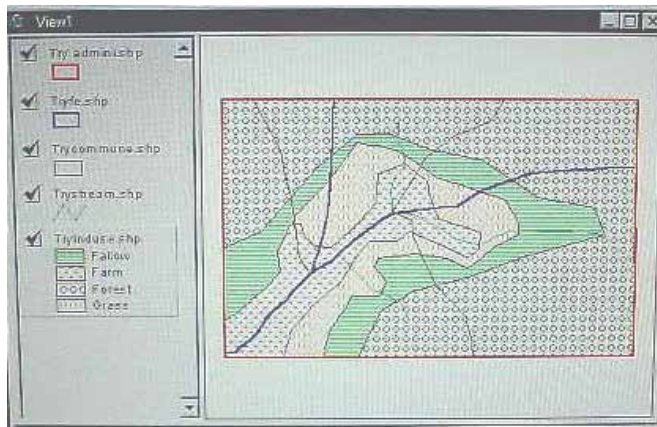
This sample data shows a sample area by landuse, administration units (communes), Forest management units (Forest Enterprises), and river lines in simplified pattern. “Arc View” drawn outer boundary of the area as tryadmini.shp, then on the same screen Arc View draw “try

commune.shp”. Same process, FE (Forest Enterprise), land use, and stream are drawn. Finally land use pattern and stream are remaining on the screen.



Arc View draw map data from left up to right down above, then finally you can see the last picture above. To describe every factors on the screen, you need to arrange legend by describing order and pattern that are drawn by foresight, back sight or outline.

A sample of right figure shows every items on a screen of this practice data.



Note: Basic knowledge on Esri file pattern

Esri Arc View files are basically consist of three patterns of files, **.shp, **.shx and **.dbf. “shp” file store polygon data that are defined shape of polygons. “dbf” file store tables that are defined characters such as ID, category, etc. using dBase IV format. The polygons on GIS map can display different colors, and patterns using dbf file categories. “shx” file is defined the locations (coordinates) of the polygons. “shx” file is controlled only by the computer, therefore, ordinary user can not access “shx” file and need not to consider this file. After you made some amendment to a shape file, computer will make several files automatically such as “**.sbx”, “**.sbn”. These new patterns of files store amendment processes. If you want to copy a shape file data to other computer or directory, you have to copy all patterns of files under the same name and different extension.

2.3 How to arrange legend pattern

A polygon can draw two types. One is fill a color uncolored pattern. If you use pattern only black and white picture also described. Second is outline. If you use outline Arc View drew these lines on other shape screen, therefore you can see several categories of shape on a View screen.

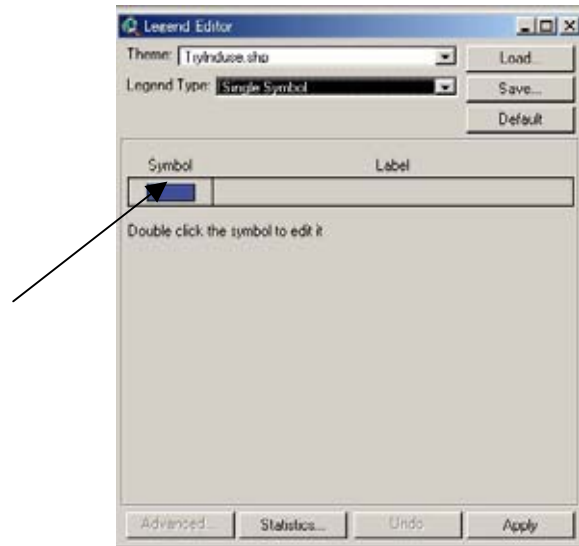
2.3.1 Drawing order arrangement

First, arrange drawing order. In this sample, land use is base, and to add FE boundary, Commune boundary, and finally drew total area boundary

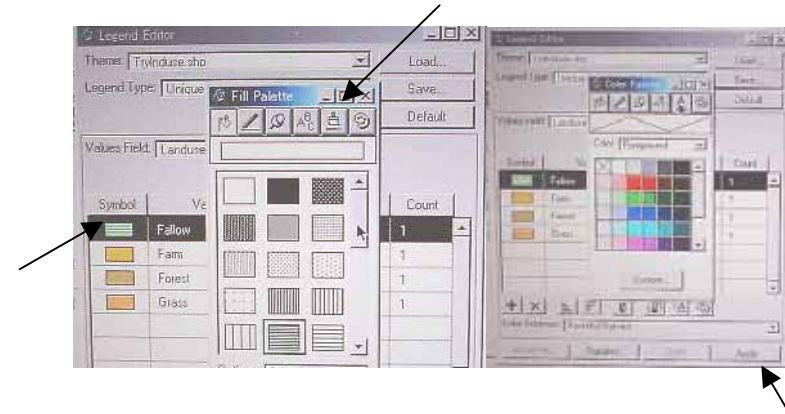
and streamline. So arrange shape file order “try admini.shp”, “tryfe.sha”, “try commune.shp”, “trylanduse.shp” from top to bottom. Click a file name. The legend of the file change selected pattern then push left button of your mouse and move to upper or lower place (drag and drop). You can make arrangement drawing order to Arc View.

2.3.2 Legend pattern/color selection

Click “trylanduse.shp” , for example, by left button twice, a legend editor window will come on your screen.

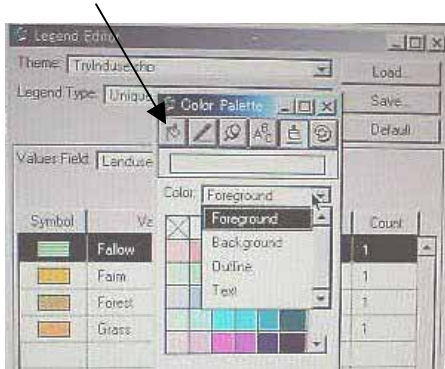


Double click on symbol on legend editor box. A fill pallet box will arise.



Then click brush icon. Color pallet box will come. Open pull down menu click on the right side of color column. And select foreground or outline. Then click a color pattern that you like. Then symbol pattern of the legend editor box will change to the selected color. Then click apply button right bottom side of the legend editor box.

If you want to use color pattern, click fill icon upper left side of the color pallet box, and select a pattern. Then click apply button.



In case for this practice, land use category is divided into 4 types such as fallows, farm land, grassland, and forestland. To draw this four category, you have to change legend type from single to unique value. Open pull down menu of legend type, and select unique value on legend editor box.

Next open pull down menu of value field, and select an item for land use category (Land use). Then symbol colors of each column will show on legend editor box. Color and pattern of each legend should be arranged same procedures above.

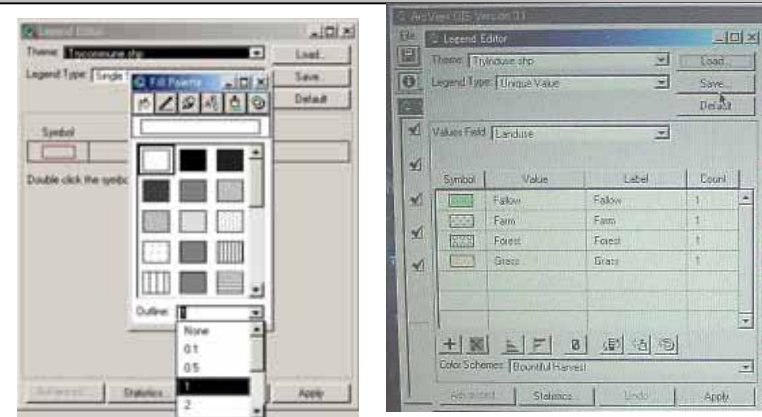
Finally you can make legend patterns as sample below shows.



Procedures how select legend patterns in case for unique value.

Click double a shape file list on a view window -> select "unique value" on the pull down menu of legend type on editor box. -> select an item from pull down menu list on value field on legend editor box. -> double click a symbol -> select a pattern within the fill pattern box. -> click brush icon on the fill pattern box. -> select foreground from the pull down menu of color on color pallet box. -> then repeat the procedures for other symbols on legend editor box. -> click apply button on the legend editor box. -> click X marks on color pallet box, fill pattern box, and legend editor box to clear these windows.

For line polygon: after click the shape file on view screen, a pen pallet box will come. Then select line pattern and line size from pull down list of size box.



Other legends for FE, Commune, and Administration are defined as outline using fill pattern pallet. Select empty square type. Open pull down menu of outline on the bottom side of fill pattern box, and select a line size to decide thickness of the outline pattern.

2.3.3 Save the legend pattern

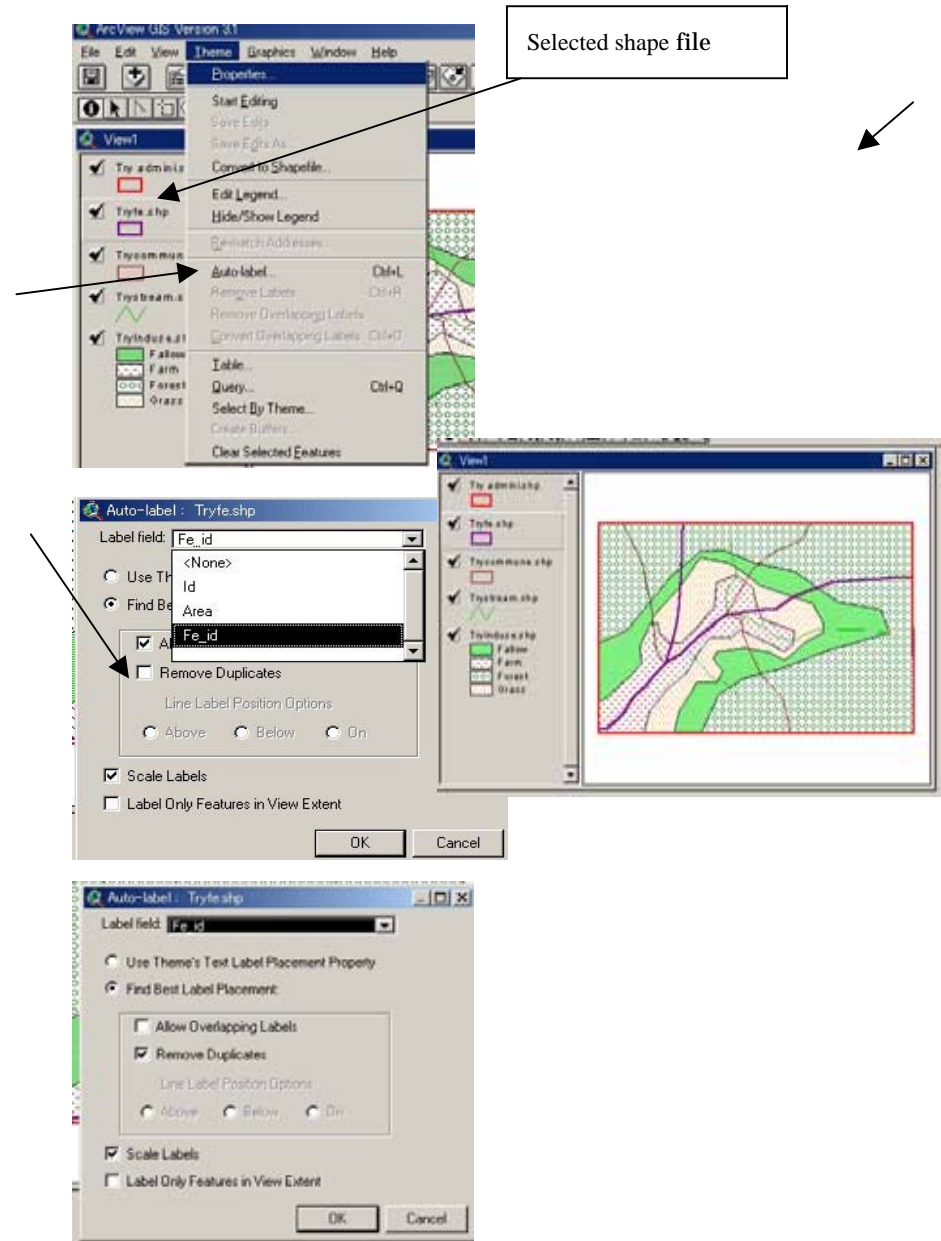
You can use different set of legend type for your presentation purposes. Nevertheless to make legend pattern needed many steps is troublesome, therefore, the pattern can be saved. When you finish the arrangement set of legend patterns, click save button on legend editor box. Then give a name to legend file, and indicate a folder to store the legend file. The procedures are follows.

Click save button -> type a file name -> choose a folder for store -> click OK button

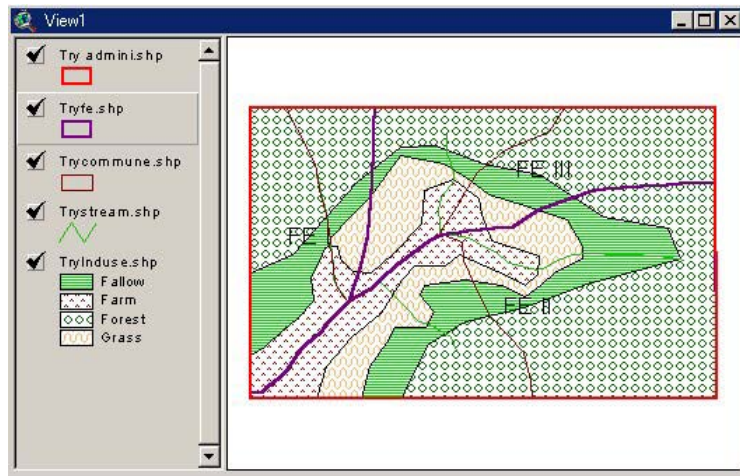
2.3.4 Add labels of polygons on View screen.

On the GIS View, every polygon was drawn, but it is difficult which polygon shows for what. If the names of communes, FEs are described, you can see the map more easily. For this Arc View prepare labeling function.

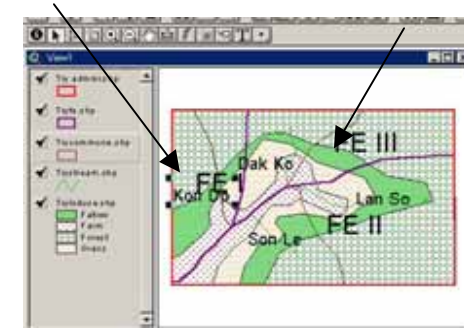
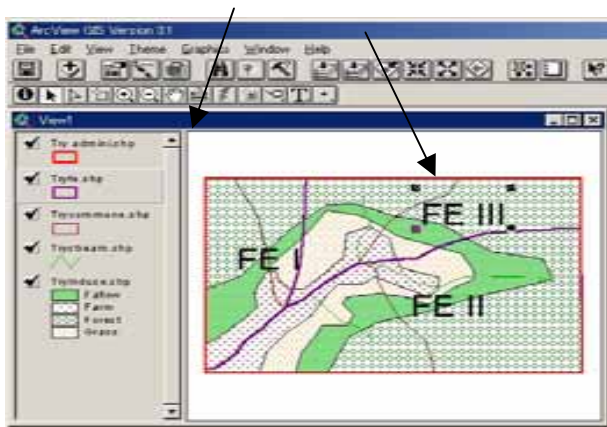
Click a shape file for example "tryfe.shp" on legend part of view screen. Then the shape file will change selected condition as bellow. -> Open pull down menu of theme, and select auto label. -> Open pull down menu of label field on auto label box. -> Select a field for labeling (this sample case is "Fe id". -> Give mark to allow Overlapped label or Remove Duplicate (this case allow overlapped: left side down figure) -> Click OK button.



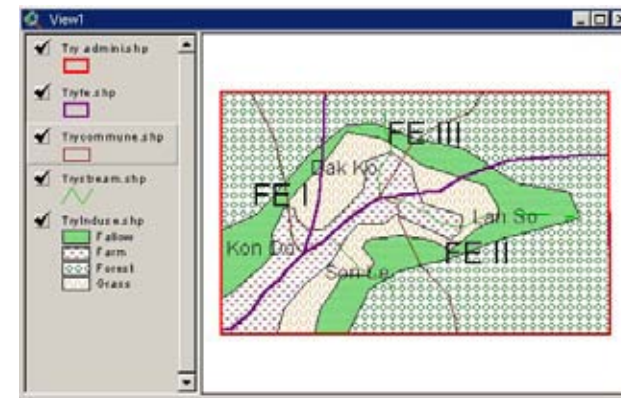
Then View screen will change to below. To arrange labels position and size, you need following several procedures necessary.



Click the black arrow icon on view screen. -> Click a label for selection -> Arrange size and position by your mouse (drag and shift for expanding or reducing).




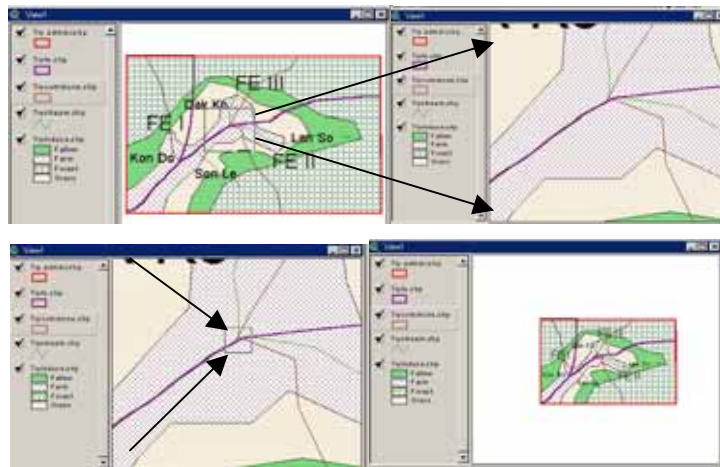
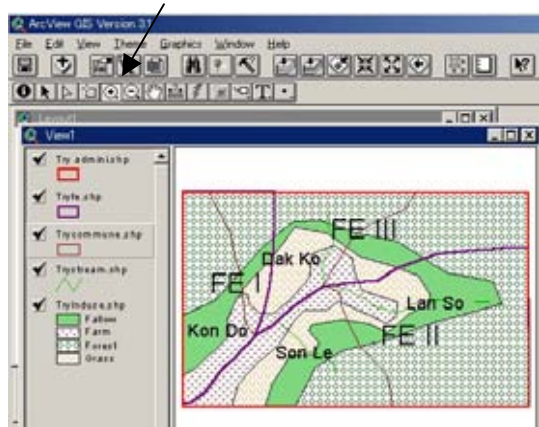
Repeat the same process for label commune. Then arrange the labels to avoid overlapping. Then finally a following figure is formulated on the View screen.



2.4 Arc View screen control (Zoom in and out)

To observe Arc View map in detail (Expand) or overview (Reduce), you can operate map scale/size using Arc View functions. Procedures are follows:

Click + icon for zoom in (- icon for zoom out) -> put the pointer/cursor on a rectangular position. -> push left button of your mouse button and pull the mouse to the another rectangular point. 



2.5 Save the GIS Map (Project file)

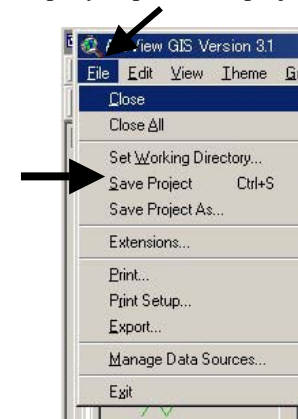
In Arc View, you can save the work you do on any project component by saving the project that contains it. When you resume work on the component, it will be in the same state it was in the last time you saved.

You can save at any time during a session. When you save a project, you save the work you've done on all the components to which you've made changes. If you haven't saved the project, Arc View will prompt you for a name. Also, if you close the project or quit Arc View and you've made any changes, Arc View will prompt you if you want to save the project. The Arc View Map that you made is called as "project".

To save your work the same name of project

Open pull down menu of file on main menu list of arc view. ->Choose "save Project"

This saving procedure is applied to the case you processed (change or add something) to a existing project, for example you processed project that made yesterday.



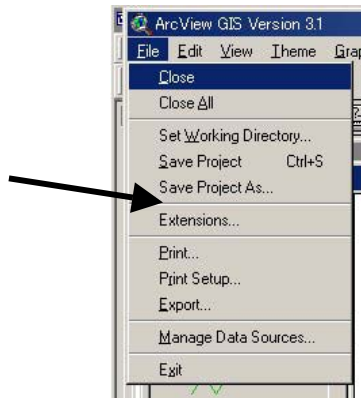
To save your work to a project with a different name

Procedures are follows

Make the Project window active. ->From the File menu choose Save Project As.
-> In the dialog box that appears, navigate to where you want to save the project and enter the project name.

In this practice the project file is expected to store in the folder named “project” located as sub folder “ of “GIS practice” folder on root directory of C: drive (hard disk). Project file is defined name and .apr extension “(name) + .apr”.

This procedure will apply if you want to keep the yesterday works as well as today’s job. To save the results of today have to be given a different project file name. How type in the file name is same process as the case of Word or Excel files saving.



When you recall today’s job at next occasion. You can load the same style Arc View map on your computer. Procedure is follows:

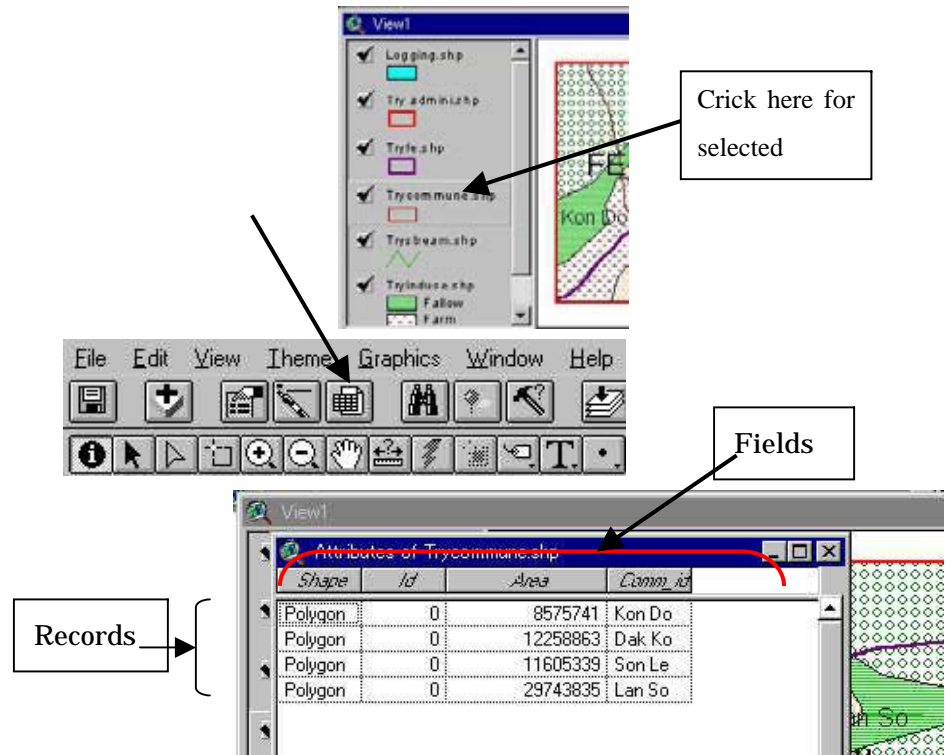
Start GIS Esri 3.1/3.2 -> select existed project -> Chose a project file name within the list appeared selected folder that you saved.

2.6 Look Data Table

Arc View table (dbf file) is stored linked data with polygons. Each polygon is characterized several items for example that this polygon is belong FE I, Dak Ko commune, grass land, etc. These categories are stored in each column called “field”. One polygon is defined several characters field by field. This set of fields is called

“Record”. One shape file stored a set of polygons, and a “dbf” file stored same number of records linking with each polygon. To open a table, procedures are follows.

Click a target shape file on View screen legend list to define “Selected” -> Click table icon on the main menu icon list. ->Then automatically a table connecting with the selected shape file comes as table view.

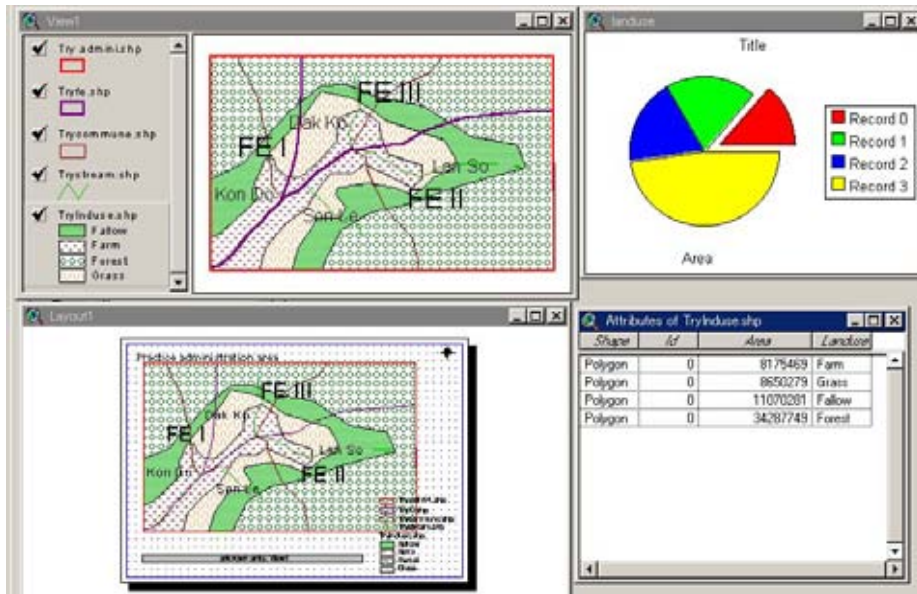


2.7 Review the Arc View functions

Figures and table

Arc view GIS consist of three type of files shape, data table, and location. The map figures are stored as project file. And legend of shape files are kept as legend file.

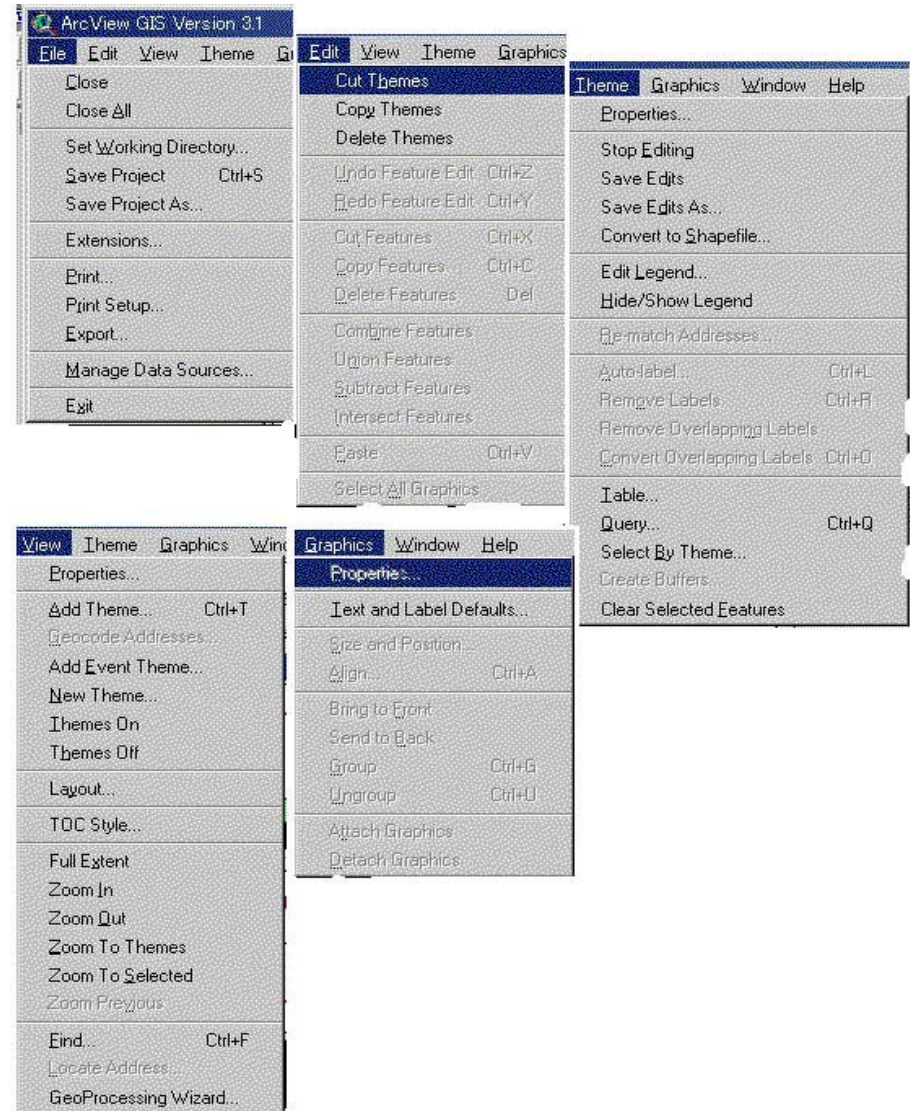
The map data are drawn on View screen. Tables can see the same screen. Main feature of arc view screens are follows.



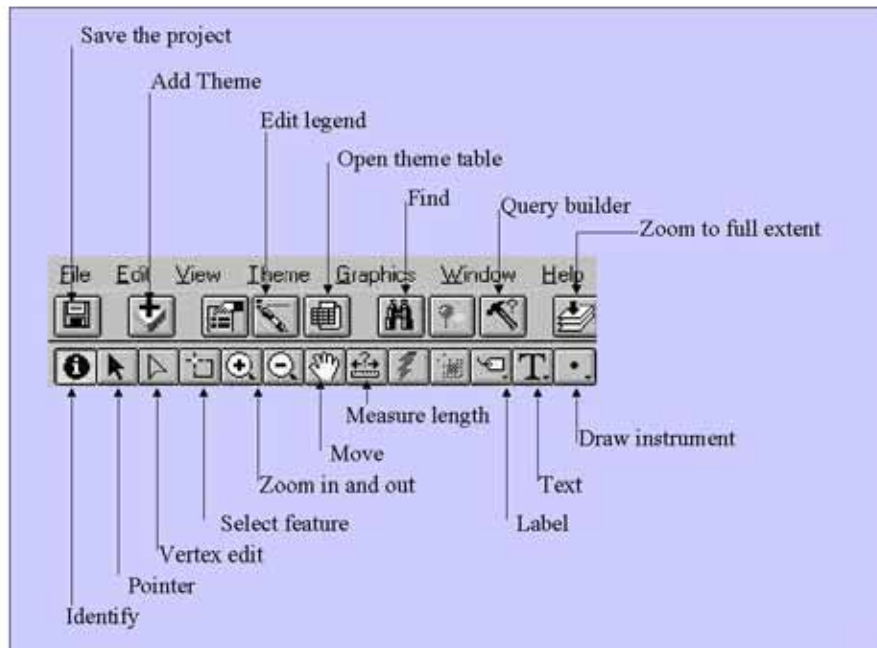
upper left: View screen upper right: Graph
 lower left: Layout lower right: Table

Main page manus and Icons

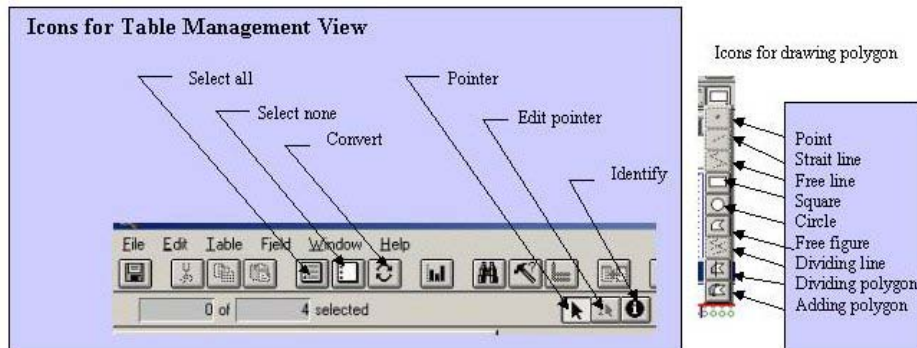
Pull down menus



Icons on Main View window



Icons for Table Management View

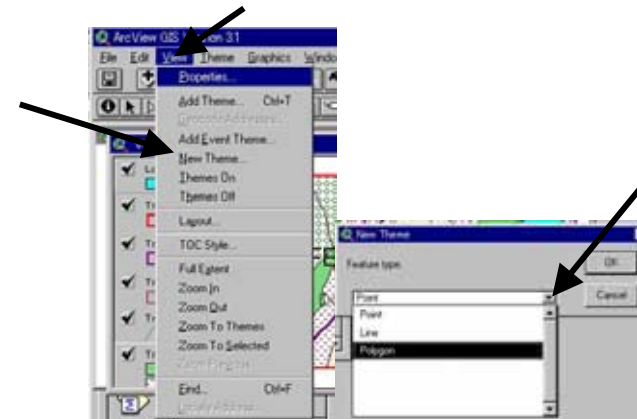


2.8 Create new shapes/polygons

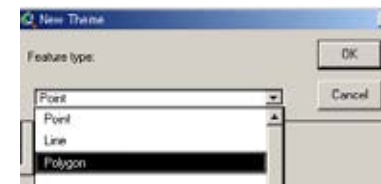
If you want to add new map items to the existing project, for example in this practice, new paddy field development plan, you can make new polygons as a new shape file.

Procedures consist 5 steps. To notify new shape file making to the Arc View. To define the type of polygon. To decide name of file, and stored folder. To draw polygons, To save the new file edited.

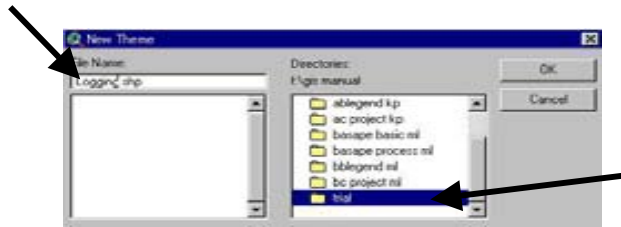
2.8.1 Notify the new shape file Creation



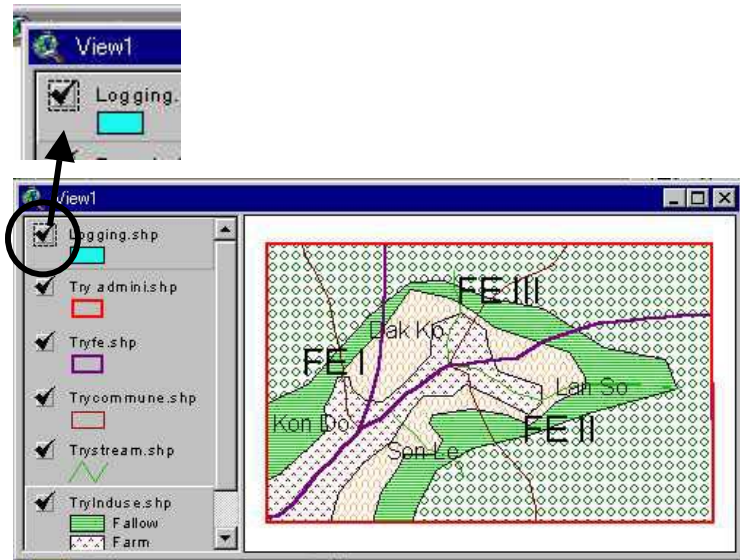
Open pull down menu of View on Arc view main screen. -> Select "New Theme."
-> Open pull down list and choose a feature type (point, line, polygon). -> Click OK button. -> Give a file name and select a folder to store the new shape file. In this practice the new file name is "logging.shp".



Decide type of shape

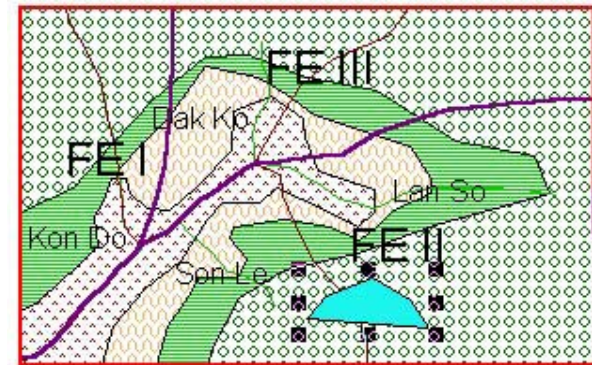
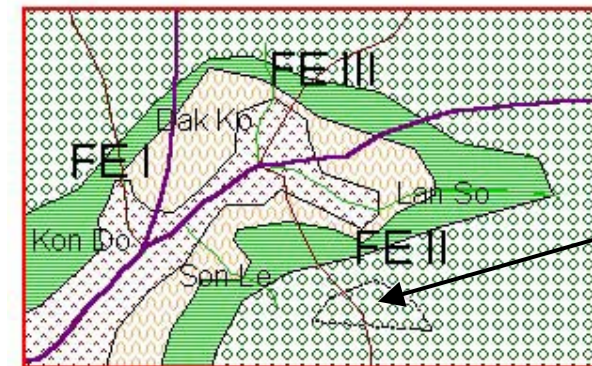
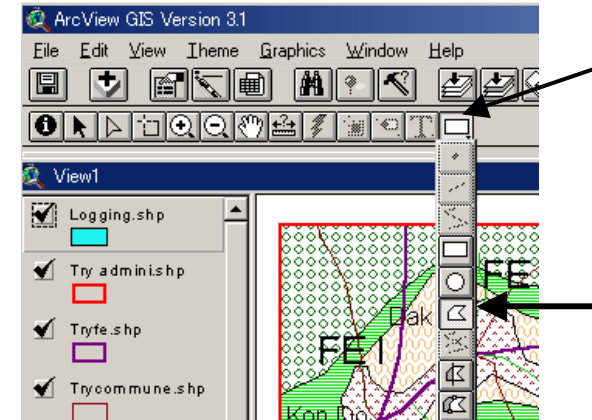


Then Arc View screen come back. New shape file is listed top of the legend list. And column of the legend mark is enclosed by dot Line Square. This mark means that Arc View is prepared standby condition to edit the shape file. You can start to draw polygons for logged areas.



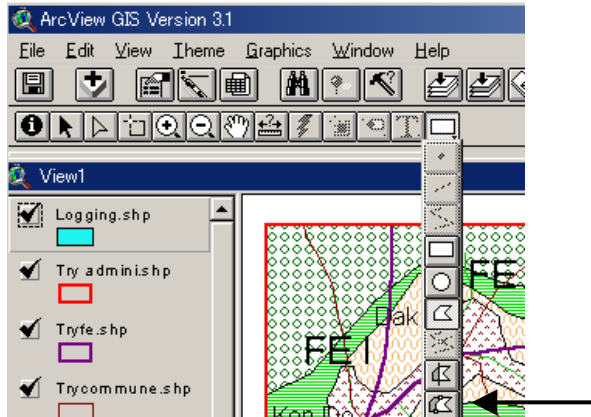
2.8.2 Add a polygon

Now you can finish preparation to create Logging area map to the project. Click free shape button, and put the pointer (+) to the starting point of the View screen.

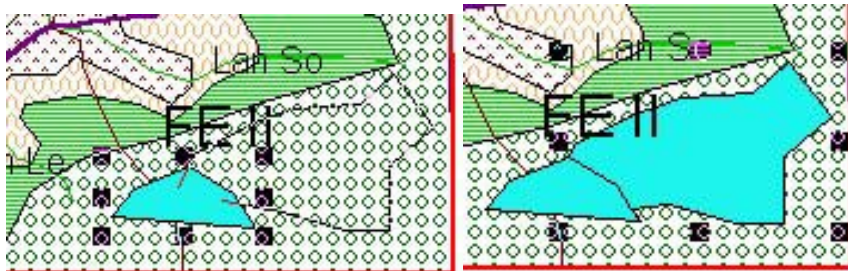


2.8.3 Add a polygon continuation with other polygon.

For example, you draw the area logged 1997, the area 1998 and 1999 is connected with area1997, to draw the area using drawing icon of expanding.

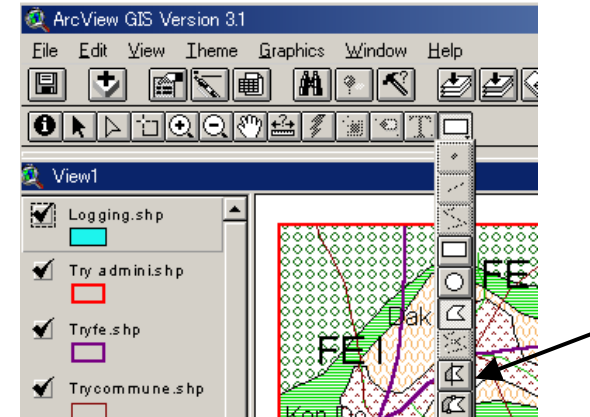


First set the pointer (Click once left button of your mouse) on the near place inside of the 1997 polygon, then the pointer move to the next point cross the outline and click once, Then same process to other points, finally, put the pointer on the place to cross outline of the 1997, then click twice. A polygon 1998 and 1999 area turn filled colored pattern just continued polygon.

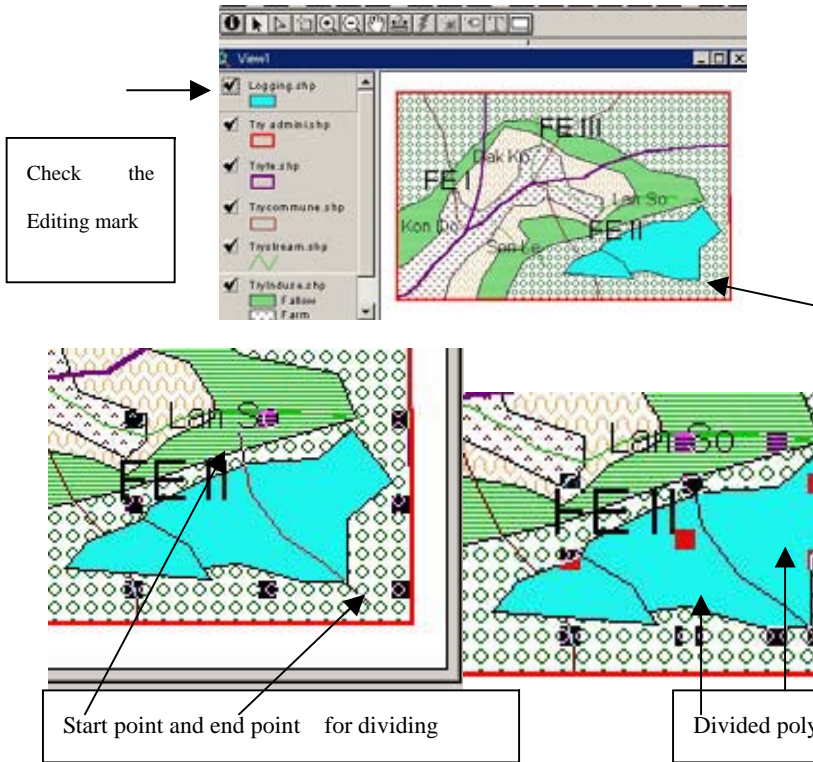


2.8.4 Dividing a polygon to two polygons

If you want to divide 1998 area and 1999 area, you can draw using divide polygon icon.



Click theme-> Start Editing ->Click select icon -> Click a shape to be connected (in case, 1998-1999 polygon for selection) -> Draw new polygon (start point is outside point near the first cross point on the polygon 1998-1999 then make cross line to divide. Final point on the point outside of the polygon 1998-1999) then click twice. (note: dividing line you draw have to pass to points on a polygon, therefore, be careful not cross surrounded polygon line.)

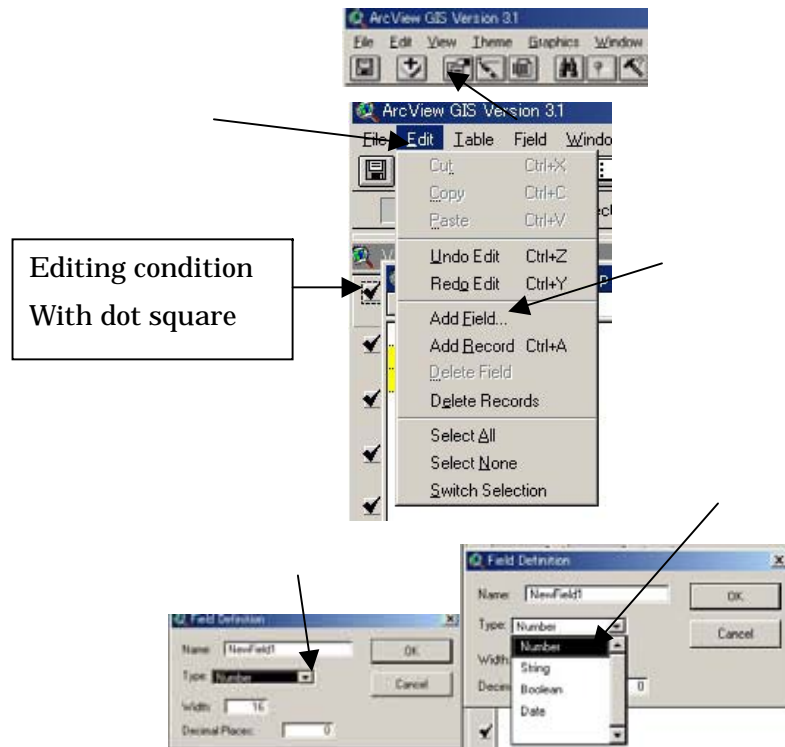


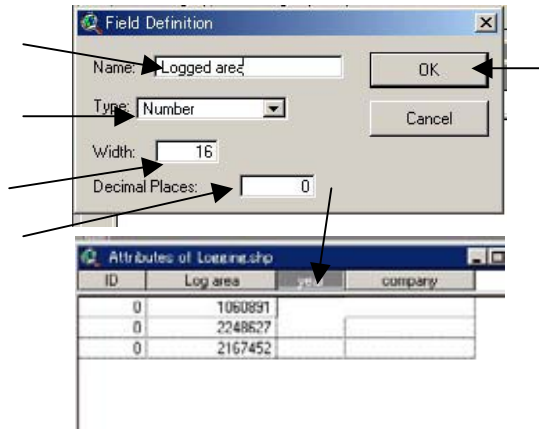
2.8.5 Editing for linked table on logging results

Three polygons had drawn for logging result. But you need to make records the meaning of these polygons. Categories of these polygon data is stored on dbf file, therefore, you need to amend /edit this dbf file. Open theme table, you can see three-recorded line. Two lines are yellow. This means within this theme “logging result” is consist three polygons, and two polygons are under the selected condition. You need to add several items (fields) to identify or give the meaningful ID for these polygons. Following procedures explain edit for the table. For example, If you want to add area by each polygon (yearly logged area), logged year, logged company, you

have to make three fields on the table, and fill text to each column of records by each field. (Note: first check the shape file is under “Editing” condition

Click open theme table icon -> Open pull down menu by Edit and choose “Add field” -> Type name of field (Logarea is sample), Type of data (Number is sample), Wide (16 is sample), Decimal places (0 is sample) -> Click OK





Same process for other items “year” and “company”. The case of “company” data type is selected “strings”. Then needed fields are made.

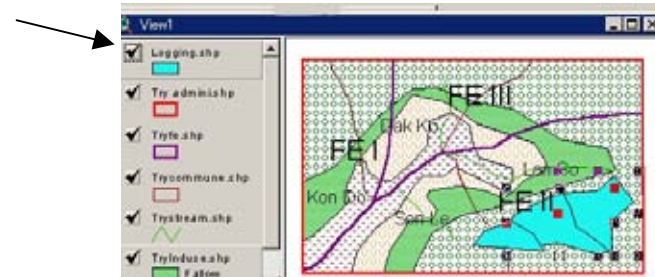
2.8.6 Area calculation

To fill the column of the field “logarea” can calculate automatically by computer as follows:

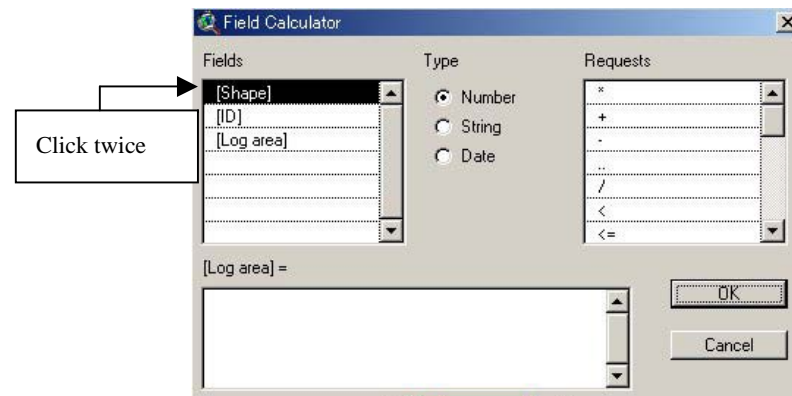
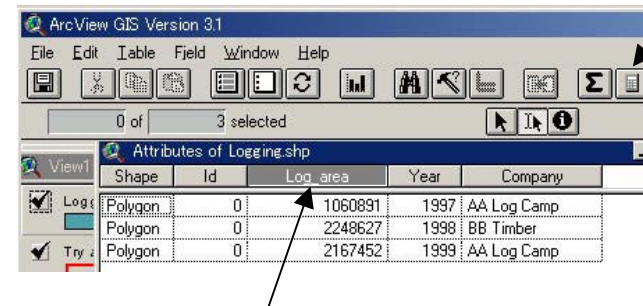
Before calculation, selected records (yellow lines) have to be changed to free condition. Click “Select nun” icon on table view screen. Yellow lines are change to white line.

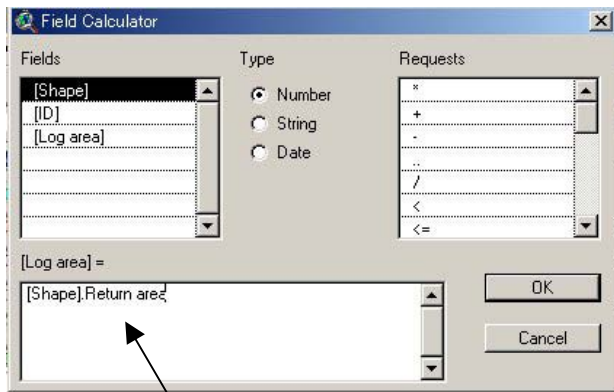


Check the condition of the shape file selected, and under the editing condition.



Click the field name (top of the field) for selection (gray turned) -> On the table view, click calculator icon then field calculator box will come. ->Click double “shape” on the calculator box then “[shap] will arise text window of the calculator box. -> Type after the [shape] “.Return area”, then click OK button.





Shape	ID	Log area
Polygon	0	1060891
Polygon	0	2248627
Polygon	0	2167452

Areas calculated by computer

2.8.7 Fill the categories on each columns by each field

Select a field for editing on the table view. -> Click edit icon and put the cursor on the column to be edit, then cursor will change to hand -> Type the needed data, column by column. Sample shows case for logged year.

ID	Log area	year	company
0	1060891		
0	2248627		
0	2167452		

Shape	Id	Log_area	Year	Company
Polygon	0	1060891	1997	AA Log Camp
Polygon	0	2248627	1998	BB Timber
Polygon	0	2167452	1999	AA Log Camp

Type form your key board

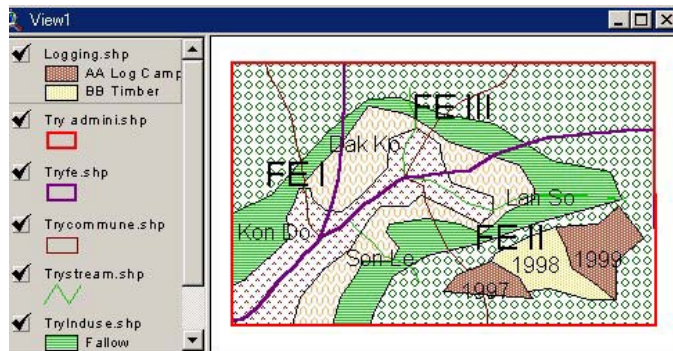
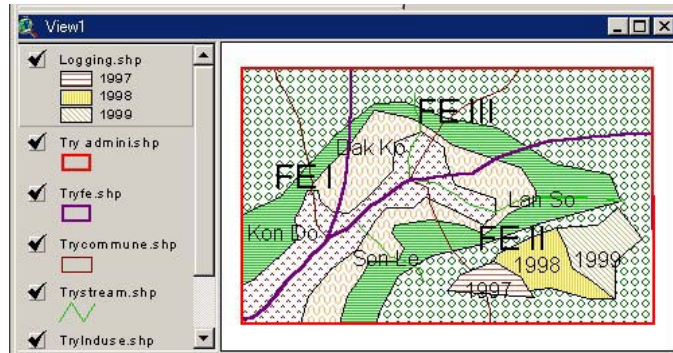
2.8.8 Save edited table

When you fill the needed columns, you have to save the results of this editing.

Close table (Click X button right up side of the table box. -> Open pull down menu of "Theme", and select "Stop editing" -> Arc View ask whether save the change of the table or not. So click "Yes".

2.8.9 Same result of table editing

After the table edit on "logging", you can show the Views categorizing, by logged year, and by logged company as figures below. (how to arrange legend and label are explained before)



2.8.10 Some additional technical hints for new theme (polygon) drawing

If you want to draw a polygon that is just connected with existed paddy line. To draw new shape line just on the same place on part of other polygon line (to trace the paddy (landuse.shp) line) exactly is not easy. If you expand the view, small gaps may remain, therefore, to avoid creating these gaps you use existing paddy line for new theme polygons drawing. Procedures are follows:

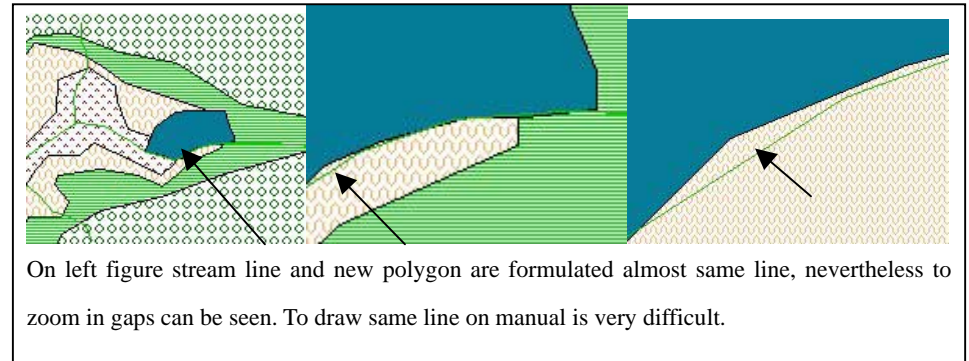
a. to copy the polygon of “landuse.shp” as other named shape file (For example

“newpaddy1.shap”)

b. to draw new shape (polygon) using add shape (click icon)

c. to cut line polygon of streamlines

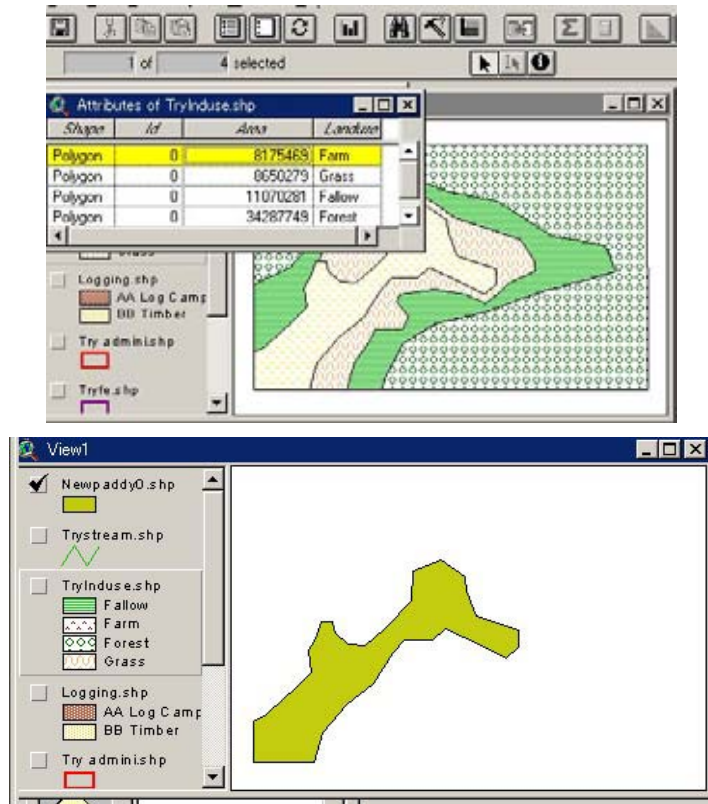
d. to save new theme.



On left figure stream line and new polygon are formulated almost same line, nevertheless to zoom in gaps can be seen. To draw same line on manual is very difficult.

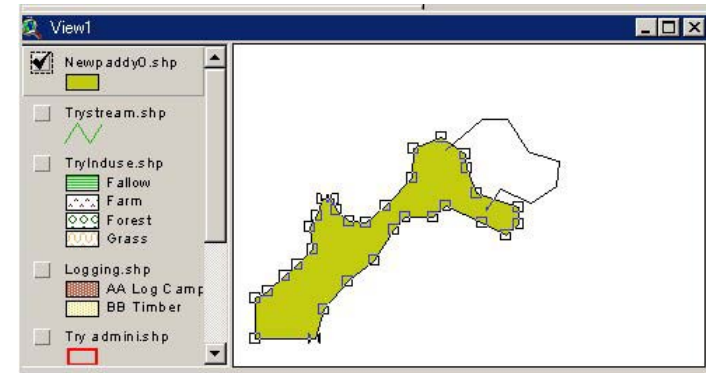
[to copy farm land polygon as new shape file]

Select “landuse” -> Click table icon to open the “landuse.dbf” -> Click pointer icon for selecting record -> Click a record line to select the farm polygon, then the polygon will change yellow color on the view screen. -> Close table ->Open pull down menu Theme and select “Convert to shape file -> Decide a new shape file name and a folder where the new shape file to be stored (newppady0) then click OK -> Arc view asks whether add the new file to view screen, so, click Yes. Then new shape file of existed farm is created.



[To draw polygon]

Click newppady0 for selecting -> Open pull down menu of Theme, and select "Start editing" -> Open pull down icon list for drawing polygon and select Expanding Polygon icon -> draw a new polygon as add to paddy.

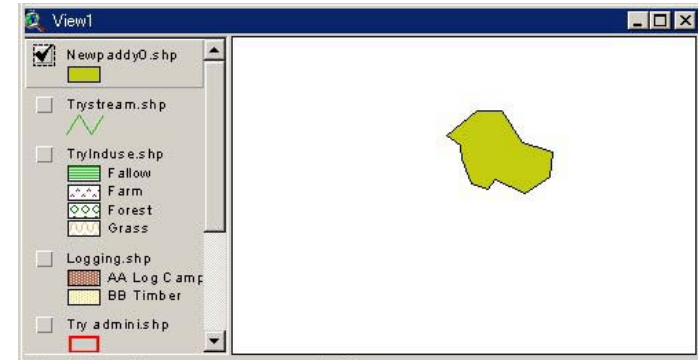


[To cut unnecessary polygon]

Draw the new polygon for new paddy development plan area just connected existed farm land. Then delete the polygon.

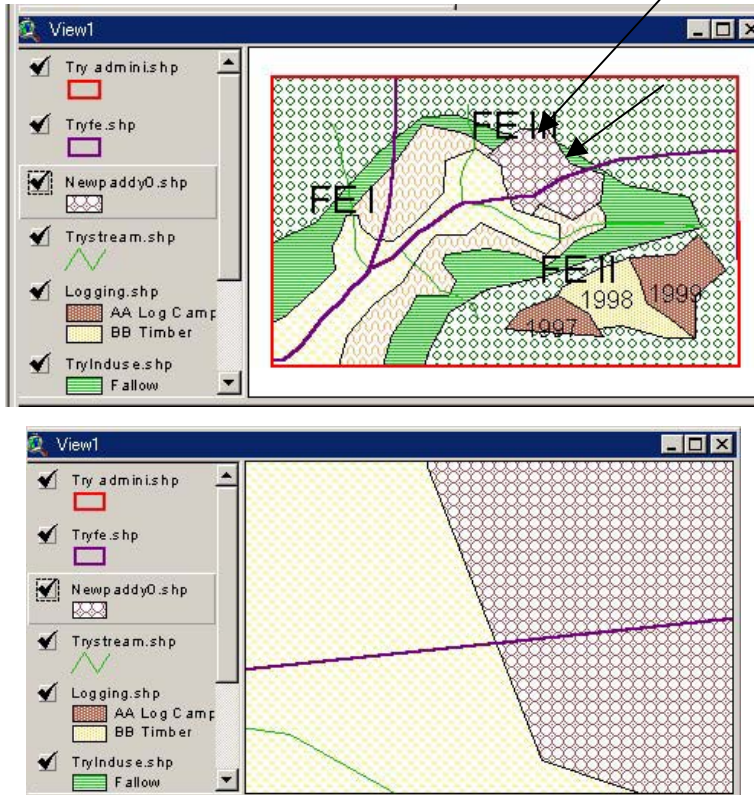
Click pointer icon -> Click the polygon to delete for selection -> Open pull down menu of Edit and select "cut the feature" Then View screen changed as below.

Open pull down menu of Theme, and select Stop Editing -> answer the question to save changes or not (yes).



Finally, to draw all shapes on View screen changes to as follow.


From this procedures, boundary between new paddy and farm land, no gap is created. To draw new polygons, as far as possible, to use this technique is applicable to make accurate mapping and area calculation.

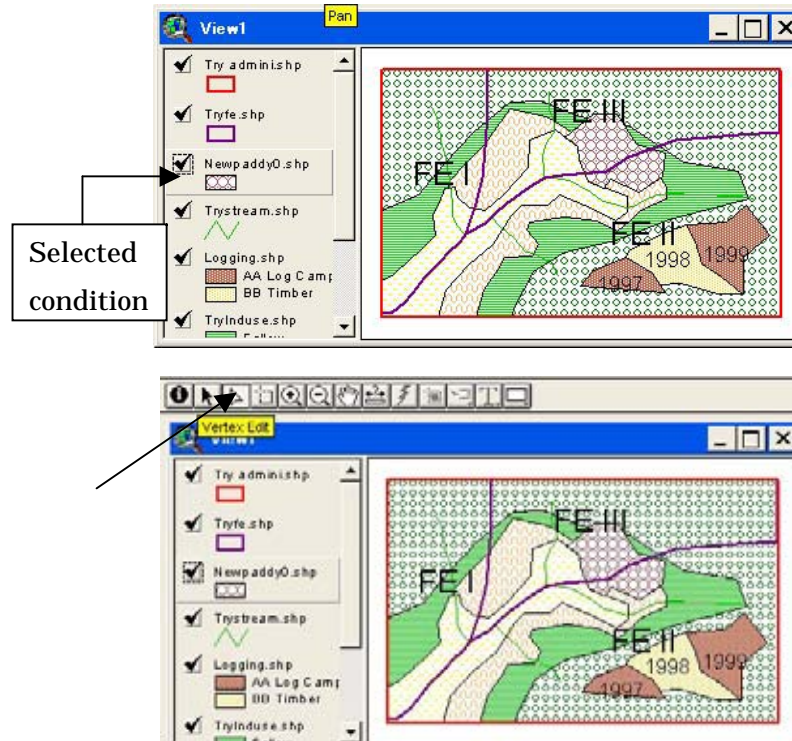


2.8.11 Amendment a polygon

If you want to amend the area/shape for a polygon. You can do this following procedure.

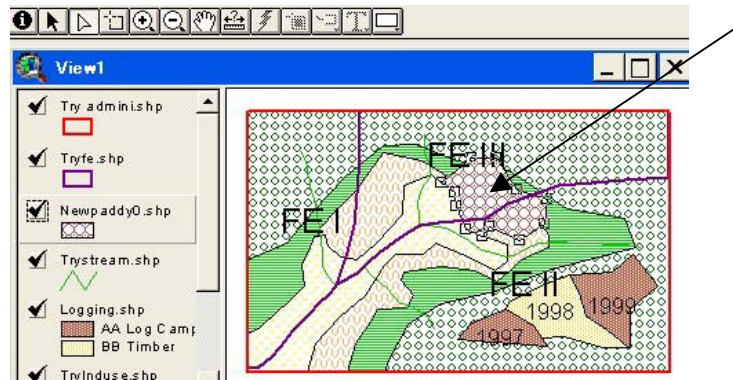
Click a theme on left side of view screen shape file legend to be selected condition. ->

Open pull down menu of “Theme” and select “Start editing”. -> Click Vertex edit icon  -> point the cursor on a polygon that you want edit. Then the points of out line will change selected pattern -> Put the cursor on a point where you want to move and push left button of your mouse then draw mouse to where you want to put the new point. Put off the button of your mouse. -> Repeat the same procedures for next points. -> When all needed points had moved right places, open pull down menu of “Theme” and select End of editing (Stop Editing) -> When computer ask you whether the edited shape to save or not, Click “Yes”.

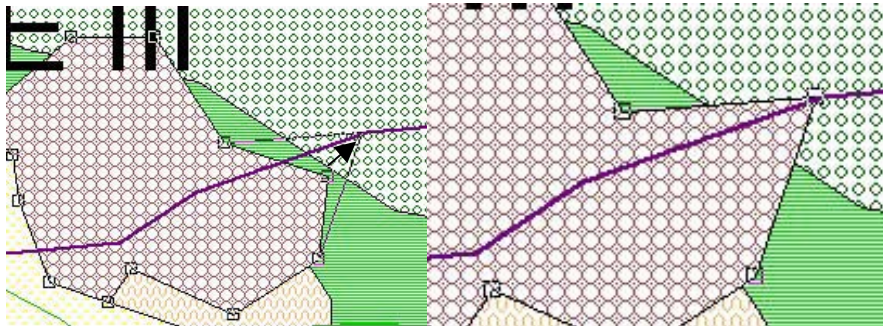


Select “Vertex Edit” icon. Then the icon will move on the polygon you want to amend

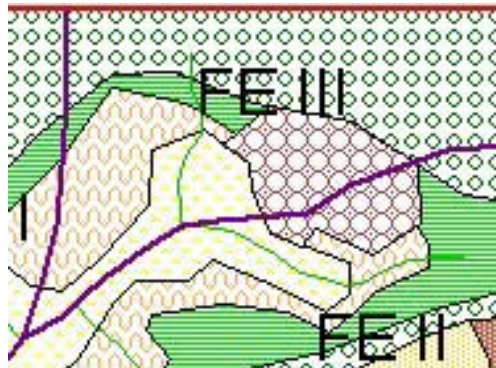
The polygon you clicked will change selected condition with boundary points.



Zoom in the Selected polygon. Put cursor on a point. Then move the point.



Arrange every points not go into forest area. Finally adjusted figure is below.



2.9 Save the project

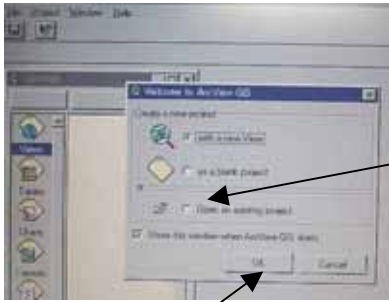
You did every amendment or to suspend the job, you need to save the all of files. If you save this project you can start on same view you had saved when you want to continue your job. Saving procedures are follows:

Open pull down menu of “Files” and select “Save Project”

If you want save the project on different name because existed project without latest amendment may use different objectives, then select “Save Project as”. Computer will ask new project file name and a folder to store, then you type file name and specify a folder. Click OK.

2.10 Recall a project

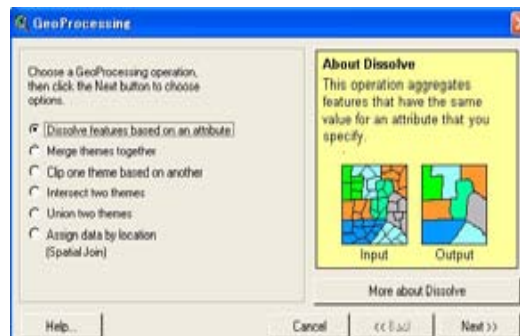
When you start your job using previous View above, you can call saved project. After run the Arc View (Esri 3.1/3.2), the first window asks whether new project or existed project you want to use, then choouse existed one. Computer asks you what project to be opened, so you select folder where you had saved the project, and specify a project name then click OK. Then you can see the View screen same as you had saved.



2.11 Geo-processing

In this practice five shape files are viewed on the view screen, “Commune”, “FE”, “Land use”, logging”, and “Newpaddy”. For the forest management, you may need areas for example, FE areas by commune, by land use, by logging area, etc.. To calculate these areas, five category of polygons to be overlaid and change into one shape file linking with original polygon’s characters. This function is called “Geo-processing”. When shape file A + shape file B is done by the Arc View, new shape file will draw. Shape file A’s polygons divided by the lines of shape file B’s polygons, and same time computer create a new “dbf” file/table showing every polygons linking with newly divided polygons keeping both characters file A and B, that have both file’s fields and records. To export this new “dbf” file to Excel, you can calculate areas categorized factors using functions of Excel.

2.11.1 Preparation for Geo-processing



To start Geo-processing you need to do two preparation procedures. One is to add a function to Arc View, and second to arrange every “dbf” files characters (ID for each record of every table).

[add Geo-processing function]

Open pull down menu file and select “Extension” -> Give “\” mark on Geo-processing -> Click OK -> Open pull down menu of “View” and select “Geo-processing wizard”. Then Geo-processing wizard will come.

[Table preparation]

In this practice five table stored. Check fields of each table whether at least one field categorizing records of the table. For example, table commune, have every record name of commune, table land use, have every record can identify land use category?

Attributes of Trycommune.shp				Attributes of Tryfe.shp			
Shape	Id	Area	Comm id	Shape	Id	Area	Fe id
Polygon	0	8575741	Kon Vo	Polygon	0	12797068	FE I
Polygon	0	12258863	Dak Ko	Polygon	0	32256211	FE II
Polygon	0	11605339	Son Le	Polygon	0	17130499	FE III
Polygon	0	29743835	Lan So				

Attributes of Newpaddy0.shp			
Shape	Id	Area	Landuse
Polygon	1	2970208	newpaddy

Attributes of TryInduse.shp			
Shape	Id	Area	Landuse
Polygon	0	8175469	Farm
Polygon	0	8650279	Grass
Polygon	0	11070281	Fallow
Polygon	0	34287749	Forest

Tables above are the list for this practice. Field name of "landuse" is used two tables, therefore, the field name of table "Newpaddy" to be change other name "Paddy Dev". The checking point are a. at least one field of all columns filled some Identical description for the table category, b. the field name used for identify is not same to other field names of all other tables. After the Geo-processing, newly created table have fields that original tables have, therefore, you may difficult to identify which field link to which original table.

Table new paddy had amended to the above table (added field "paddydev").

2.11.2 Clipping

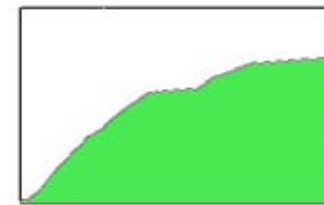
Geo-processing Clip is used for down sizing data. For example, the study for Kon Plong district prepared every shape file covered full area of Kon Plong district, therefore file size is large. If you use these data for analyzing only Man Den Forest enterprise (FE II), shape files arranged on Man Den area is more convenience and operation of Arc View may faster than using full data. In this practice, procedures for clipping land use by a Forest Enterprise are follows.

Create clip theme

Attributes of Logging.shp				
Shape	Id	Log area	Year	Company
Polygon	0	1060091	1997	AA Log Camp
Polygon	0	2248627	1998	BB Timber
Polygon	0	2167452	1999	AA Log Camp

Attributes of Newpaddy.shp				
Shape	Id	Area	Landuse	Paddydev
Polygon	1	2970208	newpaddy plan a	

First make a clipping shape file (administration boundary of FE II: admiFEII.shp). Select Tryfe.shp -> Open Table -> Select the record FE II by pointer icon -> Open pull down menu of Thema and select "Convert shape file" -> Give file name and folder to store ("admiFE II.shp).

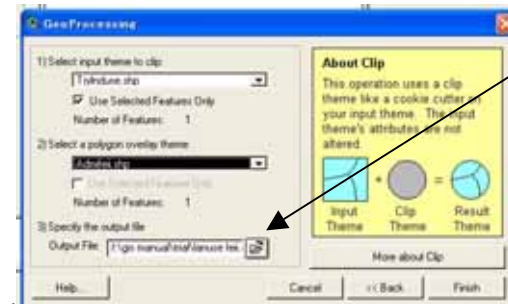


administration area of FE II

Clipping land use by admiFEII (input teme= landuse, clip theme=admiFEII)

Open pull down menu View then select "geo-processing" -> mark Clip... and click next button -> Give shape file name for input theme and clipping theme. -> Give a file name and folder for saving new shape file after clipped. -> Click finish -> when arc View asks whether the new shape add to view screen or not, then, click "Yes"-> Give mark on the new shape file on the legend part of the View screen.

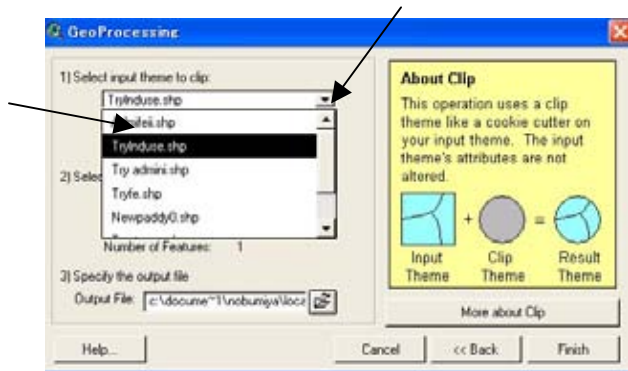




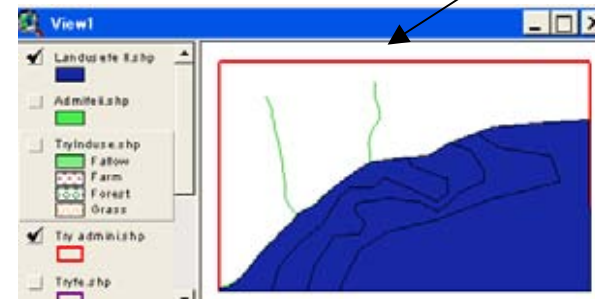
Give file name and folder

(¥...¥trial¥landusefell)

Note: Don't forget to give a new shape file name and a folder. If you forgot these, computer automatically give a file name temporarily and store the file temporarily on folder of window¥system¥tem. Then you face difficulty to find the file next time.

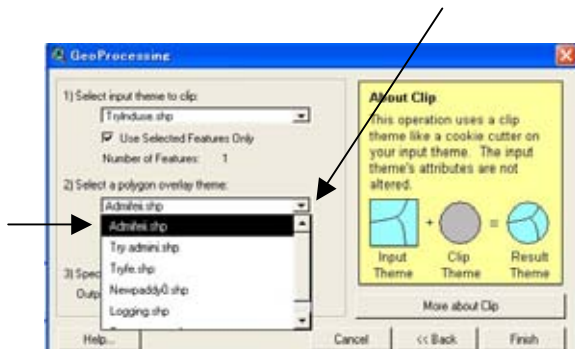


Input theme land use

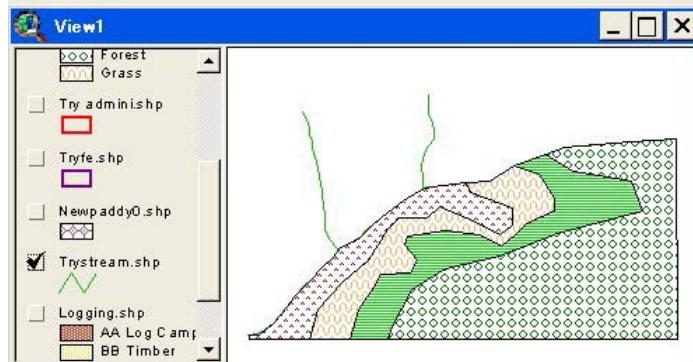


Clipped shape on the area of FE II

Then legend should be arranged to use saved legend on land use, then final figure bellow is created. This shape shows land use only for the area of FE II.



Clip theme admiFE II



Shape	Id	Area	Landuse
Polygon	0	8175469	Farm
Polygon	0	8650279	Grass
Polygon	0	11070281	Fallow
Polygon	0	34287749	Forest

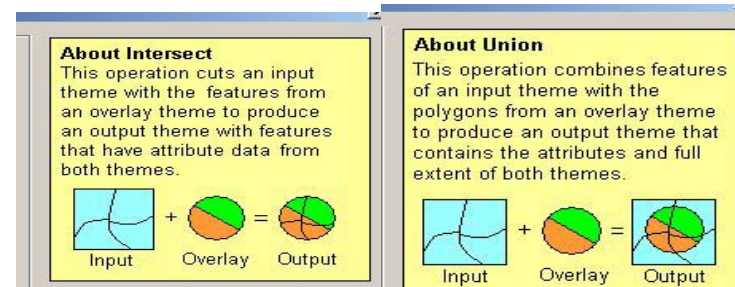
Id	Area	Landuse	areafe
0	8175469	Farm	3946909
0	8650279	Grass	4798328
0	11070281	Fallow	6203579
0	34287749	Forest	17307394

Add a new field for area FE II, and calculate areas as above. (See Calculation methods on 2.8.6 before)

2.11.3 Intersect and Union

These functions are prepared to merge two shape files. Polygons of one shape will divided by the other polygons, then, divided polygons linked two tables and have

fields of both dbf table. In case of this practice, if you merge Commune and FE, new shape file divided every polygons of commune into different FE areas, and new divided polygons have both categories. You can calculate a commune area by FEs or one FE area by communes. To use this function you can analyze areas sub divided categories that you want. The functions Intersect and Union are, if the areas of two themes are same the results are same, but two themes covers different areas, results are little bit difference (see below images). This processing process is almost same as clipping explained and shows below.



In case of Intersect, new theme (shape file) creates only areas that are covered by overlay theme. Incase of Union, new theme create to cover wider area.

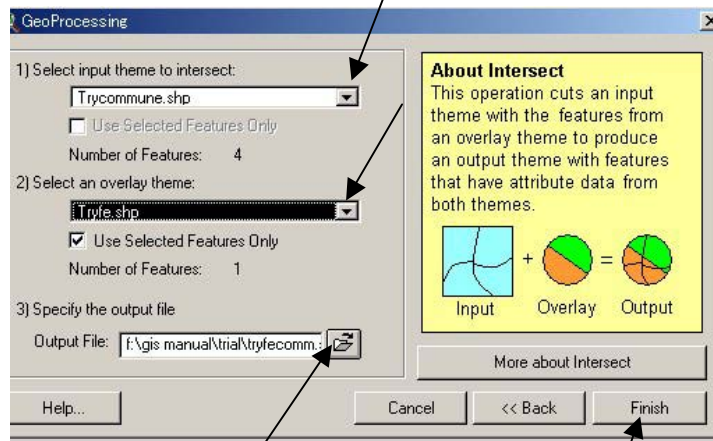
The following practice explain the procedures to calculate areas of land use by FE and Commune to create a new theme file to fulfill columns of the table below.

		Farmland	Fallow	Grass	Forest
@@ FE	@@ Commune				
	@@ Commune				
	total				
@@ FE	@@ Commune				
	@@ Commune				

First create a new theme (tryFEComm.shp) to use function "Intersect" FE (tryfe.shp) and Commune (trycommun.shp). then intersect again with the new theme and land use (trylanduse.shp) to create final result (tryFECommfuse.shp).

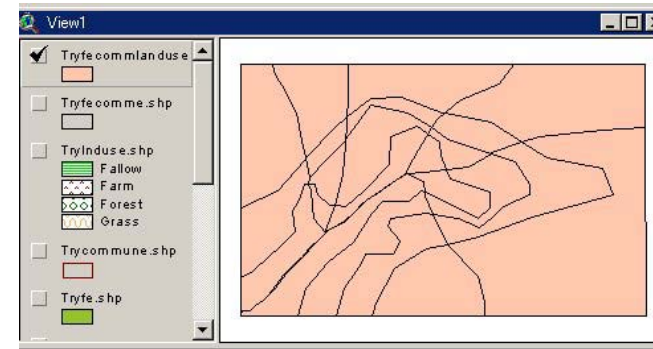
[Intersect FE and Commune]

Open pull down menu of View and select geo-processing. -> Mark on intersect on the geo-processing wizard and click next. ->Select a shape file from input theme window on geo-processing wizard (tryfe.shp). -> Select a shape file from overlay window on geo-processing wizard (trycommune.shp). Give a file name and a folder for store the new theme file (D:\GISmanual\trial\tryfecomm.shp). -> Click finish.



Don't forgot file name and folder for new theme file

Repeat same process to intersect "tryfecomm.shap" and "trylanduse.shp". The new theme "tryfecommlanduse.shp" to the same folder (D:\GISmanual\trial)



Final result by intersect three themes. 3 FE, 4 Commune, and 4 land use polygons divided into 38 polygons on the new theme.

Attributes of Tryfecommlanduse.shp										
Shape	Id	Area	Comm_id	Id	Area	Fe_id	Id	Area	Landuse	areaLuse
Polygon	0	8575741	Kon Do	0	12797068	FE I	0	8175469	Farm	199601
Polygon	0	8575741	Kon Do	0	12797068	FE I	0	8650279	Grass	61
Polygon	0	8575741	Kon Do	0	12797068	FE I	0	11070281	Fallow	235360
Polygon	0	8575741	Kon Do	0	12797068	FE I	0	34287749	Forest	419560
Polygon	0	8575741	Kon Do	0	32256211	FE II	0	8175469	Farm	95
Polygon	0	8575741	Kon Do	0	32256211	FE II	0	8175469	Farm	1207
Polygon	0	8575741	Kon Do	0	32256211	FE II	0	8175469	Farm	1583
Polygon	0	8575741	Kon Do	0	32256211	FE II	0	8175469	Farm	104
Polygon	0	12258863	Dak Ko	0	12797068	FE I	0	8175469	Farm	34616
Polygon	0	12258863	Dak Ko	0	12797068	FE I	0	8650279	Grass	73672

Above table was created through this process of the Intersect. 38 record have name of FE, name of Commune, and land use category. Field "areaLuse" (area for new theme) is given area calculation (See 2.8.6). Three fields of area show original number linked with original polygon, therefore, these fields are no more use. Delete these fields including three fields of ID.

Arrange table (cut field)

Open pull down menu theme and select "Start editing. -> Click Table icon ->

Click a field name for delete. -> Open pull down menu “Edit” and select “Delete field” -> click yes on delete field box. -> Repeat from Click a field name to delete file for other two ID and three fields of area. -> Close table. -> Open pull down menu Theme and select Stop editing. -> Click Yes for saving.

Finally, the table arranged as below.

Shape	Comm_id	Fe_id	Landuse	areaLuse
Polygon	Kon Do	FE I	Farm	1996019
Polygon	Kon Do	FE I	Grass	611
Polygon	Kon Do	FE I	Fallow	2353609
Polygon	Kon Do	FE I	Forest	4195608
Polygon	Kon Do	FE II	Farm	950
Polygon	Kon Do	FE II	Farm	12072
Polygon	Kon Do	FE II	Farm	15833
Polygon	Kon Do	FE II	Farm	1040
Polygon	Dak Ko	FE I	Farm	346164
Polygon	Dak Ko	FE I	Grass	736726

[Area totaling]

To full fill the table before, you need to make totaling using “Excel”. Next process shows how the Arc View table to be converted to “Excel” table using export command.

Open the table (Click table icon) -> Open pull down menu of File and select “Export”. -> Click “Delimited text” then Click OK. -> Give a file name for text file to export and stored folder. Click OK. After this the process transfers to Excel. Run Excel -> Click open file icon and select a text file you saved. -> Mark to Data category (data punctuated by comma (,)) on the text file wizards 1. and click next. -> Give mark on comma on text wizard 2 then click next. -> Click Finish button.

You got Arc View table on your Excel. You can calculate any kind of totaling by

function “Data” , “Pivot-table”, or “sorting”

Areas totaling table below made by Excel’s function of “Pivot table”.

Total : area Luse		Land use				G Total
Fe_id	Comm_id	Fallow	Farm	Forest	Grass	
FE I	Dak Ko	533279	346164	2632464	736726	4248633
	Kon Do	2353609	1996019	4195608	611	8545847
	Son Le		2587			2587
Sub totaFE I		2886888	2344770	6828072	737337	12797067
FE II	Dak Ko		3563			3563
	Kon Do		29895			29895
	Lan So	3647897	1104310	13851616	2030363	20634186
	Son Le	2555682	2809142	3455778	2767966	11588568
Sub Total FE II		6203579	3946910	17307394	4798329	32256212
FE III	Dak Ko	759981	1337137	3447258	2462291	8006667
	Lan So	1219832	532469	6705025	652323	9109649
	Son Le		14184			14184
Sub total FE III		1979813	1883790	10152283	3114614	17130500
G.Total		11070280	8175470	34287749	8650280	62183779

Note: This area shows sq mater (m2) unit.

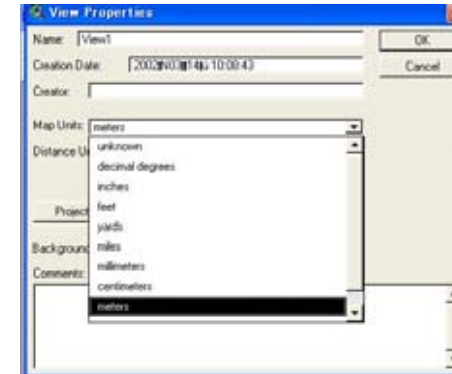
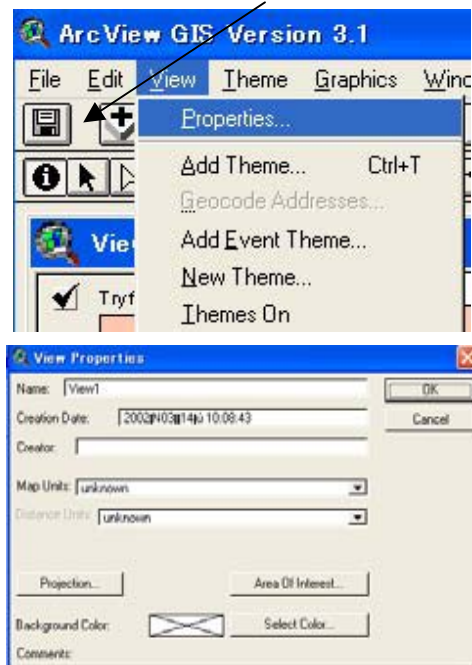
2.12 Buffering

Buffering is the function prepared by Arc View to create a shape file definite ranged areas surrounded from designated polygons (a shape file mainly defined line or point polygons). For example to identify the buffer areas for scenic protection zone on the

areas 1 km from national road, protection forest 500m both side from a streamline. In this practice, you try to analyze land use condition on 500m both side of streamline protection zone. Procedures are a. to create a shape file designate the areas 500m from streamline, b. to intersect created polygon and land use, c. calculate areas by the land use.

[Preparation for buffering]

Before buffering you have to arrange Arc View scaling.

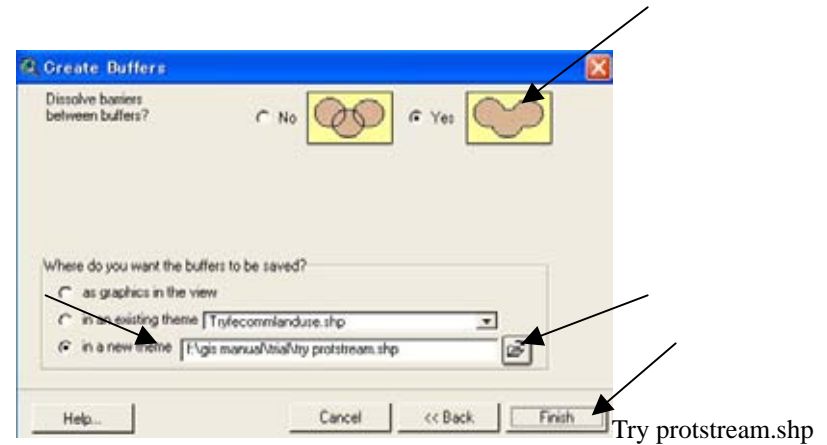
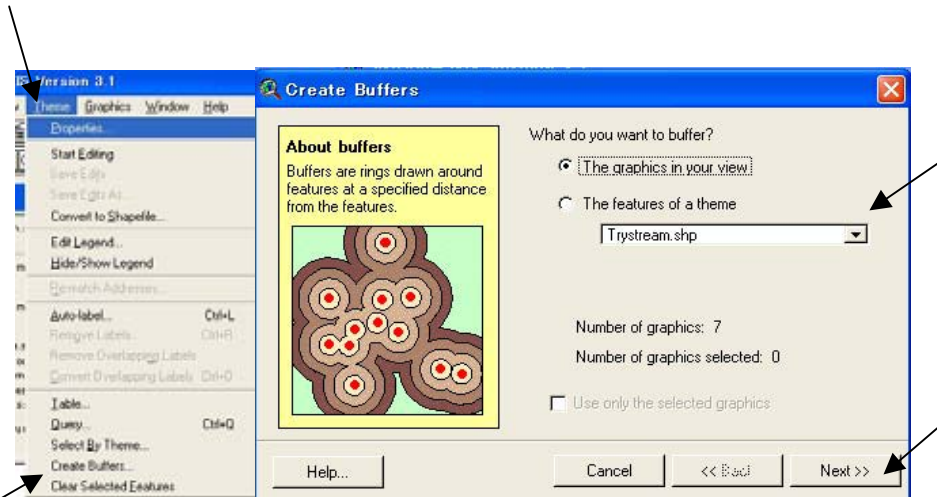


Open pull down menu of “View” and select “Properties” -> Open pull down menu of Map unit -> Select a “Unit” (In this practice select “Meter”) -> Open pull down menu of “Distance unit” and select a Unit (Meter), then click OK

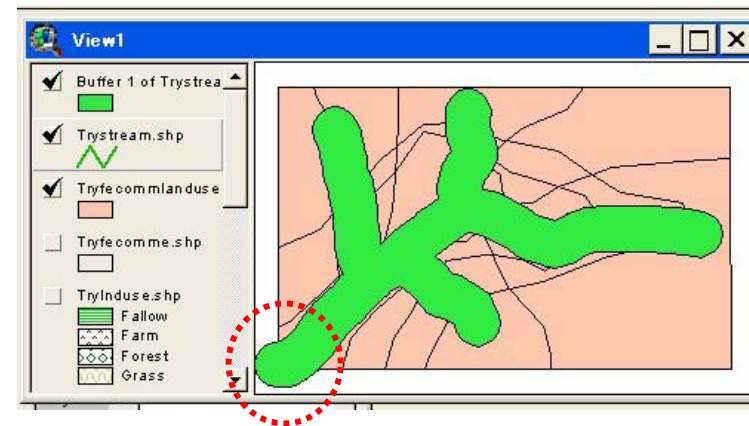
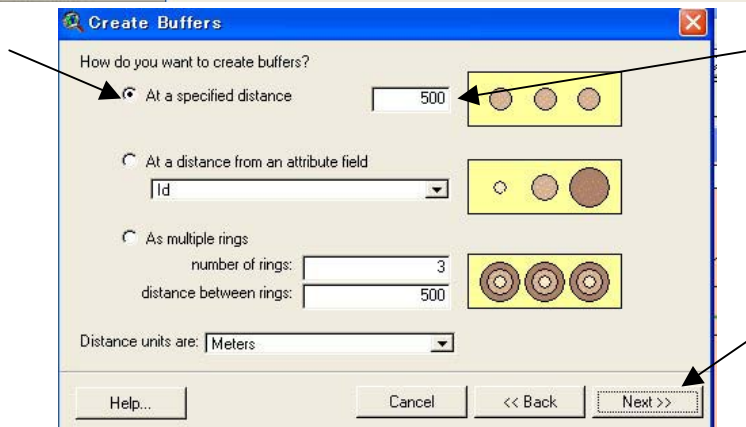
Without setting map unit and distance unit, Arc View function “Buffering” could not work. If you can not find “Create Buffers” within the pull down menu of View, you need to check map scale setting procedure.

[Buffering]

Open pull down menu of “Theme” and select “Create Buffers” -> Mark to “the feature of theme” on the Create Buffers box -> Open pull down window and set a theme (shape file/ trystram.shp) to create buffer from. -> Click “Next” button -> Give mark to “At a specified distance” and key in meters (500m), then click “Next” button. -> Mark whether Dissolve barriers between buffers (Yes).-> Mark on in a new theme and give new theme name and folder where the new shape file to be stored. Then click finish button on the Create Buffer box.

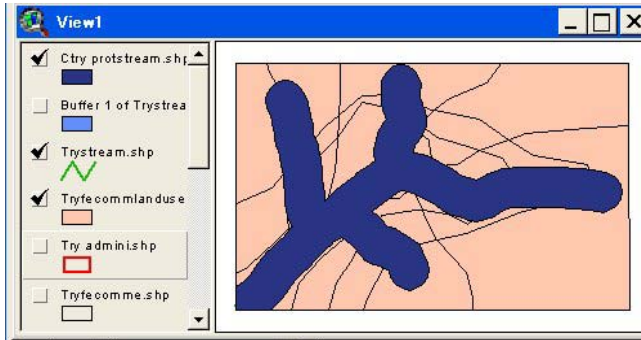


d:\y...yGISmanual\trial



The area distance from stream line is drawn. But the area is exceeded to the area of total administration boundary, therefore, you need to cut the polygon where exceeded. Procedures are follows (Using Crippling of geo-processing between “try protstream.shp and Try admini.shp. See 2.11.2).

View (Geo-processing) -> Crippling ->Next -> Set input theme=try protstream.shp, Crip theme=try admini.shp, New theme name=try protstream01.shp, folder= D:\y...yGISmanual\trial -> Finish



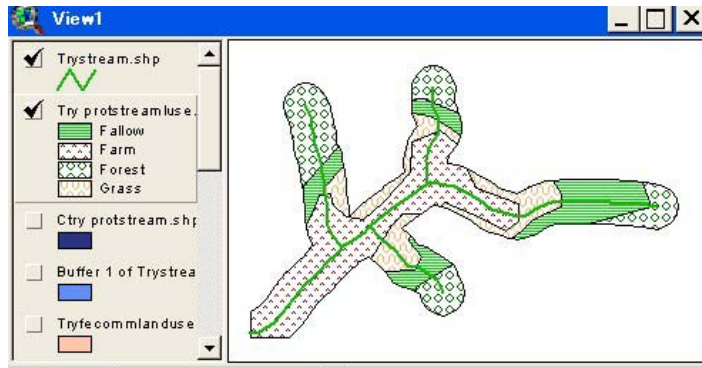
[Intersect between new theme/shape file and land use.]

Procedures are follows (Detail is shown 2.11.3).

View (Geo-processing) -> Intersect -> Next -> input theme=try landuse.shp, overlay theme= try protstream.shp, new theme= protstreamluse.shp folder=D:...¥GISmanual¥tryal -> finish -> {(arrange legend) -> click twice protstreamluse.shp to call legend edit box. -> click rode legend button -> select land use, then OK}

You can draw land use condition on the area 500m distances from streamline and “dbf” table as below. Area is calculated (process explained on 2.8.6).

Shape	Id	Area	Landuse	BufferDis
Polygon	0	7392627	Farm	500.0000
Polygon	0	1178165	Grass	500.0000
Polygon	0	882103	Grass	500.0000
Polygon	0	1288210	Grass	500.0000
Polygon	0	579215	Fallow	500.0000
Polygon	0	420677	Fallow	500.0000
Polygon	0	2048869	Fallow	500.0000
Polygon	0	668800	Fallow	500.0000
Polygon	0	754090	Forest	500.0000
Polygon	0	1826753	Forest	500.0000
Polygon	0	833573	Forest	500.0000
Polygon	0	878796	Forest	500.0000



Part II How to use GIS for forest management planning

1. Preparation of the practice

1.1 Objectives of this practice

This part will explain how to process the shape files that were prepared for the master plan formulation for the forest management plan of a Forest Enterprise. The procedures to use GIS for analyzing forest condition and to organize planning items to harmonize forest management objectives for sustainable management are introduced in this part. First process is how to arrange GIS data for a Forest Enterprise from existed shape files of full area of Kon Plong district Vietnam.

1.2. Contents of the shape files for Kon PLong

The shape files for the Master plan formulation consist as follows.

File name (shp)	Type	Contents	Remarks
Geography			Digitized from published topographic map (1/50,000) by PASCO
cont50000kp.shp	line	Contour line by 20m	
houseskp.shp	point	Position of hamlets	
n road24kp.shp	line	National road	
p roadkp.shp	line	Provincial road	
riverkp.shp	polygon	Big river having recognizable area	
streamkp.shp	line	streams	
Administration			Administration maps of Kon Tum and Kon Plon People's
adminikp.shp	polygon	Outline on the study area	
communekp.shp	polygon	Outline of communes	

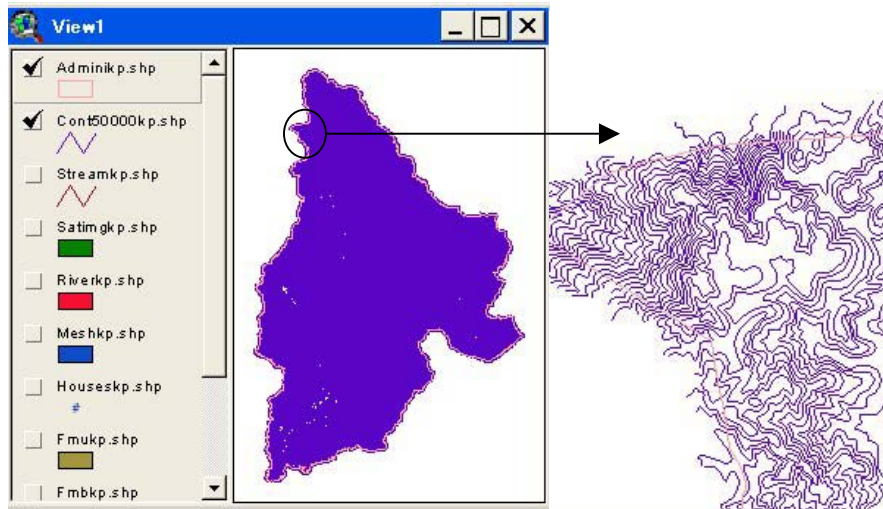
fekp.shp	polygon	Outline of Forest Enterprises	committee
Management unit			
fmukp.shp	polygon	Outline of Forest management unit by authorities	Forest situation map of Kon Tum FPD and information from FEs
fmbkp.shp	polygon	Forest management block	- do above-
Manage factor			
corrid kp.shp	polygon	Proposed bio-corridor for wildlife protection	Proposed by the study team
prot func kp.shp	polygon	Proposed areas to refrain logging operation for maintain functions on water, soil, and land conservation.	Analyzed using mesh data, and proposed for sustainable forest management
prot steepkp.shp	polygon	Proposed areas to set aside from logging operation as steep land.	- do above -
meshkp.shp	polygon	Mesh analysis base data	Mash analysis conducted by the stuffy team

Forest/Landuse			
satingkp.shp	polygon	Saterait TM image for land use and forest condition (2001)	TM data converted by PASCO technical group
ftypelusekp.shp	polygon	Latest forest type and land use that were used for the master plan formulation by the study team (2001)	Formulated using TM data, aerial photograph and field survey

For the formulation of logging operation areas are calculated using these shape files on Arc View. The forest areas had grown and reached to enough size of stands and volume for yielding are recognized on land use and

forest type map. Basically 5 factors for sustainable management are considered such as, to maintain or not to make negative effects to water, soil, and land conservation, to avoid too steep areas, to conserve wildlife, to protect village daily water sources, to support villager's to improve standards of living. The areas matching above five factors are excluded from logging operation areas from matured forest areas. These areas fixing had analyzed using GIS Arc View.

Following figures show the image of each shape on a View screen of the Arc View.

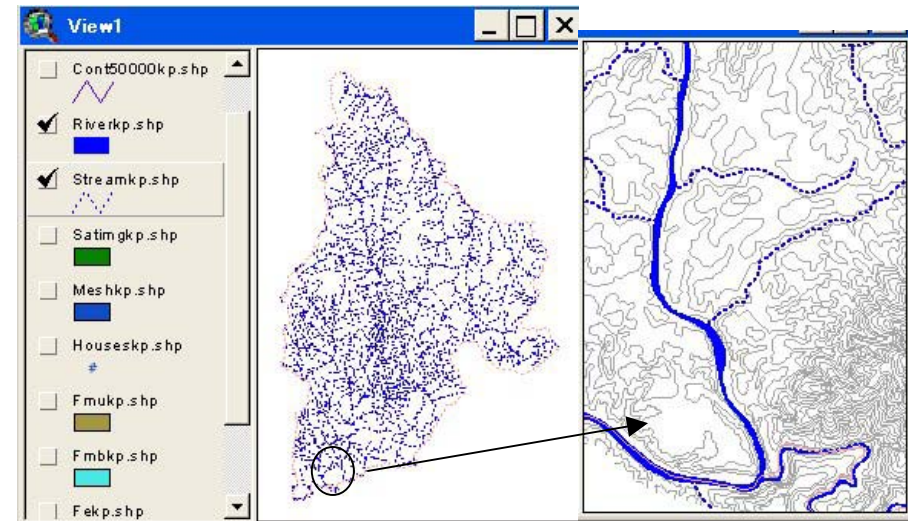
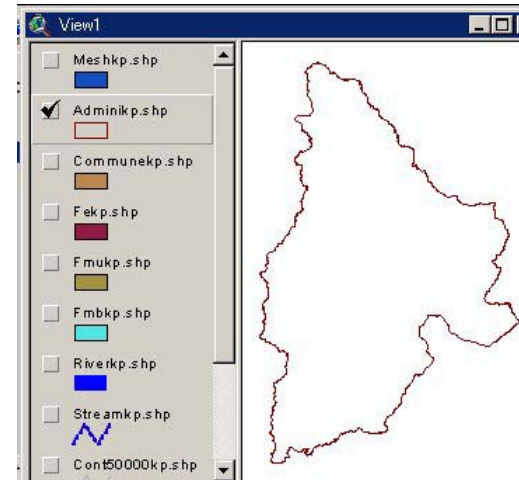


cont50000k.shp : Contour lines (1/50,000) on the View screen. Right side figure is Zoomed in the shape file.

adminik.p.shp: The study area total.

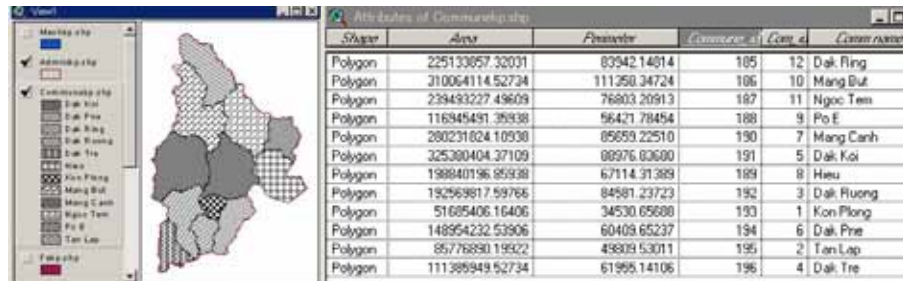
Contour lines are the bases to judge land feature analysis, such as complication of landscape, elevation, slop angle. The mesh analysis of land

feature pattern had implemented using 1 cm mesh on the 1/50,000 topographic map to count how many contour lines located in a mesh square.



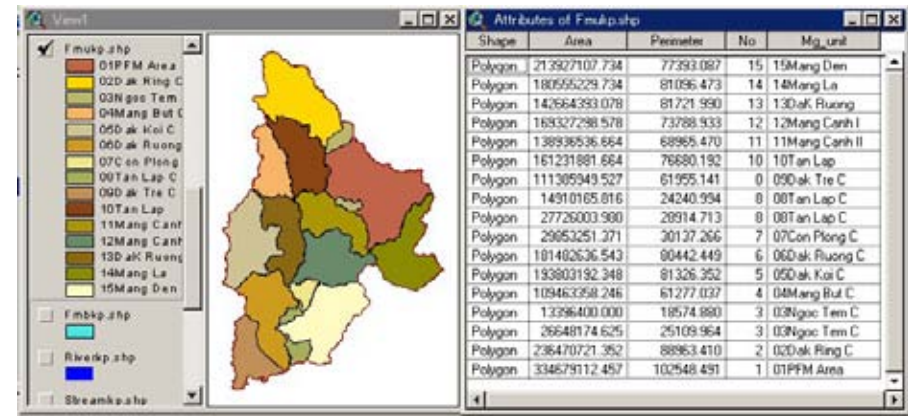
streamkp.shp and riverkp.shp: river line map is important information to

examine forest road planning.



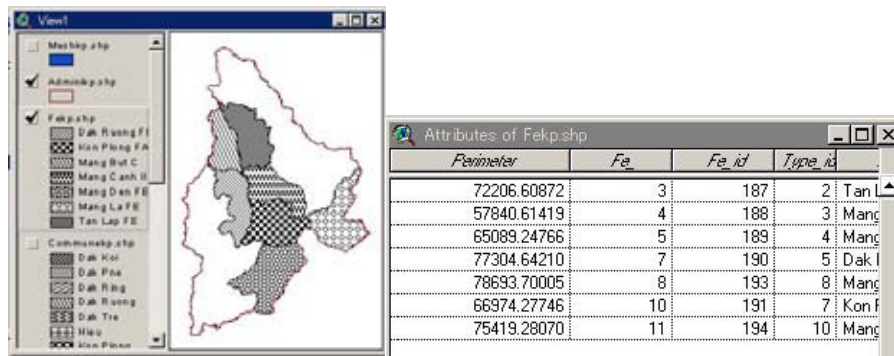
commune.kp.shp and table:

This table have fields ,area, perimeter, Block number, commune ID, and commune name. Perimeter means length of outline of each polygon. Block number shows one block name within the polygon. This field is not important. Commune ID shows official ordering on general statistic table, therefore to arrange tables concerned this field “com ID” may use to make tables ordering indicator.

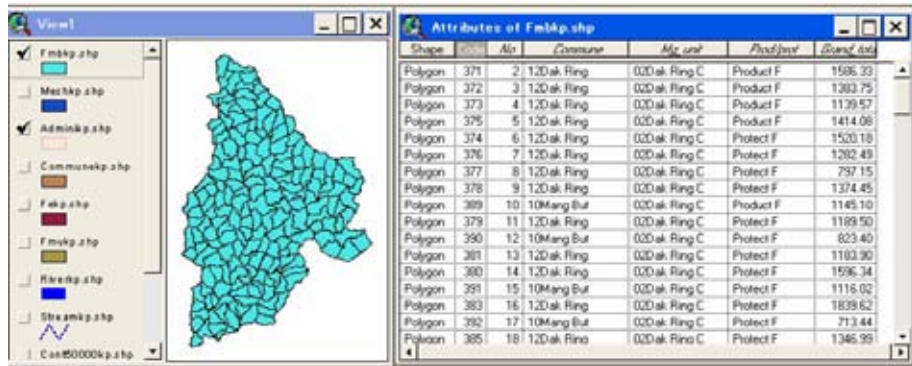


fmukp.shp and table

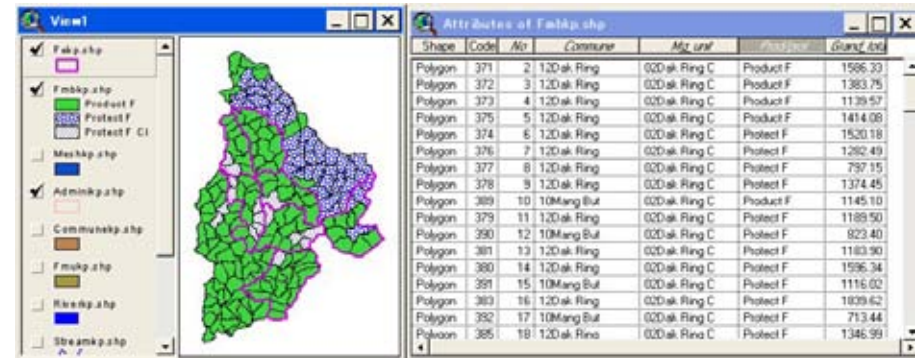
Forest management unit means jurisdictions by managing authority including Forest enterprise and outside of FEs. The areas not covered by FE is basically defined that protecting responsibility of the areas are belonging with commune authority (People’s committee of each commune).



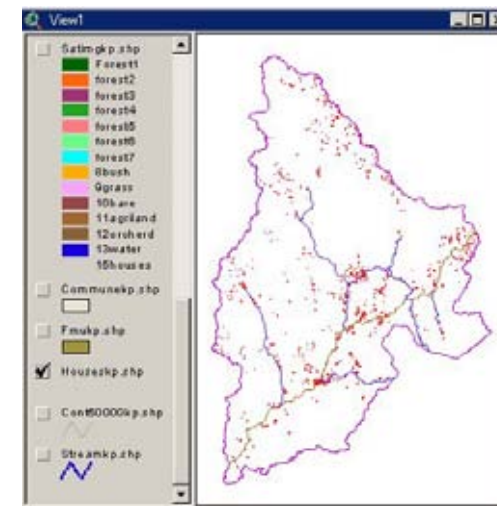
fekp.shp and table



Fmbkp:shp : Forest management block and table. This table has fields for, linking with, Commune name, FE name, and whether the block belongs production forest, protection forest or crucial protection forest. Figure below shows the blocks categorized forest management objectives (production forest or protection forest. GIS Arc View can draw map divided polygons into different color or pattern using a category in a field data. Therefore, using this table's fields, maps showing by commune, by management unit, and by management objectives are can be drawn. If you add some other categories on new fields for example population by block, original forest shear (%) by block, etc. you can draw these map on the Arc View screen.

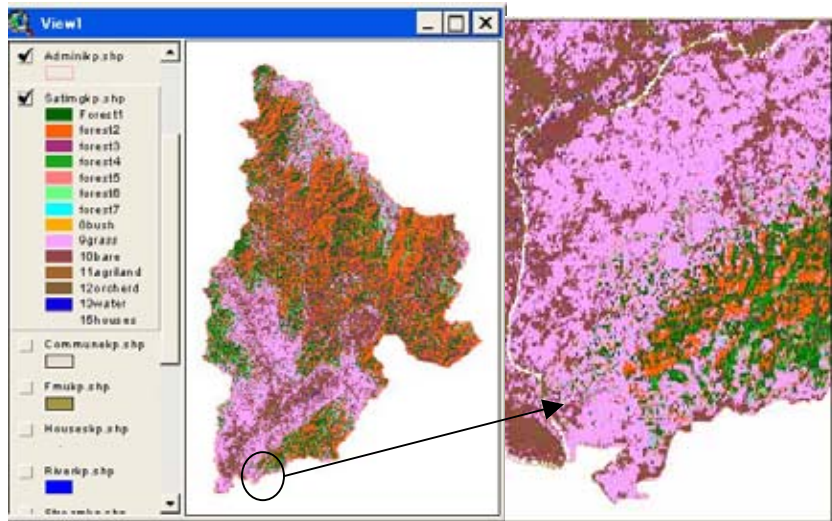


Above figure shows blocks divided into crucial protection forest, ordinary protection forest and production forest, and same time added FE boundary.

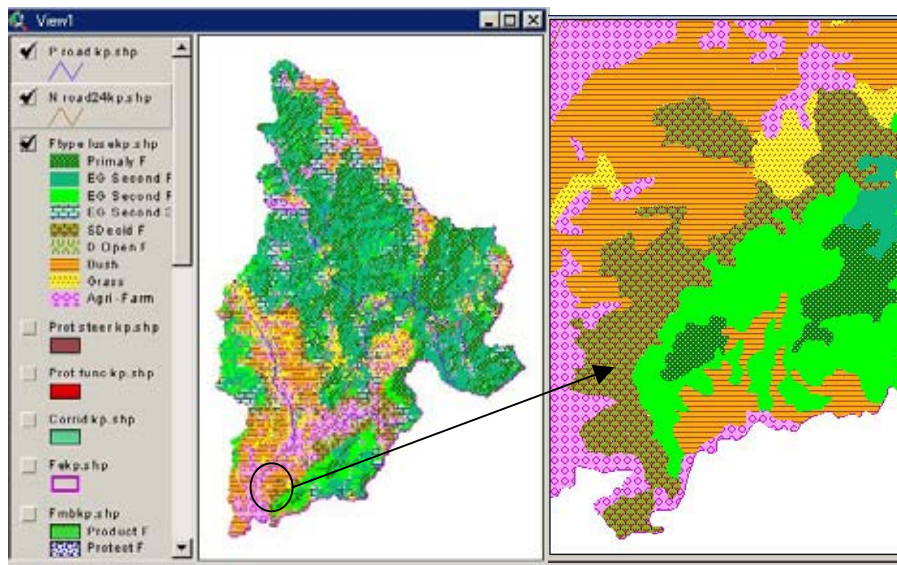


Houseskp:shp and N rode24kp.shp, P roadkp: This shapes show the location of hamlets and public roads that were recorded on 1/50,000 topographic map. This information is used for selection of the areas for

villager support program.



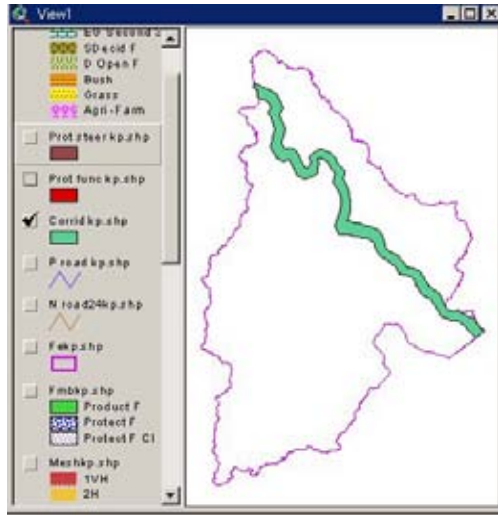
Satingkp.shape: 2001 satellite data processed figure for land use and forest types.



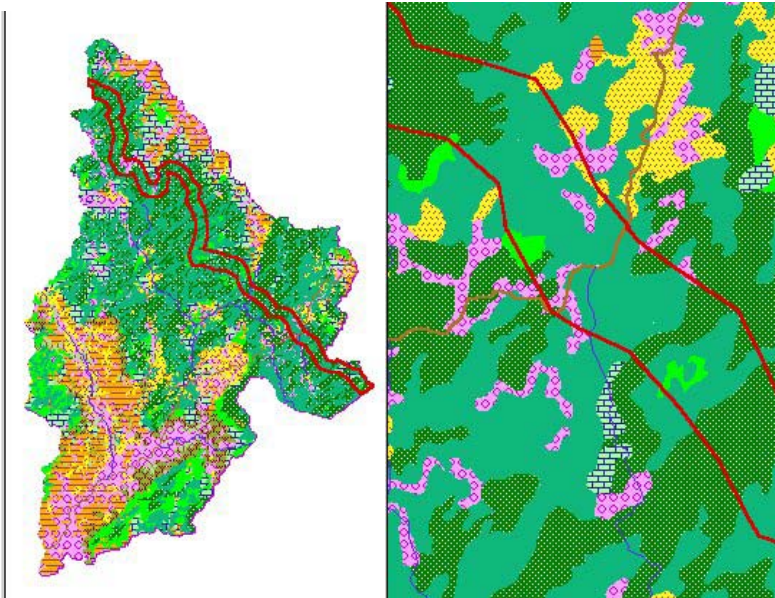
F type Lusekp.shp :Final arrangement for Land use Vegetation map. This shape file is bases to fix logging operation areas as matured and enough volume and stands size to meet yielding standards.

Next several shape files show regulating factors for logging operation on conserve water, soil and land, wildlife protection, and steep areas for logging operation. For wild life conservation, the Master Plan proposed by the Study the team a bio-corridor. Bio-corridor proposed is located in the matured natural forest and as far as possible to avoid across the areas affected with human activities except several points to cross national and provincial roads. Steep areas identified using contour line density and drew the polygons by manual control of Arc View drawing function.

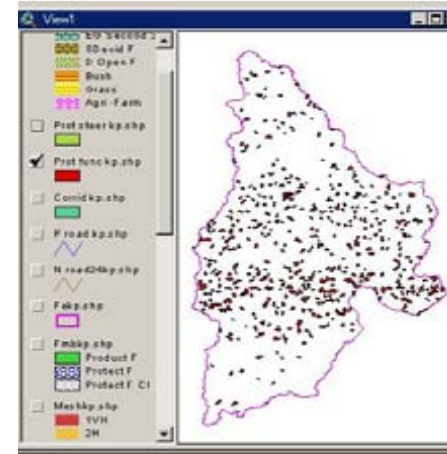
For conservation of water, soil and land, first topographic analysts had done by mesh analysis. Every mesh had categorized into three factors and several categories, thereafter, these each mesh had given scores for each forest function, then these three functions are integrated. The analyzing methods is explain in supplemental data book of the final report of this development study cooperation.



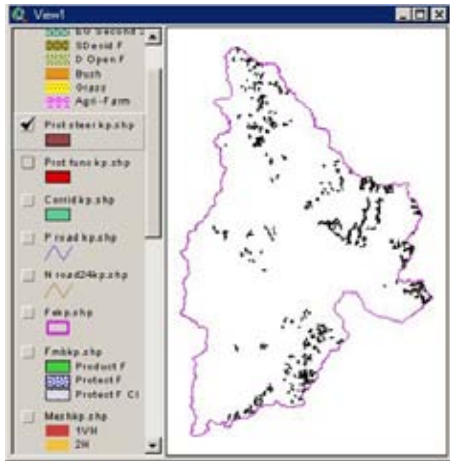
from human affected areas shown the zoom in figure. On this place the bio-corridor cross the national road, and surrounded national road some small rice field along the stream are located. To maintain bio-corridor, cooperation and collaboration measures with these people who cultivating paddy farm there are important. The forest management planner easily can identify where the important places, village, hamlets, or inhabitants necessary to approach for wildlife protection through analyzing this kind of View.



corrid kp.shp : down two figures drew with forest type. Bio corridor pass through thick forest basically, nevertheless, could not avoid completely

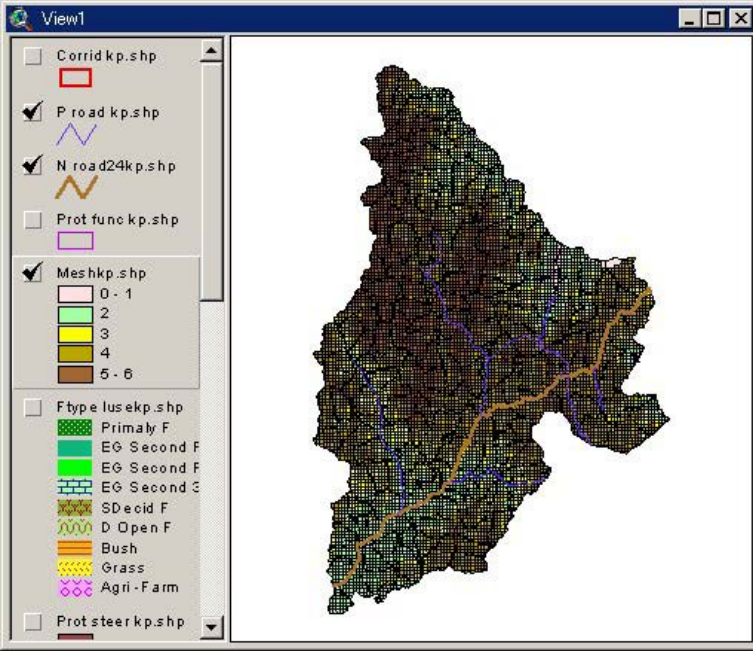


prot func kp.shp



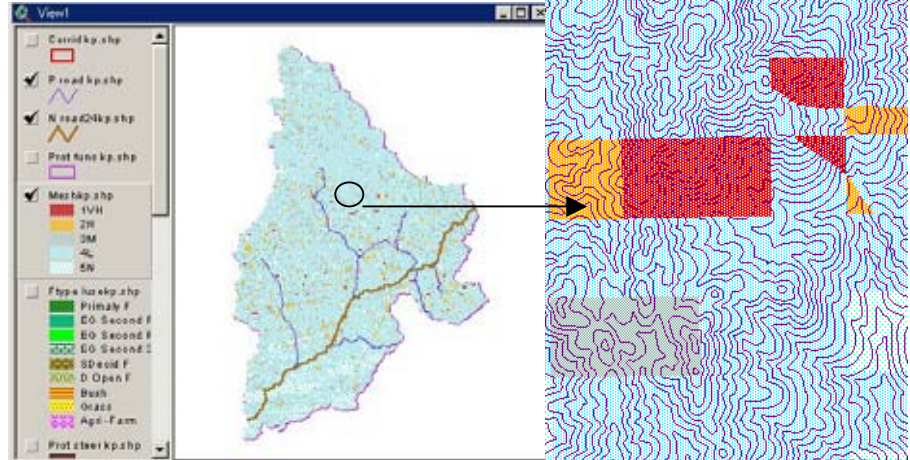
prot steepkp.shp

Mesh analysis

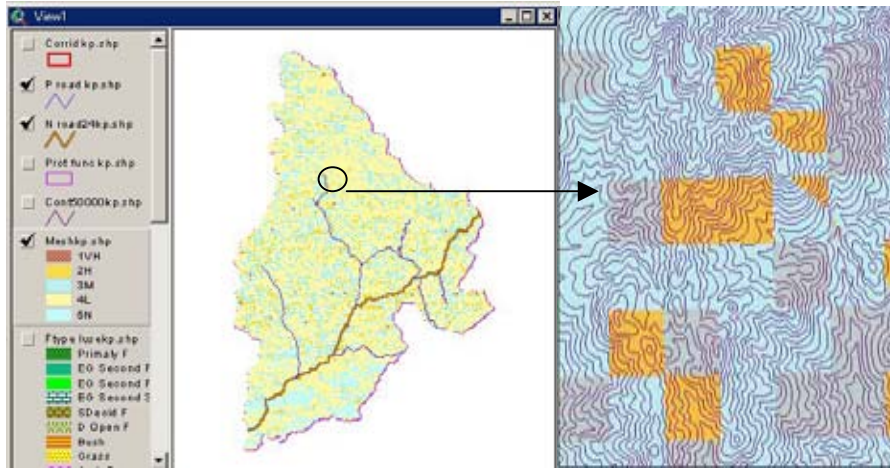


Shape	Area	Perimeter	Perim/A	Code	Var	Hor	Elev	Class	Riv. no	Topo. Res	W. topo	S. topo	L. topo	Complex	Angle	Waterc	Soils	Lands	Integr	
Polygon	162286.000	1598.573	1	371	1	Z	1540	6	1	4	4	A	B	C	D	A	2H	3M	4L	3
Polygon	85121.160	1482.616	2	371	1	Y	1620	6	0	4	3	A	B	C	D	A	2H	3M	4L	3
Polygon	80176.020	1351.916	3	371	1	AA	1300	5	1	4	4	A	B	C	D	B	3M	3M	4L	2
Polygon	54256.900	1154.733	4	371	1	X	1680	6	0	1	3	A	A	C	D	B	3M	3M	4L	2
Polygon	1514.527	195.385	5	371	0		0	0	0	0	0	A	B	C	D	A	2H	3M	4L	3
Polygon	196678.700	1820.212	6	371	2	AB	1300	5	0	4	2	A	B	C	D	B	3M	3M	4L	2
Polygon	249966.900	1999.868	7	371	2	AA	1300	5	2	5	3	A	B	C	D	A	2H	3M	4L	3
Polygon	249982.300	1999.929	8	371	2	Z	1440	5	1	4	3	A	A	C	D	B	3M	3M	4L	2
Polygon	249997.600	1999.990	9	371	2	Y	1450	5	0	5	2	A	B	C	D	C	4L	4L	4L	0
Polygon	249886.900	1999.130	10	371	2	X	1580	6	0	5	2	A	B	C	D	C	4L	4L	4L	0
Polygon	80275.980	1380.264	11	371	2	W	1600	6	0	1	2	C	A	A	D	B	4L	3M	3M	2
Polygon	13503.780	630.393	12	371	0		0	0	0	0	0	A	B	C	D	B	3M	3M	4L	2

Read from topographic map
 Read from topographic map
 Classify effects by function
 Integration and final judge

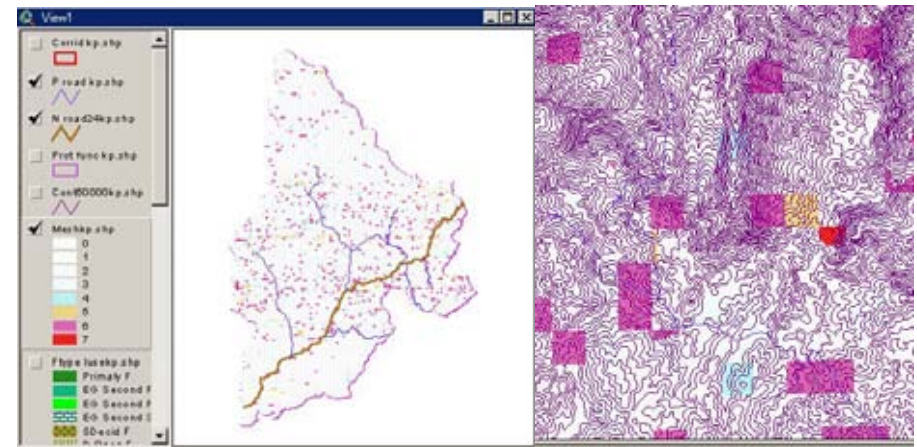


Field of water conserve on the Meshkp.shp. Important places for water conservation.

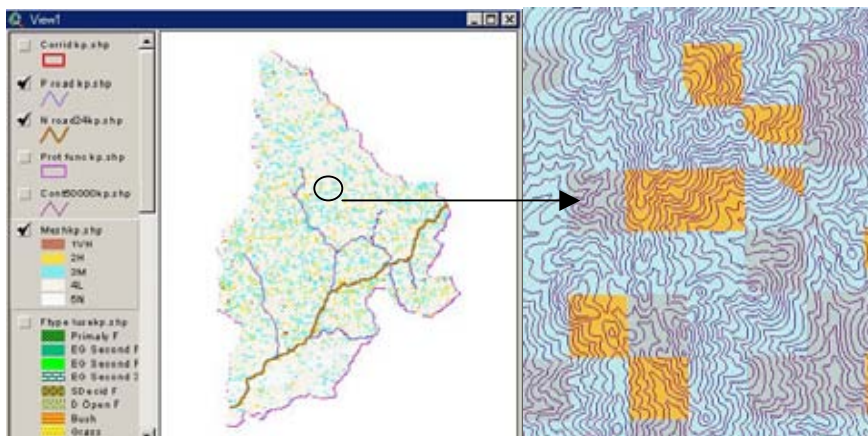


Field of soil conserve on the Meshkp.shp. Important places for soil conservation

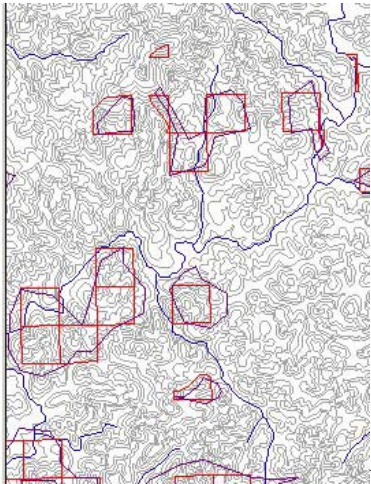
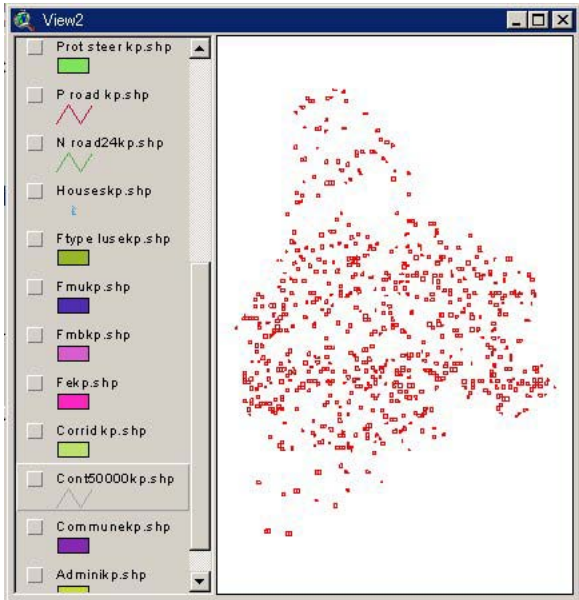
Field of land conserve on the Meshkp.shp. Important places for land conservation



Field of integrated function judgment on the Meshkp.shp. Important places for conservation of forest function conservation are shown.



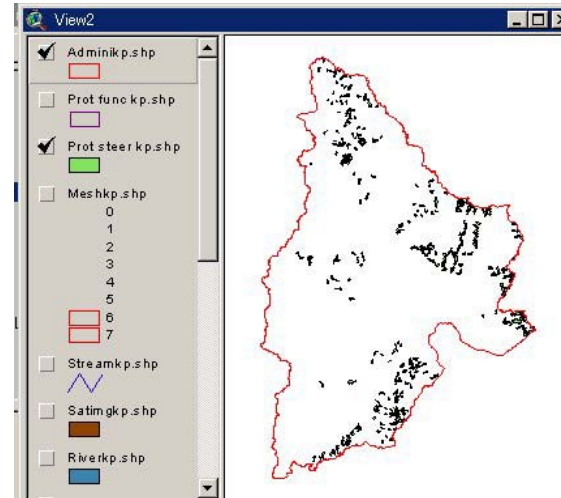
Important places for forest function conservation capability, the places Integrated functions show on mesh are harmonized to the real topographic feature matching contour lines of 1/50,000 map. The new shape polygons are drawn using drawing instrument of the Arc View.

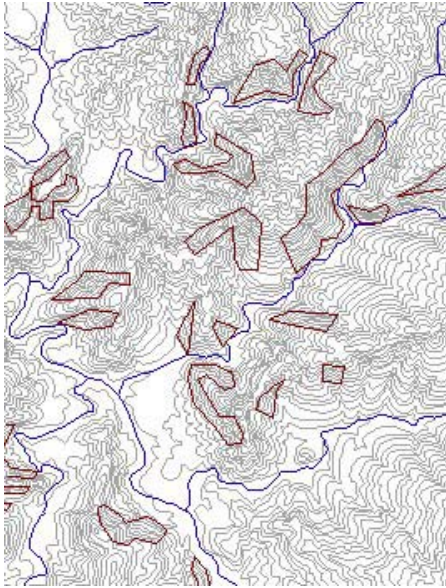


prot func kp.shp

Up figure shows important places for forest function (water, soil, and land) conservation by mash bases. Down figure shows the mesh

convert to polygon to adjust real land feature. Steep areas set aside logging operation is fixed by 1/50,000 topographic map, and drawn polygons on the map by manual using drawing instrument of the Arc View.





prot steepkp.shp

2. Usage of GIS for Forest management planning on a Forest enterprise

In this section, the manual shows and explains how can use GIS data for forest management plan on a Forest Enterprise. Basically, GIS shape files prepared for the forest management master plan shown on the previous section are processed and used.

How operate GIS Arc View is explained on Part I, therefore, in this section, operational process are not explained detail. Please see the previous part if you feel hard how to follow the explanation and reproduce figures and tables.

In this manual shows a sample of the management planning procedure and calculation. The work will carry on the area of Man Den FE. In the real planning you need detailed land use information, forest inventory data etc. are needed, nevertheless, in this manual these data are not available, therefore, forest situation data is used same one prepared for master plan for practice.

The sample result is not means the real forest management planning. For the real forest management plan formulation, you need more detailed maps, field knowledge, socio-economic survey and other field observation are indispensable, especially latest forest inventory for land use and forest type, real volume estimation, etc. are needed to survey by your authorized organization.

2.1 Arrange shape files for Man Den FE

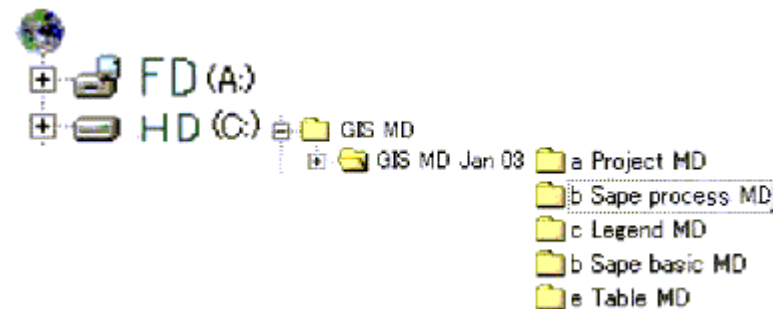
First you need every shape files arrange for Man Den FE. Clip the all shape file listed on 1.2 part II by administration area shape of Man Den FE. Procedures are follows:

a. Copy all shape files (including dbf, shx, and others on Kon Plong

The files stored on CD attached with this manual Foldr of “GIS KP). Copy all Data files (shp,dbf, shx, and other processed files) to your computer on a Folder (example, C:¥GIS KP).

b. Prepare holders for storing files for Man Den FE.

Sample is follows:



c. Start Arc View/Esri 2/3

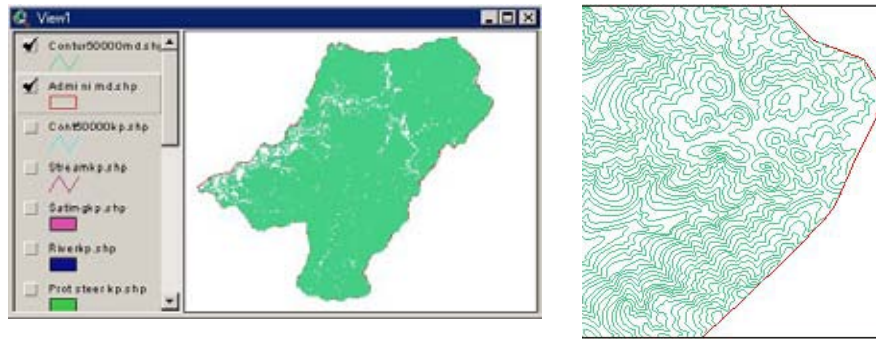
d. Add all shape files for first View

Add shape files from the folder “sape origin” under the folder “a master plan Kon Plog”.

e. Make administration area shape (polygon) of Man Dan FE

Select "FE.shp" -> open table -> select record of Man Den on field FE ID -> poen menu "Theme" and select "Convert to Shape file" -> Give new shape file name (admini MD.shp" and assign a folder (c:\GIS MD jan03\ shape process MD) -> OK

Note: The file "fe.shp" is located on subfolder "shap origin" under the sub folder "a master plan Kon Plong"



f. Clip all shape files of Kon Plong by admini MD.shape

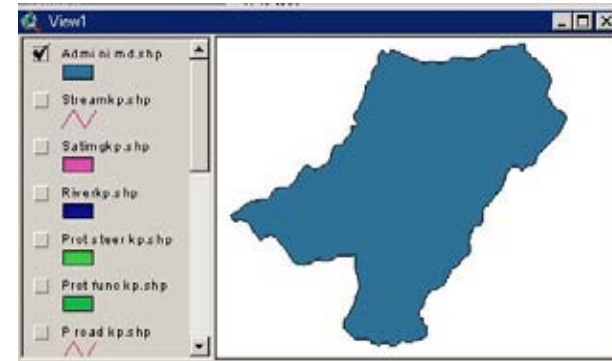
First, set the Geo-processing function to active (Process is explained on 2.11.2 of the Part I).

Example is to create contour of the area Man Den FE

Open menu of View and select Geo-processing. -> Mark to Clip -> Give shape file names (Input theme= cont50000kp.shp, Clip theme -> admini MD.shp) and folder for saving new files (c:\GIS MD jan03\ shape process MD\cont50000md) -> Click finish

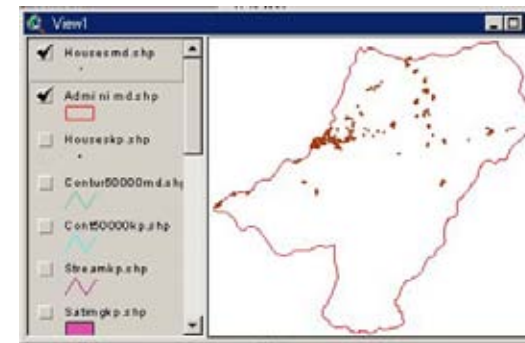
Repeat sama process for other Kon Plong shape files, then you can

create following shape files limited on the area of Man Den FE.

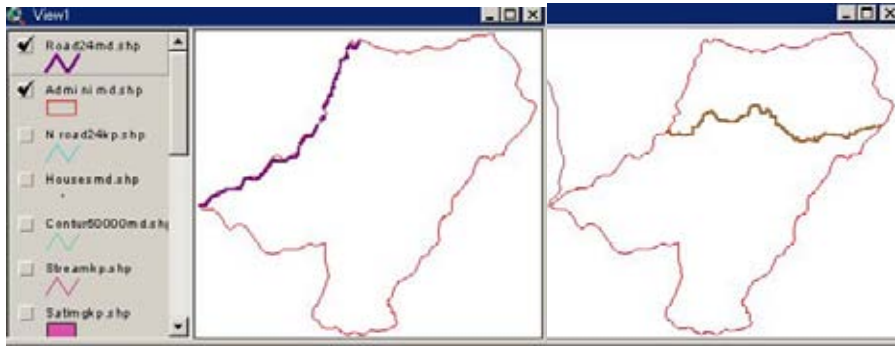


Admini md.shp

cont50000md.shp

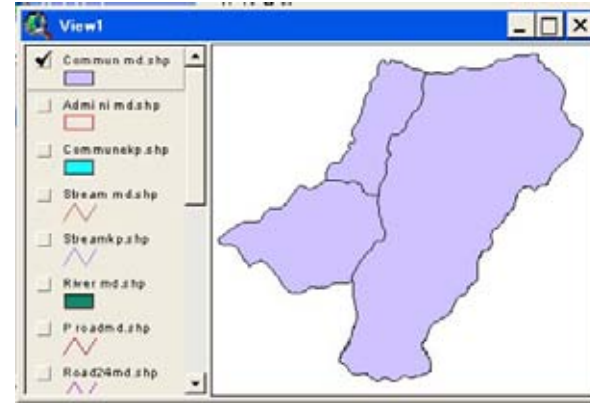


housesmd.shp



Road24md.shp

Proadm.shp

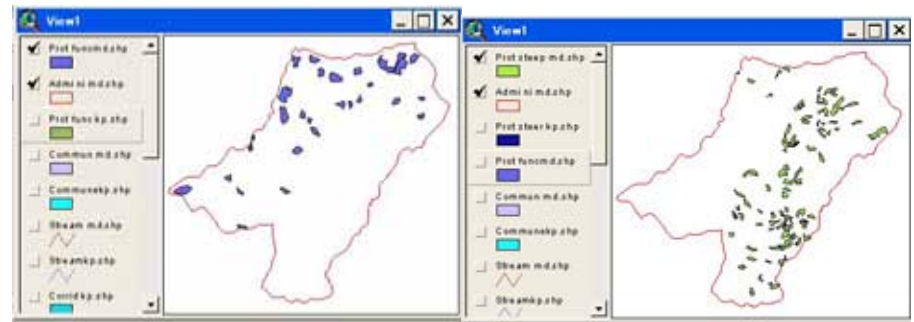


commune md.shp



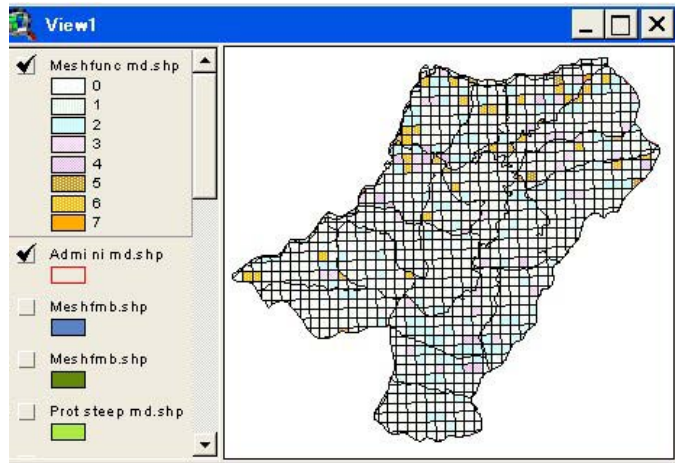
river md.shp

stream md.shp

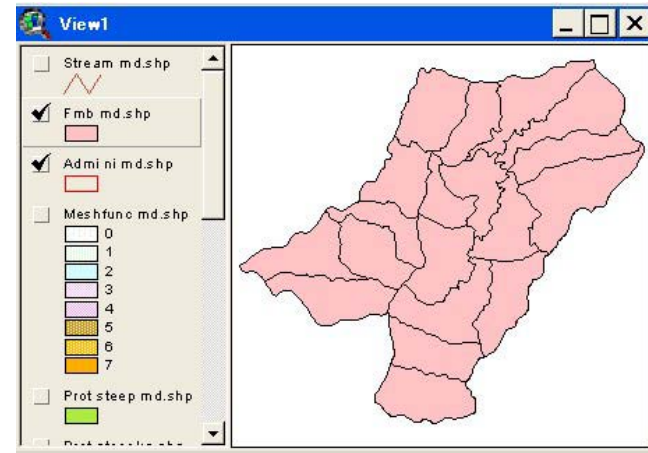


prot func md.shp

protsteep md.shp

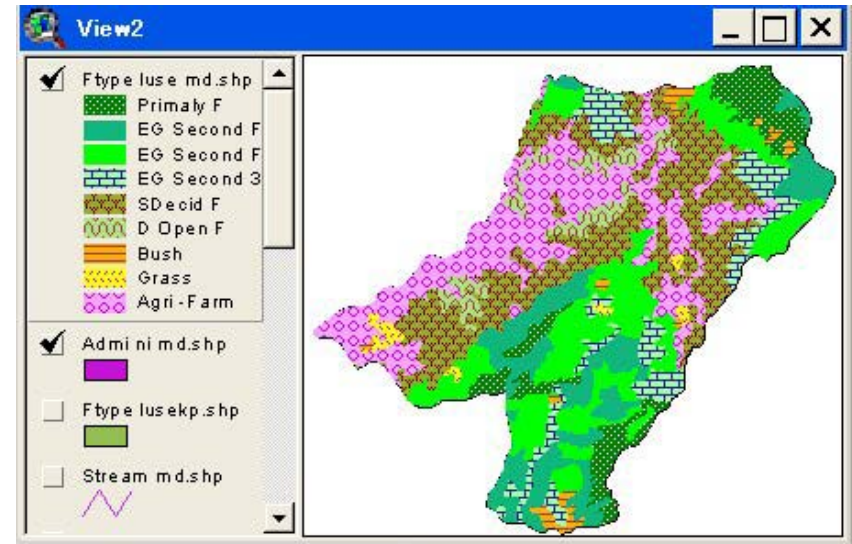


meshfunc md.shp (category integrated)

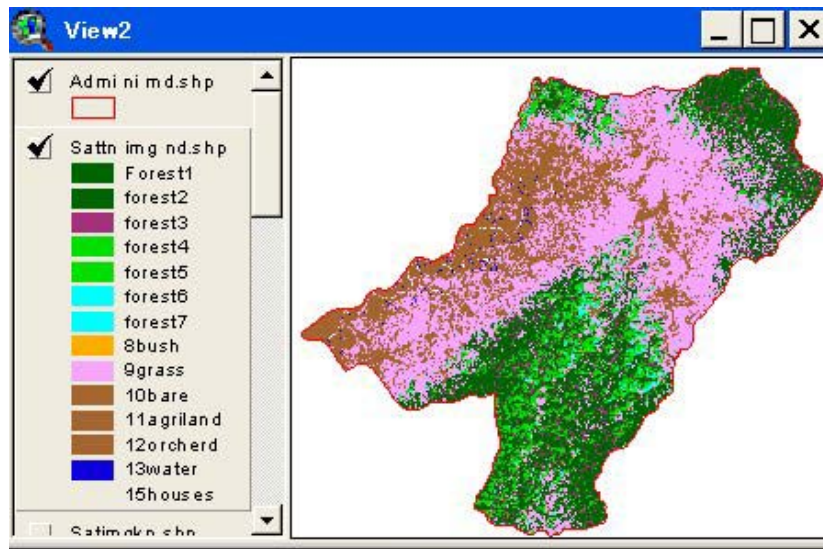


fmb md.shp

Note: Legend had arranged by score of the effective degree to integrated forest functions. How to operate legend is explained on 2.3.2 of the Part I.



ftype luse md.shp



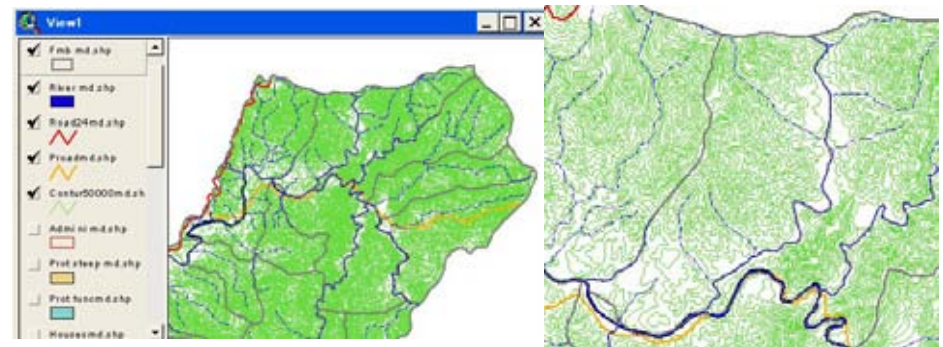
Sattmni md.shp

[Prepare compartment map as a shape file]

The yearly logging operation plan usually made based on compartment system to fix the places. Man Den FE have a map on compartment system. You can make compartment system as shape file (compart md.shp) using stream line and counter line data on Arc View screen.

Give mark on “fmb md. shp”, “nroad24md.shp”, “proadmd.shp”, “stream 10 md”, “river 10 md” “cont10 md”, on the view screen and arrange the order of these shape files from top to bottom in same order.

Then you can draw via screen as follow.




The compartment map is drawn to amend on block map, therefore, you need to make new shape file for amending block map. To make copy of the fmb md.shp as the new filename “comp md.shp” is follows:

Select “fmb md.shp” -> Open theme and select “convert to shape file” -> give new file name and folder (comp md.shp, c:\gis md\gis md jan 03\shape basic md) -> OK -> Yes -> arrange legend pattern from fill pattern to outline pattern (process is explained 2.3.2 of part I)

Now you had done the preparation work to draw compartment. Start to add polygons for compartment using block boundary lines. Procedures are follows:

Select “comp md.shp” ->Open “theme” and select “start editing” -> Open “draw instrument” and select “dividing polygon” button ->

Select a polygon for dividing -> draw new polygon to divide a compartment from a polygon (block) -> repeat same process for every compartment from a remaining part of the polygon(part of a block) -> repeat same process to other blocks

Note: To divide a polygon using “divide polygon instrument” you have to select a polygon to be divided using  button and click the part of the polygon to put selected condition. When you click the polygon the outline point will change the selected pattern.

When you finish dividing compartment from blocks, open “theme” and select “stop editing” -> Make answer “yes” to save the edited results

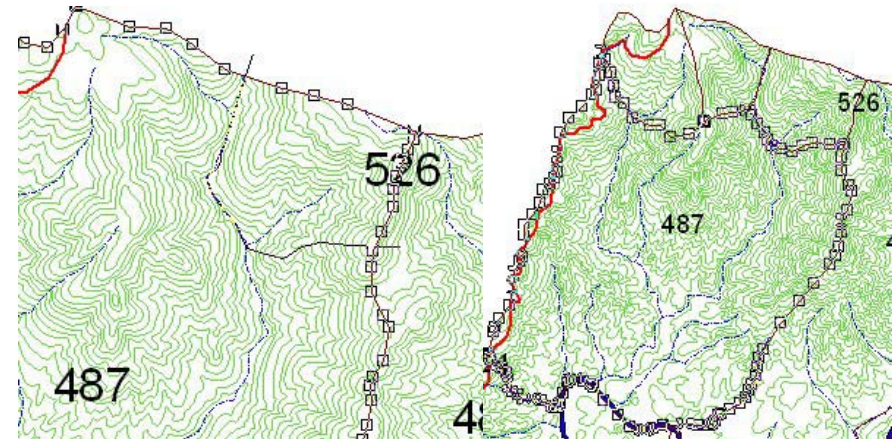
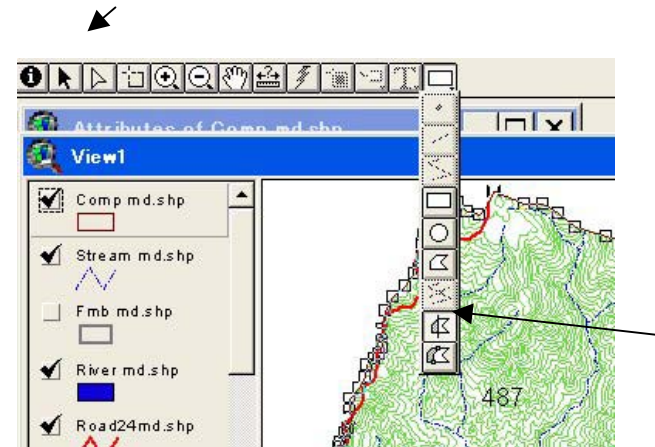
Then calculate areas by compartment.


Open table (check the shape file “comp md.shp” is under the selected condition) -> Open “edit” and select “new field” -> give new field name (area comp), and decide type of the field (number), width of the field (16) then the table create a new field ->Select the new field (click the name of the field) -> Click calculation button -> Give “[shape].returnarea” on calculation box then OK -> all columns of the field “area comp” is filled number of area (sq m)


Note: Area calculation procedures is explained on 2.8.6 of part I

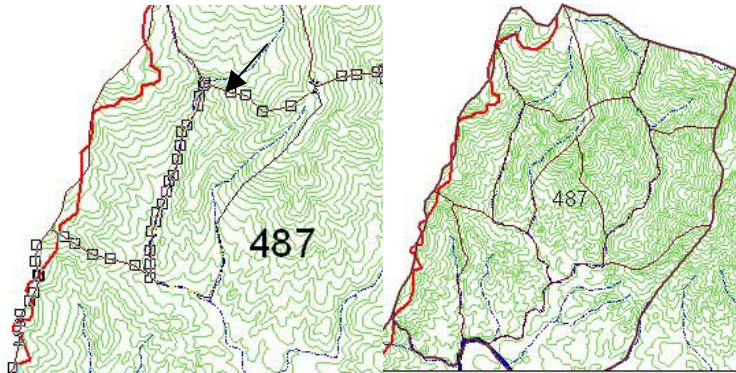
Block 487, for example, area 1287 ha is divided into approximately 100ha units/compartments. The block may be divided into 10-14 compartments.

Following compartment dividing work is a sample. In your real work for management planning you use your compartment map to trace ridge line or stream line to comparer with Arc View contour lines and your compartment map.



click the area of block  (+ cursor) then the area boundary point will

change to selected condition. select polygon make instrument , then put cursor where you want to divide a part for compartment from a block. Starting point set outside of the selected boundary line, then next point cross the line. The last point should be put cross the selected line, then click twice.



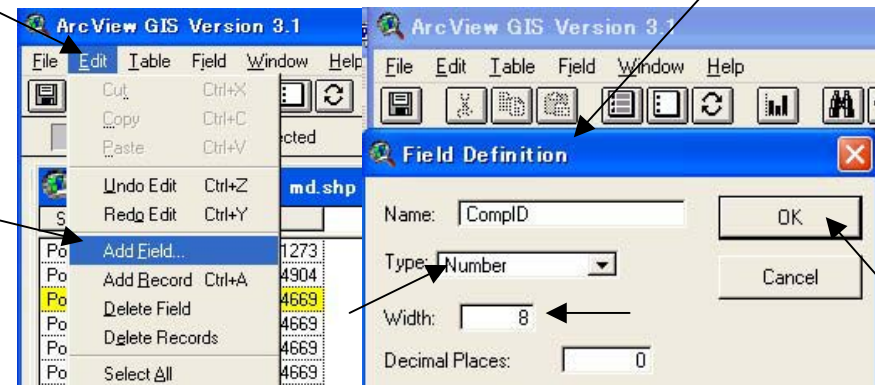
Finally you made 11 compartments on block 487.

Next you need to give names for the divided compartment. Procedures are follows

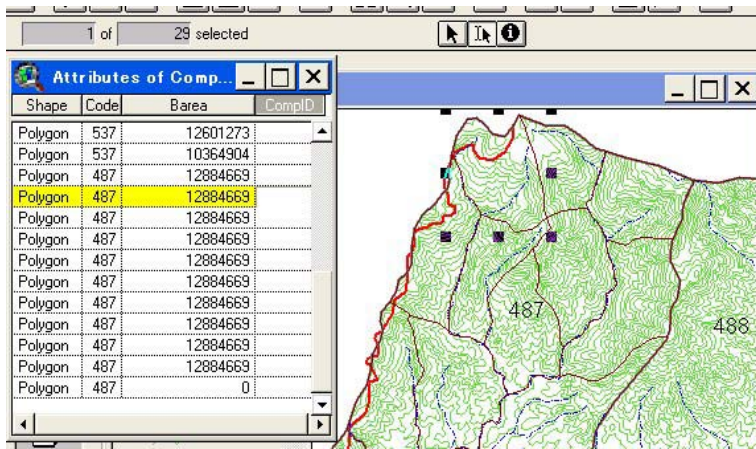
- Start editing, and Open the table
- Make a field to store the compartment name/number
- Fill the record for each column of the field
- Make a field for compartment area
- Calculate areas on the compartments
- Stop editing and save the edited results

Shape		Barea
Polygon	537	12601273
Polygon	537	10364904
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	12884669
Polygon	487	0

The table "comp md.shp" have field "code" and "Barea". Block 487 have 11 records, but area shows same number. This Barea means original Block's area, the new polygon had divided from block 487 and original area of the block is 1288469 sqm. You have to make two fields for record storing of compartment (name of the compartment and area).

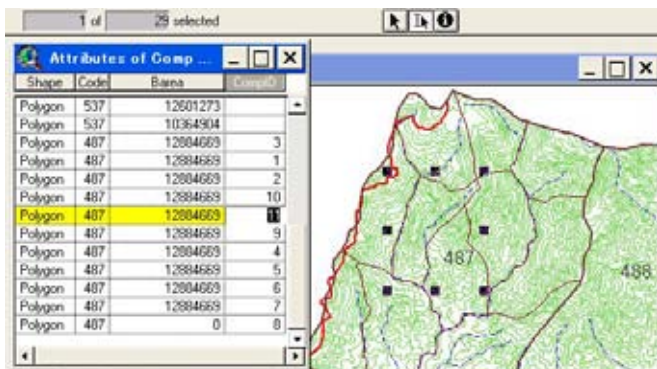


Make new fields using table definition box.



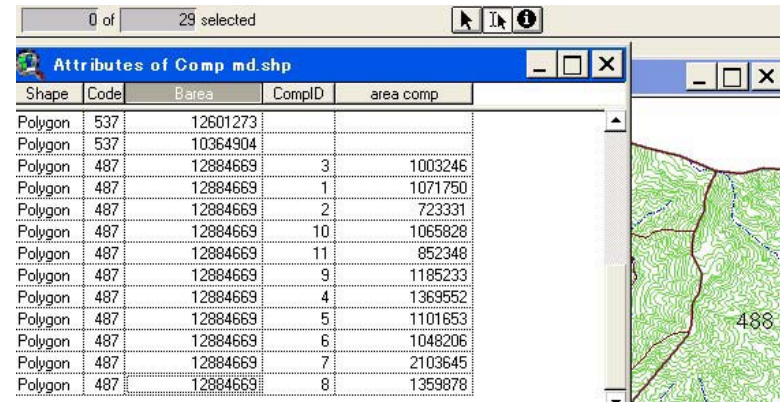
Select a record using that you want to give a name (1-11). Selected record line will change yellow and same time the polygon is marked on the view screen. Then click the column using pointer (cursor will change to “hand mark”). Type the compartment name.

Repeat this process for compartment 2-11 using select and write instruments.

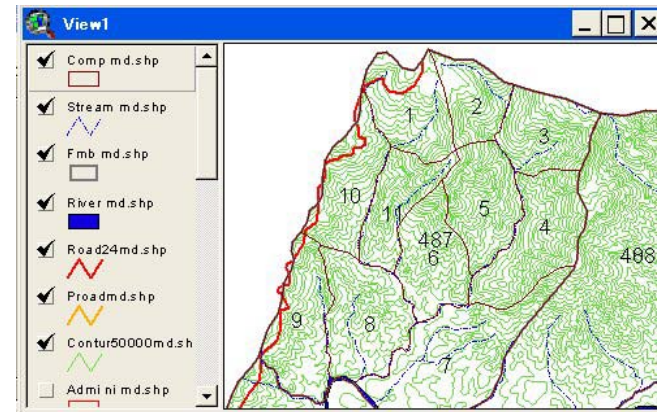


All compartments is given a name. Then make new field for compartment

area “comparea”. Calculate areas to use icon.



Areas by compartment are automatically calculated.



Draw labels for compartment and check the name of compartment.

(Note: To use auto label, you need to stop the editing, and store the edited shape file. Then after select “thema”, auto label.)

3. Processing shape files for management planning

Now you had prepared shape files for analyzing Man Den Forest Enterprise forest condition. Nevertheless, some shape files are needed to arrange more detailed one, such as base map, land use (paddy field and upland farm), forest condition, etc. The existed shape files were drawn based on 1/50,000 topographic map. For the management operation plan, you need may be 1/10,000 topographic map. Land use especially distribution of farm land including slash and burn fields where some body have traditional light to cultivate is directly effects for forest management by the FE.

In this part, some shape files are created as sample, therefore, you need to draw these shape files based on your field survey, observation of aerial photograph and field verification and other concerned maps made by related authorities for confirmation.

3.1 Process for management planning and area calculation by GIS

For formulation of forest management plan, you need to hold the latest situation of the management area on natural, and socio-economical condition. GIS itself, gives no information about management information. You need to arrange management information connecting with map. This manual is not touched the matters how this information should be collected. You need to collect these original data from various maps, field

observation, and/or your original ideas.

After collected data connecting with geographical location data, and overlaid these map data, then, GIS gives you a strong tool for analyze, organize these data connecting with map (location, area, geographic relation with multiple factors between or within).

This part explains how focus to logging operation areas and how calculate logging size to take into account sustainable forest management using GIS Arc View. Principles how to select the areas for logging operation follows the principles that the Master Plan presented by the JICA study team (Main Report).

3.1.1 Flow of the works

The processes to focus logging operation areas are mainly consisted to combine the data following 6 separated works.

Fix the forest areas where matured (tree size and average volume per hectare are reached yielding standards). (land use and forest type)

Fix the areas to be set aside from logging operation based on various factors for realizing sustainable management such as, water, soil and land conservation, wildlife conservation etc.

Fix the areas to be set aside from logging operation based on natural condition (steep, swamp, land slide, special soil pattern, high elevation, etc.).

Fix the areas archeological and historical areas to be protected,

Select the areas for villager support (target areas for agro-forestry and/or farm land development).

Fix the areas needed for daily water source protection for isolated hamlets and paddy fields.

The logging operation area (LA) is defined as:

$$LA = - (+ + + +)$$

Then areas for logging operation and possible volume of yielding by block or compartment are calculated by exported table from Arc View to Excel.

The calculation on various aspects could be done focus on the factors on each fields stored on Arc View table (dbf).

The areas of logging operation by block or compartment is defined using Arc View's function of geo-processing to merge several shape files with the shape file of block or compartment.

The each procedures of to are explained following chapters.

3.1.2 Fix the forest areas

Forest condition of the Man Den Forest Enterprise is described on the

shape file "ftype luse md.shp". Nevertheless, this map had drawn using satellite image and on the map of 1/50,000. For the management plan of real operations, you may need more large-scale map and more detailed information about the forest such as volume size, crown density, main commercial wood species share, etc. For this you have to create a new shape file storing such information. Therefore, you need additional field survey data collection and careful observation of aerial photographs. Then you have to prepare detailed forest inventory map. How to identify the forest types, crown density class, and to divide the forest areas into several groups focusing to possibility for logging operation is next step. This procedures especially how to use aerial photographs will explain in other technical manual. The study team provided 1/20,000 aerial photographs on 2001 and 1/10,000 topographic map for the areas on 6 Forest Enterprises in Kon Plong district.

Note: Provided aerial photographs is covered 65 % of Kon Plon district, therefore, some southern parts of the study area is requested to use old aerial photographs (1991).

Topographic map 1/50,000 is provided in digital map as well as hard copy covered full Kon Plong district, and stored shape file format on the attached CD.

[Land use and forest type identification]

Detailed forest type and land use condition map is made by manual to use aerial photographs, knowledge obtained through field survey, and other information that you can collect and existed shape file “ftype luse md.shp”.

First you make new theme shape file “f condition md.shp”, or several shape files such as for farm land, forest, grass land, to divide several categories of the land use and forest type condition to draw. If you make several shape files for land use and forest you have to keep in mind the polygons on different shape files are never duplicated (same place have not defined different land use, for example, if a part of the place defined rice field on a shape file is included grass land on the other polygons is strange). If polygons on different shape files duplicated, total areas for land use and forest may exceed than the total administration area. Therefore after formulated shape files you need to delete areas duplicating. On the other hand, each factor of land use, in real job, so many polygons have to drawn, therefore, every items to draw same time is not easy and difficult to avoid conducting errors. Delete this duplication may troublesome but can implement computer practice.


In this manual, land use and forest type map is made separated shape files, such as, farmland, grass land, other non-forest land, and forest land, then after integrate all shape files to “ftype luse md.shp”. Then evaluate records by fields, and identify the combinations never happen, then delete all records from the integrated shape files.

If you want to use shape files divided category, you can make new shape

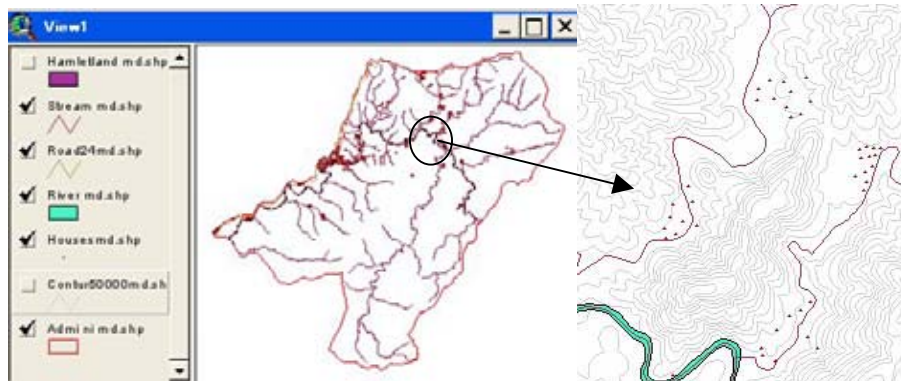
files to select from final shape file “ftype luse md.shp” by selected category using command “create new polygons”. How to delete duplicated polygons is explain other section below.

(1) Village area for houses

Village area is identified from aerial photographs. You make polygons on a new theme shape.

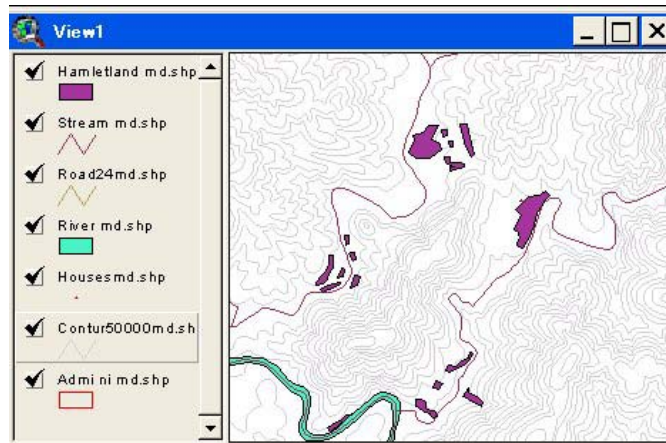
View -> New theme -> Select the form of shape (polygon) -> Type a file name “hamletland md.shp” and assign a folder name to store the new file -> Draw polygons using drawing instrument .

Before to start the drawing, you arrange the first view screen showing several shapes help your next job. Same times every shapes needs to be prepared suitable legends for easy identification. The following figure shows sample view screen for preparation. The view screen shows administration area, river and stream, and houses position that were picked form 1/50,000 topographic map. To draw the polygons you need to enlarge the areas focused on the place where villages located. It may effective to show contour lines (contour50000md.shp) to hold exact place.




View screen for village areas drawing

You have to create polygons on the areas houses lands. The locations shows on view screen (zoom in screen showing right side above) is some times not correct (in old location), therefore, you need careful observation of latest aerial photographs and fields.



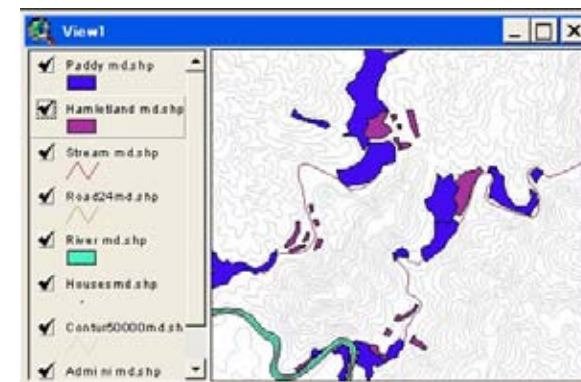
Areas had drawn the village houses.

Check the table and arrange data files. Make new fields (Vill ID, Ham area) and fill records to identify the records meaning (paddy). Then calculate areas by a polygon using calculator icon  (Please see 2.8.5 and 2.8.6 part I).

Shape	Id	Vill_id	Ham area
Polygon	1	Hamlet	7091
Polygon	2	Hamlet	49200
Polygon	3	Hamlet	9924
Polygon	4	Hamlet	20967
Polygon	5	Hamlet	5484
Polygon	6	Hamlet	5554
Polygon	7	Hamlet	4960
Polygon	8	Hamlet	6488
Polygon	9	Hamlet	2879

(2) Farm land

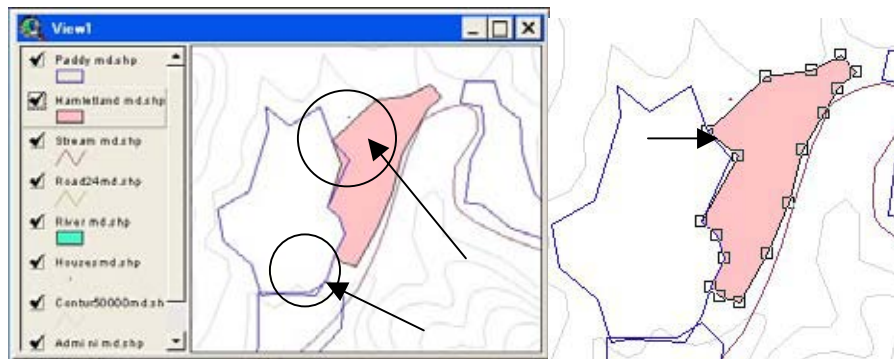
Farmlands are categorized paddy fields, fixed farmlands, and upland farms. First you try to create a shape file “paddy md.shp” using aerial photographs. Process is same as village areas polygons drawing.



Areas of the paddy fields

(3) Delete duplications

The polygons hamlets and paddy fields are drawn by manual. Usually these two types of areas are closely connected, therefore some times two polygons drawn over lapped (duplicated). You need to check and amend these polygons to delete duplications. For the checking of the duplication, shows the polygons on outline type using legend change, if two shapes are duplicate you can see on the view screen.

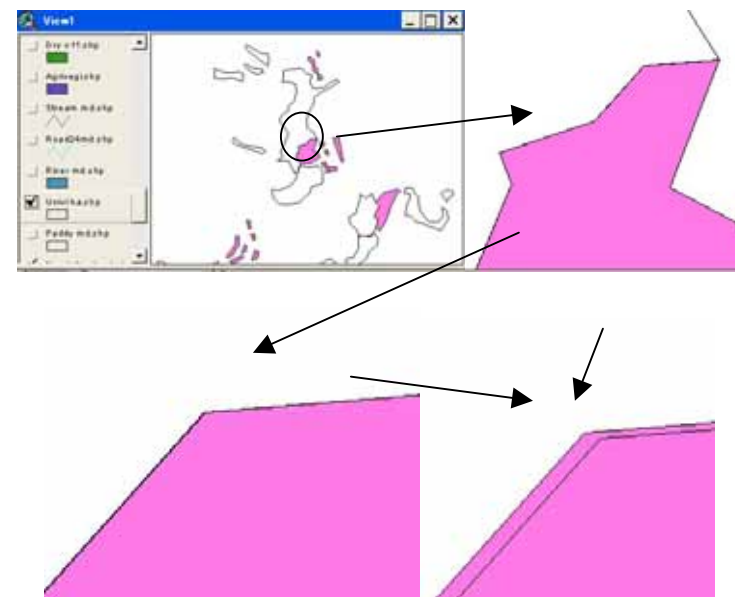


Click a polygon under the selected and editing condition, the outline points of the polygon will change as above view. Put the cursor on the point to be amended and draw your mouse to move the point on the right point to avoid duplication. These amendments should be done within the same shape file as well as different shape files.

If the drawn polygons are small number, you can amend other polygons through same process above. Nevertheless, on actual job, you have to




manage thousands of polygons, to amend polygon-by-polygon is may be troublesome. More systematic way can apply as follows using function of Geo-processing.

- Union two themes as a new shape
- Look table of the new shape
- Check records where one polygon have two id (paddy, hamlet)
- the polygons c. above are the places duplicated
- select record duplicated then watch view screen the place is shown selected condition
- zoom in the place, and decide union the polygon to continuous one.



Shape	Id	Area	Vill_id	Ham_area
Polygon	119	57658	0	0
Polygon	121	154781	90	26422
Polygon	121	154781	90	26422
Polygon	121	154781	90	26422
Polygon	121	154781	90	26422
Polygon	121	154781	0	0
Polygon	0	0	6	5554
Polygon	0	0	20	34113
Polygon	0	0	54	24759
Polygon	0	0	55	27519
Polygon	0	0	90	26422

After the geo-processing “Union” done, on the top of Legend part of the view screen new shape (named uni pad ham.shp) will come. Give check mark to the new shape and delete check mark from other two shape.

Start editing to the new shape (uni pad ham.shp) (Check the mark had changed to or not). To expand the view , you can find the duplicated parts if it is very small. Open the table . The polygons duplicated can identify on the table. If there are no duplication, polygons have records only paddy or hamlet. If data find both columns of a record, the polygon is the part of duplicated. Calculate areas for every record .

Delete small polygon (less than 100 sqm for example), or union the duplicated polygon to hamlet polygon connected (priority is given to the hamlet area). Check whether editing condition

All duplicated polygon had removed. Then every record has only one identifying code (hamlet or paddy). For the next polygons drawing, this table should be arranged to delete unnecessary fields and order like following figure.

Shape	Id	Vill_id	Ham_area	Idb	Area	Idb	Agri_id	area2
Polygon	103	Hamlet	1673	0	0	0		1673
Polygon	104	Hamlet	4098	0	0	0		4098
Polygon	105	Hamlet	4052	0	0	0		4052
Polygon	106	Hamlet	3605	0	0	0		3605
Polygon	0		0	1	24812	1	paddy	24812
Polygon	0		0	2	13054	2	paddy	13054
Polygon	0		0	3	81609	3	paddy	81609
Polygon	0		0	4	14540	4	paddy	14540
Polygon	0		0	5	81548	5	paddy	81548
Polygon	0		0	6	24995	6	paddy	24995
Polygon	0		0	7	5772	7	paddy	5772

Delete field: Under the table view, Edit -> Delete field -> OK

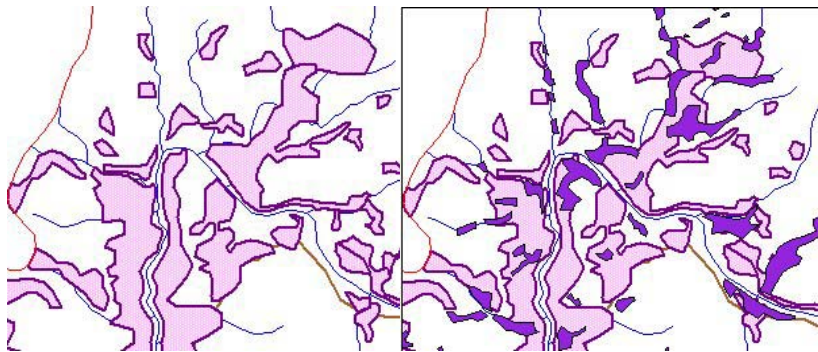
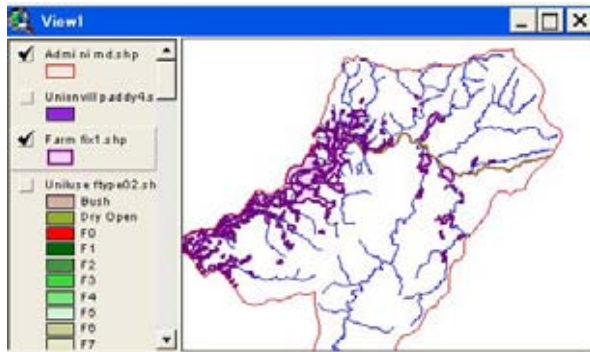
Arrange the field order: Click a field name -> Drag and drew the field to the place you want.

Shape	Id	Vill_id	Idb	Agri_id	area2
Polygon	103	Hamlet	0		1673
Polygon	104	Hamlet	0		4098
Polygon	105	Hamlet	0		4052
Polygon	106	Hamlet	0		3605
Polygon	0		1	paddy	24812
Polygon	0		2	paddy	13054
Polygon	0		3	paddy	81609
Polygon	0		4	paddy	14540

(4) Fixed farm



Fixed farms are located surrounding hamlet areas, paddy fields, therefore to draw polygons not duplicated such areas polygons is not easy on manual drawing. The polygons for fixed farms are drawn the outer boundary lines including such areas, then after, the polygons hamlet and paddy are delete from the polygons drawn by manual through similar procedures as (3) above.

Fixed farms are drawn as figure below.

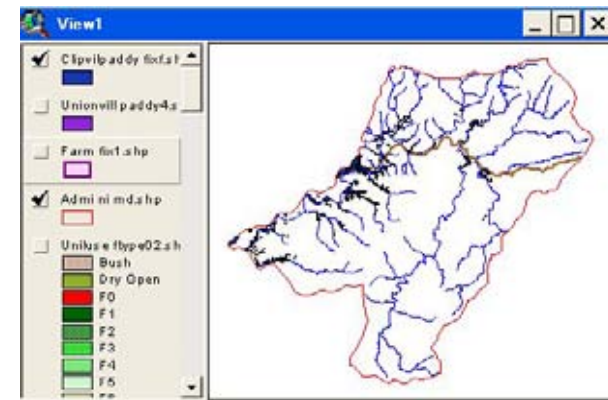


Polygons for fixed farms (Farm fix.shp) and overlaid paddy and hamlet area (union villPaddy4.shap that had created (3) before).

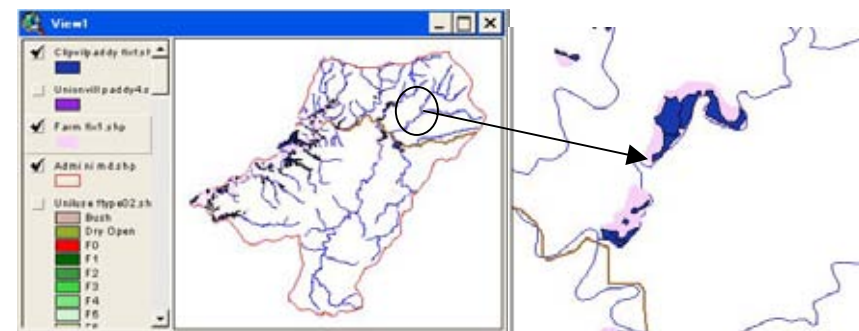
The fix farm areas are identified as follows

- a. First, unitize polygons of fixed farm you draw. Add a field on the table and fill column of record as "fixfarm" (Theme -> Start edit -> Open table -> Select all  -> Close table -> Edit -> Union Graphic -> open table -> Edit -> Add field(farmid) -> type "fixf"  -> Close table -> Theme -> Stop editing -> Yes)

- b. Areas paddy and hamlet (union villPaddy4.shap) within fixed farm(Farm fix.shp) are picking up using geo-processing "Clip" (clip vilpaddyfixt.shp)
- c. Union "Farm fix.shp" and "clip vilpaddyfixt.shp" on a new shape (Uni fixfpaddy.shp).
- d. Delete the polygons that have record other than fix farm id (Fixfarm02.shp)
- e. Make new shape (Luse01.shp) by union "union villPaddy4.shp and "Fixfarm02.shp".



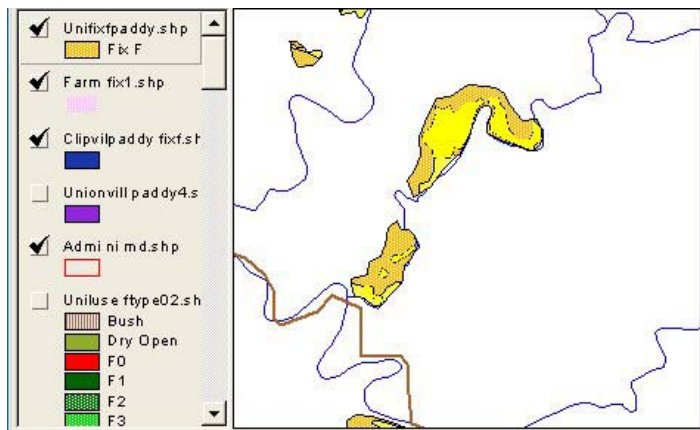
Clipped polygon hamlet and paddy within Fixed farm polygon (b.).



Over lay the polygon with fixed farm.

Note: Before geo-processing check tables. Each table has a field to identify the belonging category (Identification field). All columns of a field that the record of the polygons belong which category (Paddy and village or fixed farm) have to be filled.

Through this checking, areas of the polygons to be calculated. Small area polygons (less than 100 sqm) you find, is better to delete.




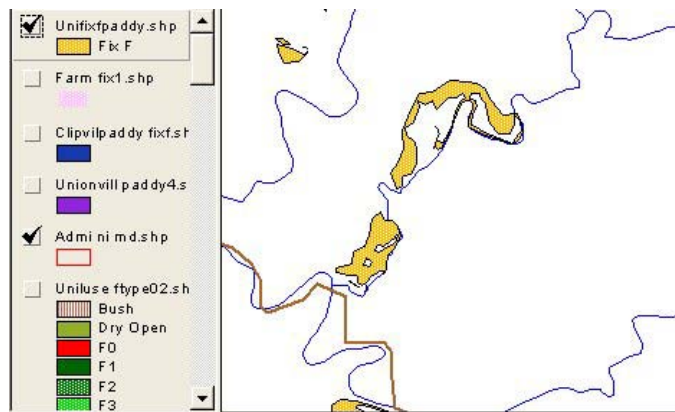
Result of the geo-processing “Union”

Shape	Code	Areablock	Farm_id	Id	Vill_id	ldb	Agri_id	area2
Polygon	0	76356	Fix F	0		0		0
Polygon	0	39633	Fix F	0		0		0
Polygon	539	820946	Fix F	50	Hamlet	0		108127
Polygon	539	820946	Fix F	51	Hamlet	0		10239
Polygon	539	820946	Fix F	52	Hamlet	0		1722
Polygon	0	0		20	Hamlet	0		33177
Polygon	539	820946	Fix F	0		0		0
Polygon	539	820946	Fix F	0		0		0
Polygon	0	0		6	Hamlet	0		5808
Polygon	0	0		97	Hamlet	0		1942
Polygon	0	0		82	Hamlet	0		16961

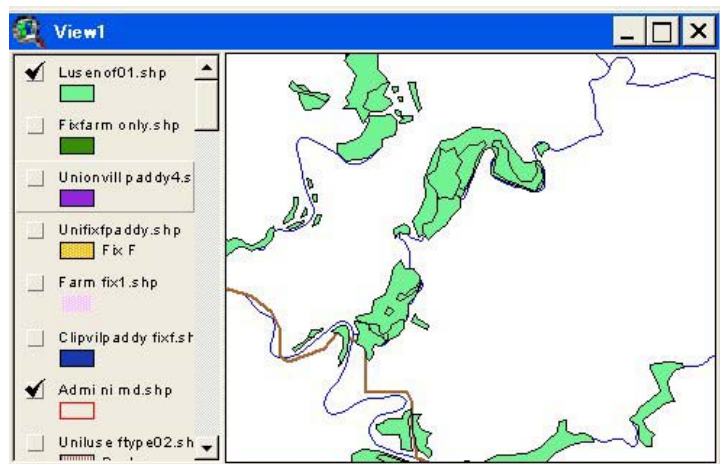
The table shows that many polygons have two categories Fix farm and Hamlet or Fix farm and Paddy. These polygons means not the fixed farm but the other categories area, therefore, these polygons have to delete.

Shape	Code	Areablock	Farm_id	Id	Vill_id	ldb	Agri_id	area2
Polygon	0	76356	Fix F	0		0		0
Polygon	0	39633	Fix F	0		0		0
Polygon	539	820946	Fix F	50	Hamlet	0		108127
Polygon	539	820946	Fix F	51	Hamlet	0		10239
Polygon	539	820946	Fix F	52	Hamlet	0		1722
Polygon	0	0		20	Hamlet	0		33177
Polygon	539	820946	Fix F	0		0		0
Polygon	539	820946	Fix F	0		0		0
Polygon	0	0		6	Hamlet	0		5808
Polygon	0	0		97	Hamlet	0		1942
Polygon	0	0		82	Hamlet	0		16961

To select every records that have “hamlet” or “Paddy” using select icon  (If you want to select records same time “shift + click”) like above figure. Then delete all records (computer delete polygons automatically), and you make final fixation of the farm areas polygons as below.



Finally you make Land-use map combined hamlet, paddy field, and fixed farm using geo-processing “Union” (3) and (4) (“clip vilpaddyfixt.shp” + “Uni fixfpaddy.shp” as the name of “Lusenonf01.shp”



Three type of land use is mapped on a shape file (Lusenonf01.shp)

Then arrange legend to identify these three categories. Arc view can show categories written only one field. But on the previous table, three land-use category is recorded on different fields, therefore, on a new field (luse01) all categories to be written. You can write directory column by column. But more than 700 polygons to write is troublesome. For more practical method, you use “Excel” for table amendment and to join the Excel table with Arc View table (DbaseIV). Procedure is follows:

- a. Calculate areas of polygons on “Lusenonf.shp” table (very small one should be delete)
- b. Export table to Exsel (as a text file formed by delimited text (data, data, data,.....)).
- c. Open Excel and to read the text file.
- d. Copy column “Farmid”, “Vill id”, “Agri id” to a new field “Luse id”
- e. Delete fields except area and Luse id (area is the key category to join the Excel table to Arc View table). The table records order is requested just same as the original arc View table, if you change the order to process Excel table, you first give numbering field to recover original ordering. (How to operate Excel is not explained in this manual, please see the operation manual of Excel)
- f. Save the Excel table as the form of DbaseIV.
- g. Add the saved table to Arc View table.
- h. Join table to previous Arc View table.
- i. Arrange legend (unique value of field Luse id)

Then you can make following view screen on your computer.

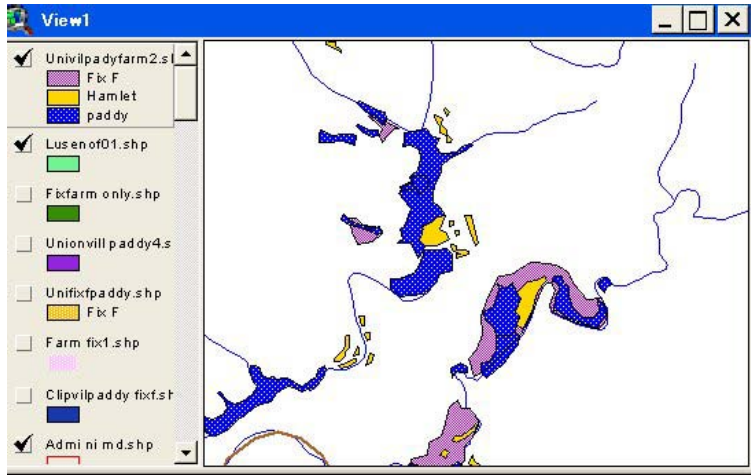


Table processing process is explained step by step.


Shape	Code	Areablock	Farm id	Id	Vill id	Idb	Agri id	area2	Id	Vill id	Idb	Agri id	area2
Polygon	0	39860	Fix F	0		0		0			0		0
Polygon	0	32421	Fix F	0		0		0			0		0
Polygon	0	76356	Fix F	0		0		0			0		0
Polygon	0	39633	Fix F	0		0		0			0		0
Polygon	0	0		0		0		0	3	Hamlet	0		9924
Polygon	0	0		0		0		0	4	Hamlet	0		20967
Polygon	0	0		0		0		0	5	Hamlet	0		3529
Polygon	0	0		0		0		0	8	Hamlet	0		6488
Polygon	0	0		0		0		0	9	Hamlet	0		2879
Polygon	0	0		0		0		0	10	Hamlet	0		1254
Polygon	0	0		0		0		0	11	Hamlet	0		1769

This table is made automatically by computer. Land use Id is shown on different fields (Farm id, Vill Id, Agri id) as FixF, Hamlet, and Paddy.

Delete fields unecessarily (Code, Areablock, two fields of Id, two fields of Idb, one of Agri id, one field of area2) (Theme -> Start Editing -> Edit ->

delete field -> Yes (repeat for every fields for delete)).

Then calculate areas for every polygon (Edit -> Add field -> give field name, type and width of column-> OK -> Click calculate icon -> [shape].Returnarea -> OK).

Delete records that are covered small area (Click field name of area for selecting -> Click data ordering button  -> Select records less than 100 sqm -> Edit -> Delete record

Shape	Farm id	area2	Vill id	Agri id
Polygon	Fix F	32421		
Polygon	Fix F	76356		
Polygon	Fix F	39633		
Polygon		9924	Hamlet	
Polygon		20967	Hamlet	
Polygon		3529	Hamlet	
Polygon		6488	Hamlet	
Polygon		2879	Hamlet	
Polygon		1254	Hamlet	
Polygon		1769	Hamlet	
Polygon		1412	Hamlet	

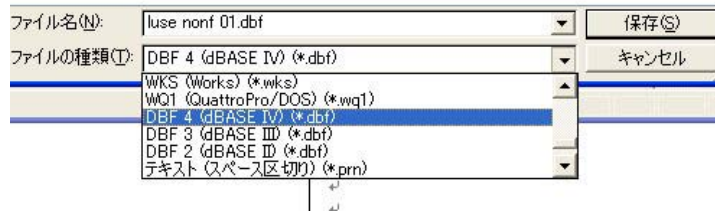
Save these amendments on the table (Edit -> Stop editing -> Save edited -> Yes).

Export the table to Excel (File -> Export -> Delimited text -> OK -> Give file name and nominate folder for saving (lusenonf01.tex).

Open Excel and read text file (lusenonf01.text) then arrange Excel table as follow:

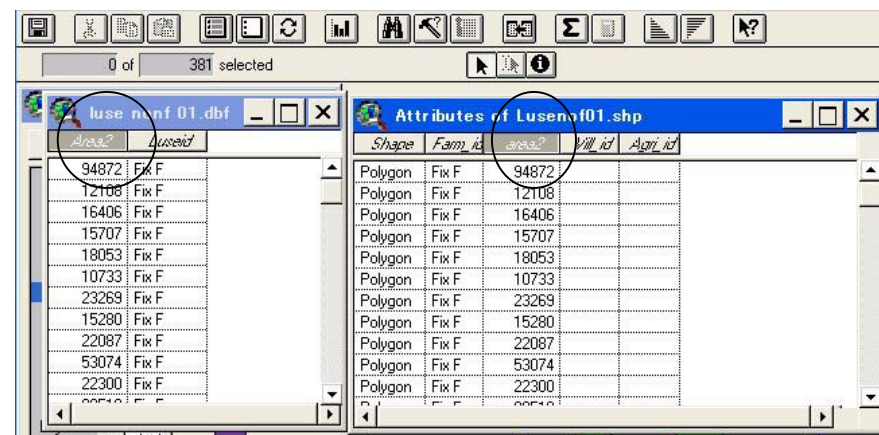
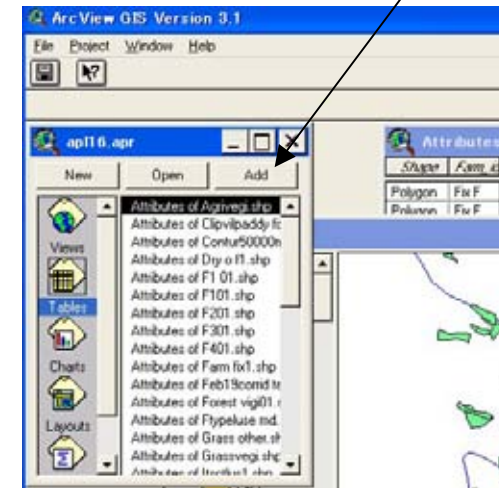
	A	B	C	D	E	F
1	Farm_id	area2	Vill_id	Agri_id	Luseid	
2	Fix F	94872			Fix F	
3	Fix F	12108			Fix F	
4	Fix F	16406			Fix F	
5		9924	Hamlet		Hamlet	
6		20967	Hamlet		Hamlet	
7		3529	Hamlet		Hamlet	
8		2605		paddy	paddy	
9		16484		paddy	paddy	
10						

Each land use id columns copied to field Luseid. Then fields of Farm id, Vill id, Agri id should be deleted. Then save the table under the form of Dbase IV using Excel function. Close Excel.



Save the file form of dBaseIV (Excel's file saving function)

Click a project view window where listed views and tables. Click table icon, you find table lists. Click add and select the table that you saved dbf file from your Excel.



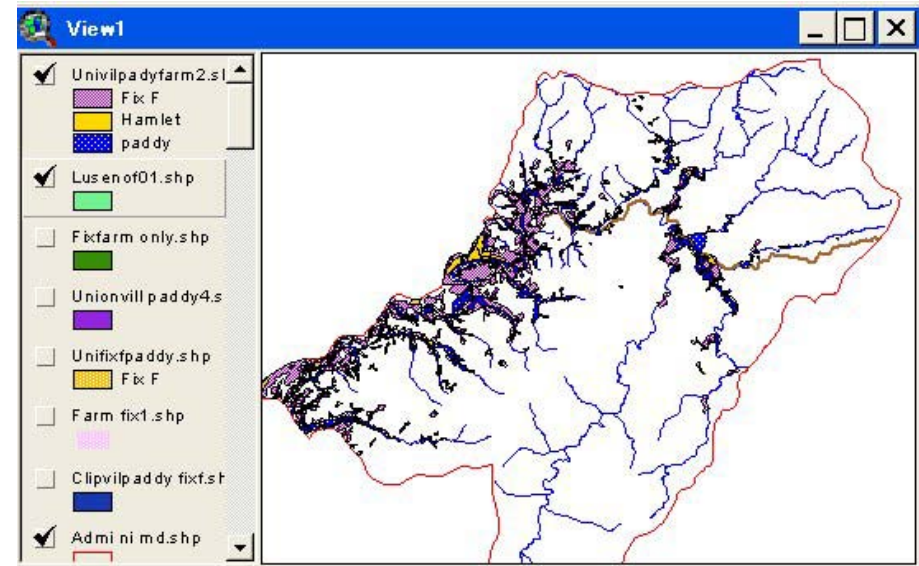
You can see above two tables on the screen. Select same named field (area2: same order, same amount or number)

Then join two tables (if you want the left table to right side table you have to set the right side table is in active (dark blue). Then operate to join(Table -> Join) You can make following table joined.

Attributes of Lusenof01.shp					
Shape	Fam_id	area2	Vill_id	Agri_id	Luseid
Polygon	Fix F	94872			Fix F
Polygon	Fix F	12108			Fix F
Polygon	Fix F	16406			Fix F
Polygon	Fix F	15707			Fix F
Polygon	Fix F	18053			Fix F
Polygon	Fix F	10733			Fix F
Polygon	Fix F	23269			Fix F
Polygon	Fix F	15280			Fix F
Polygon	Fix F	22087			Fix F
Polygon	Fix F	53074			Fix F

Arrange legend on unique value of “Luseid” and select color and pattern, you will draw a land use map (hamlet, paddy, fix farm) on your view screen.

To repeat these procedures for other land use and forest types finally you will complete land-use and forest type map on Man Den forest enterprise. Figure below is one of the examples to draw land-use map (hamlet, paddy, fixed farm).

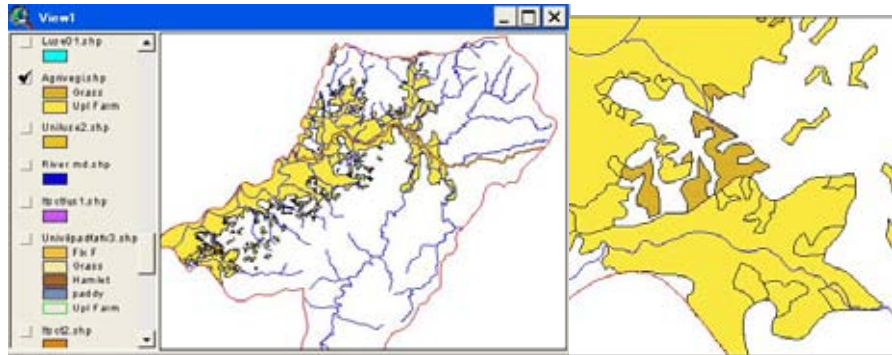


(5) Grass land, and Upland farm

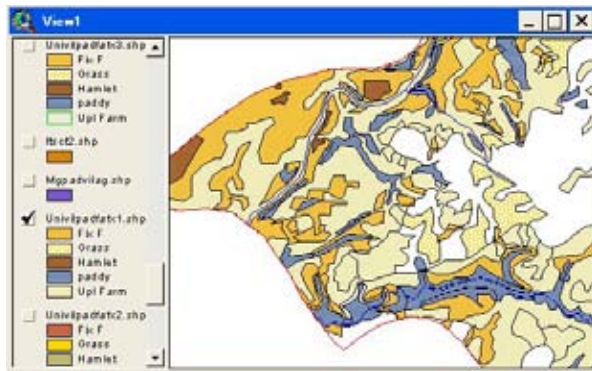
Process for Grassland, and upland farm are almost same. To draw narrower areas polygons and then combine shapes. Sample shows following figure. Upland farm is covered connecting with fix farm (upland farm scattered in the forest area will draw with forest type. Process will explain later).

Initial upland farm area will be drawn by manual and covered wider area overlapping other land use area likes below. So withdraw other land use areas and river (water body) duplicated from them, then after, to union with “landuse01.shp” using geo-processing. In this manual, the Grass-land

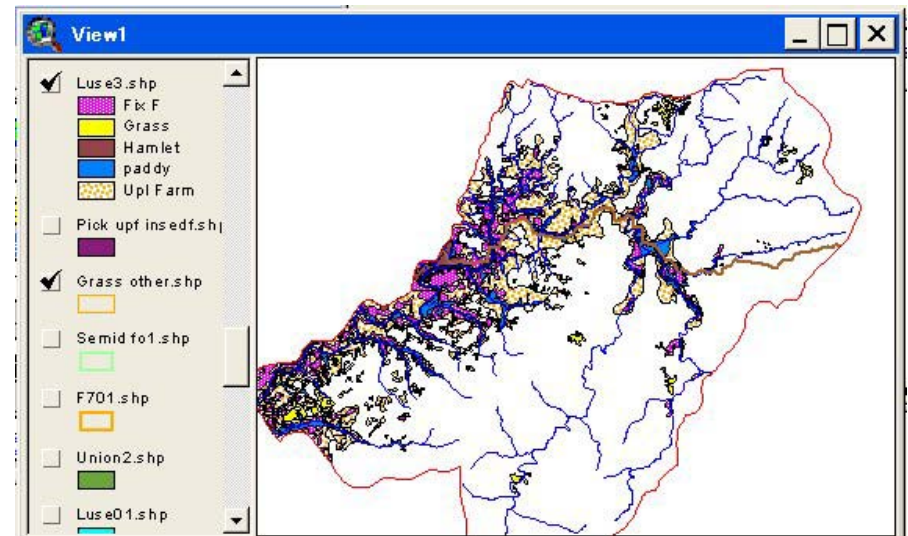
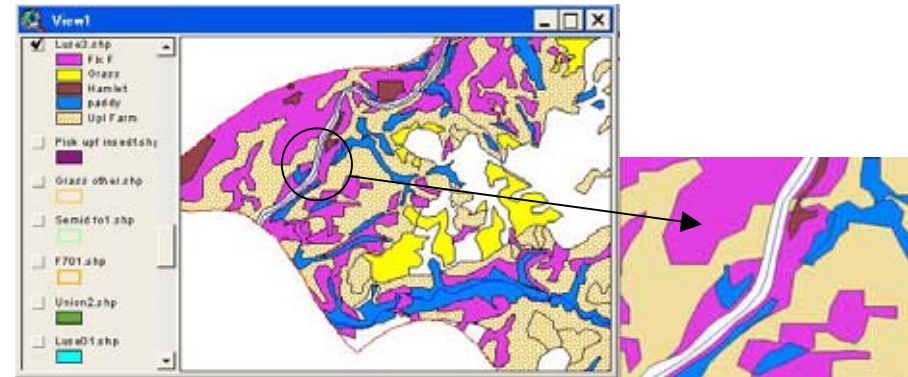
area is not so wide, therefore, grass land is drawn same time and categorized id also given polygons one by one.



Initial drawing for grassland and upland farm areas.



Union with landuse01 as named univlpadfx1.shp. This map is duplicated with water body (river). Then delete water body area as below (landuse3).



The land use map covered main part of the non-forest areas on the shape file "Luse3.shp).

(6) Forest land and Fallow/bush

To draw polygons for forest area, the process is needed some other techniques. You can draw polygons by each forest type, covered overlapping other polygons. Then delete duplication. But existed polygons number and areas are increased, to draw polygons avoiding duplication is not easy, there fore as far as possible you use existed lines for new polygon drawing using divide polygon button or expand polygon button.

In the forest area, several types of forest, fallows, and other land use areas are mixing and complicated. If you want to make the map bigger scale, complication may increase more, you need to divide areas into many polygons to describe different type of forest patterns.

How categorize forest area into different groups is depending upon your objectives to construct and use GIS database. In this manual, object is mainly focused on fixing the areas for logging operation (wood produce).

Therefore, the forest area in this manual divided detail for **matured** forest and simplified the forest types to be defined as the no logging operation planed such as semi deciduous forest, dry open forest, and young forest. Young forest scattered within matured forest is identify and exclude from logging operation to meet forest management planning objectives.

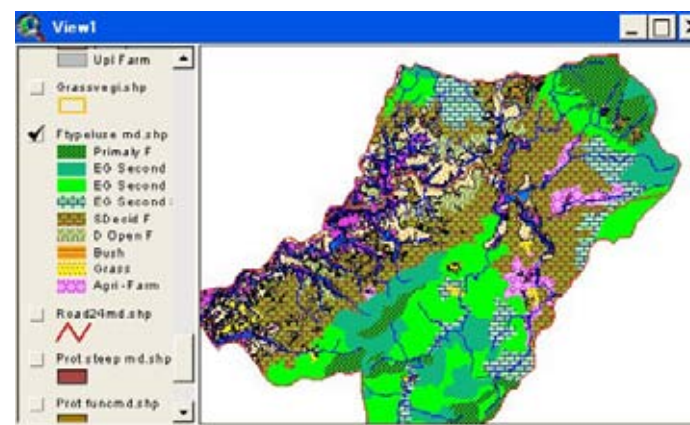
In the master plan, forest area is divided into 7 categories (original, secondary 1, 2, 3, semi deciduous, dry open, and bush). The areas last 4 is

not in detail demarcated, and others are divided polygons rather detailed.

First temporally draw some polygons for a forest type, then the areas divided into different forest patterns. For this process, polygons are made only one line for divide, and then no duplication or gap may occur.

a. Fixing forest type and land use Open Dry forest area zone


First Outline of Open dry forest is temporary used the polygons of D open F of the shape file of "Ftype luse md.shp", and divides these areas into upland farm, other forest type and other land use type if necessary. Process is follows.



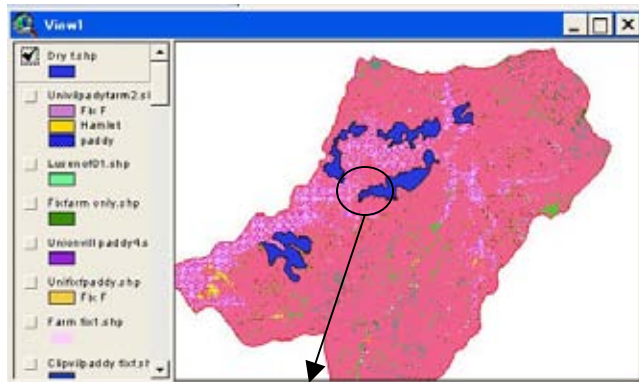
Forest type and land use type as base data

Create new shape shows Open dry forest of Ftype luse md.shp

Show "Sattmini md shp", "Cont50000.shp" and "luse3.shp" on the same order, then draw the above new file as outline.

Select Ftype luse md.shp in active-> theme -> Star editing -> Open table -> select all records “Open dry f” (or use query builder icon ) -> Close table -> Theme -> convert shape -> give new file name and select a folder to save (Dry F.shp) -> Arrange legend of shapes of “DryF.shp” in outline(if the polygon divided into plural, Open table, and select all -> Close table -> Edit -> Union feature

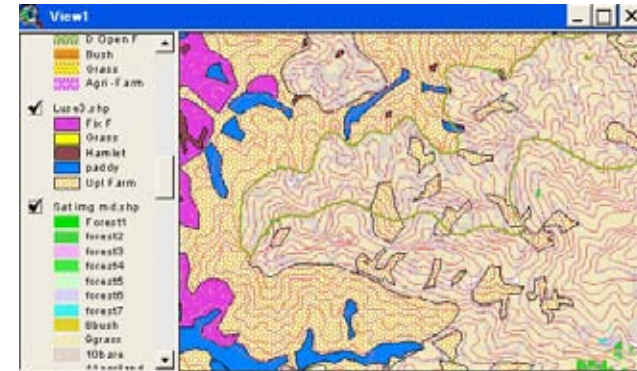
Then following view screen will come.



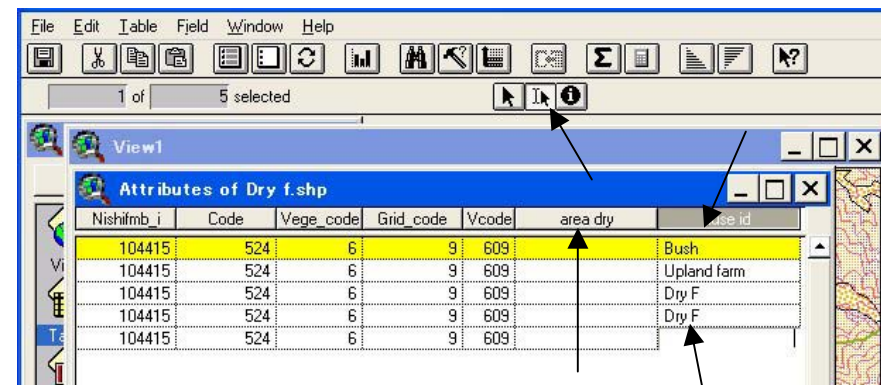
New shape temporarily defined areas of open dry forest.

Select “dry F.shp” in active, and Start Editing (Theme -> Start Editing).

Zoom in, then you can start dividing polygon.



Open Dry forest area shows with Satellite images.



Create new fields “area dry” and “luse id”. Arrange the table to delete

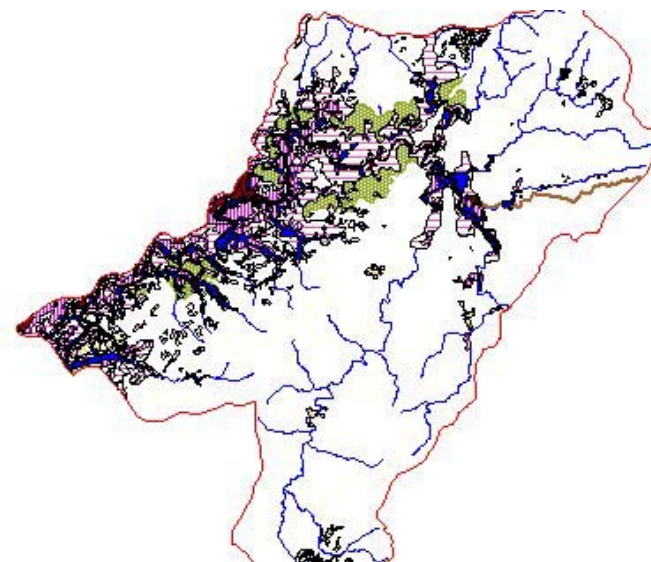
unnecessary fields. When you divide several polygons, you open the table and fill the record of the field "luse id" the real land use pattern such as Dry F, Upland farm, Bush, etc.

In the polygon if other polygons duplicated (polygons of luse3.shp) the divided line should be carefully follow the half part of the outer boundary of the polygon of "luse3.shp". Then points that of one duplicated polygon divided "DryF.shp" should be adjusted remaining side of the polygon "Luse3.shp". After this job implemented you make the view screen to enlarge (Zoom in) then you can find the polygon drawn exactly or not. If necessary you can amend the points more exact and no duplication.

To repeat the process for full part of the DryF.shp, you stop the Editing and save the result of the amendment. Then union the two shape file as "Luse4.shp"

If duplicated parts are too many, you can delete these areas using geo-processing explained before.

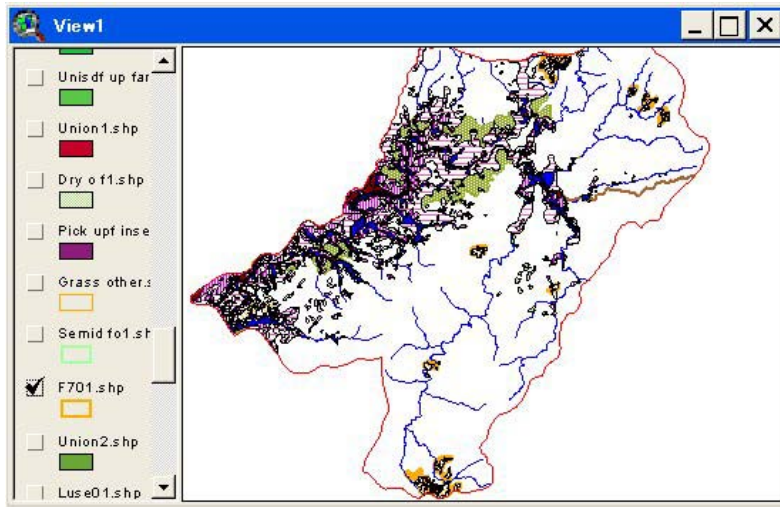
Following figure shows the result to add polygons of the temporally defined area of open dry forest.



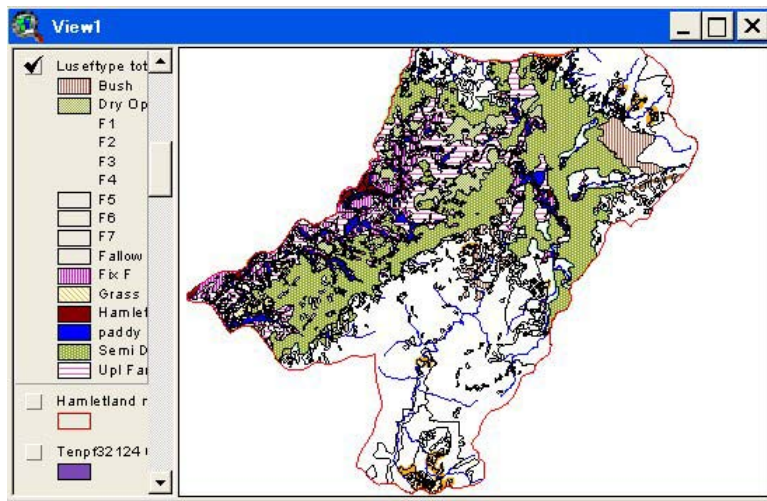
b. Other forest area

Land use and forest type map had drawn on the master plan is divided forest areas into 7 categories. Divide the polygons on the remaining part of the forest areas into detailed land use and forest type is implemented same process as the case explained about Open Dry forest area. You have bear to implement painful works for large number of polygons drawing and fill the land use and forest type ID for each record. Then you can make following land use forest type map on Man Den forest enterprise.

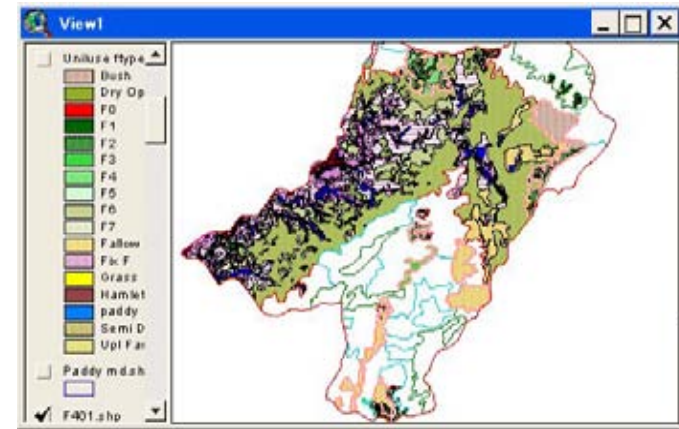
Then you reach analyzing process for sustainable forest management plan formulation. Formulation process on forest type polygons shows on following figures.



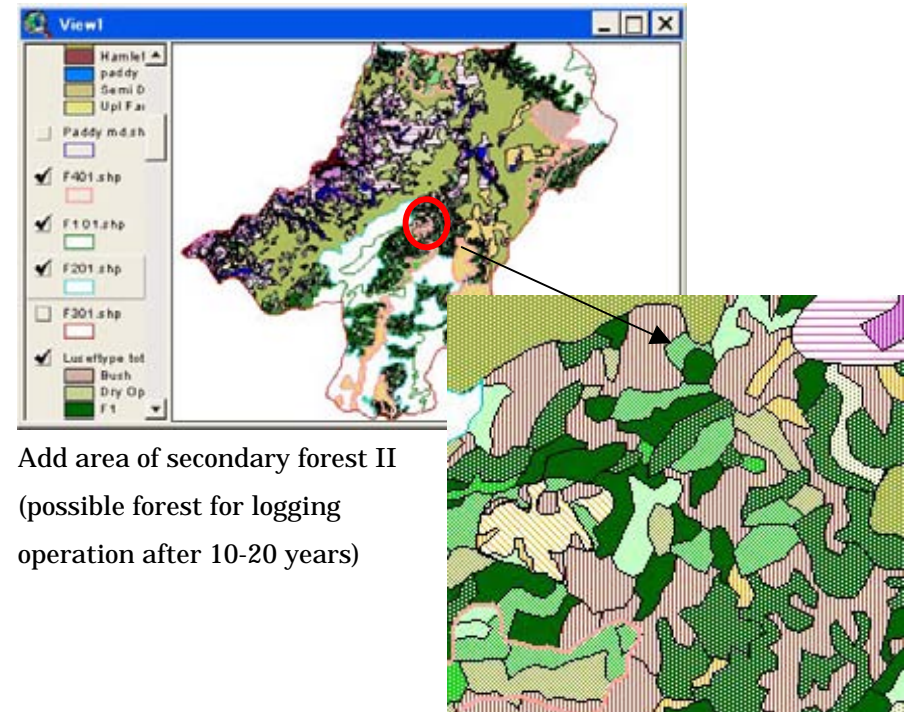
Add areas of open dry forest zone.



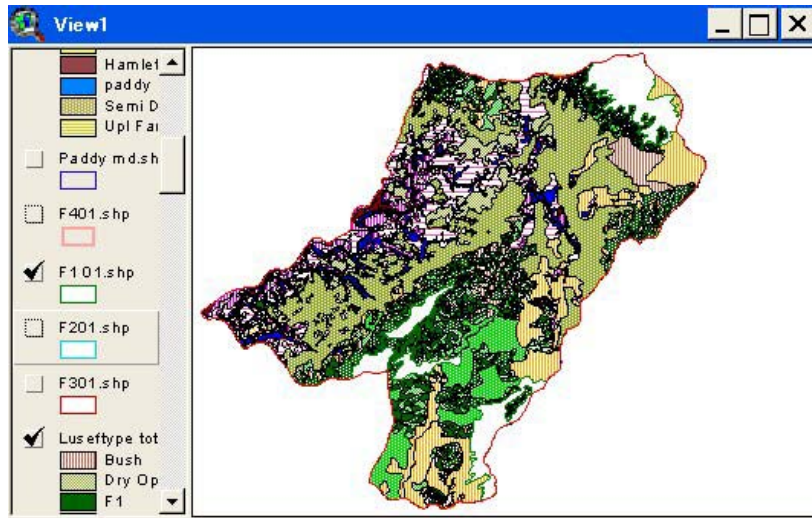
Add area of Semi deciduous forest zone.



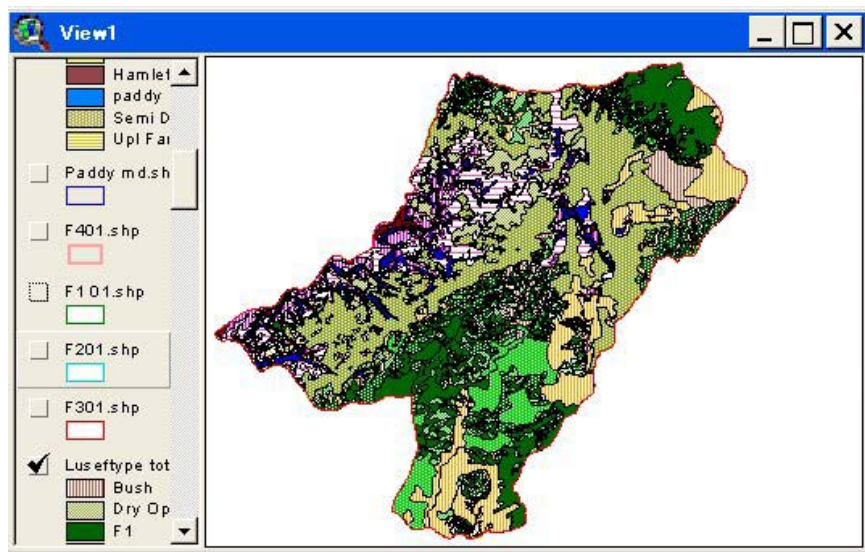
Add area of yang open forest area (mainly bush and fallow)



Add area of secondary forest II (possible forest for logging operation after 10-20 years)



Add areas of secondary forest I (main part for logging operation)



Add areas original forest (The forest keeping highest stock and main part of the logging operation) The final results on land use and forest type is

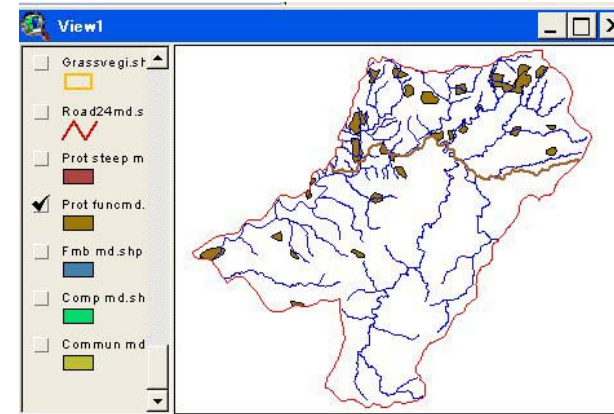
made (luseftypemdall.shp).

3.2 Fix the areas sensitive for water, soil and land conservation and wildlife conservation

Fix the areas to be set aside from logging operation based on various factors for realizing sustainable management such as, water, soil and land conservation, wildlife conservation etc.

3.2.1 Water, Soil, and land conservation

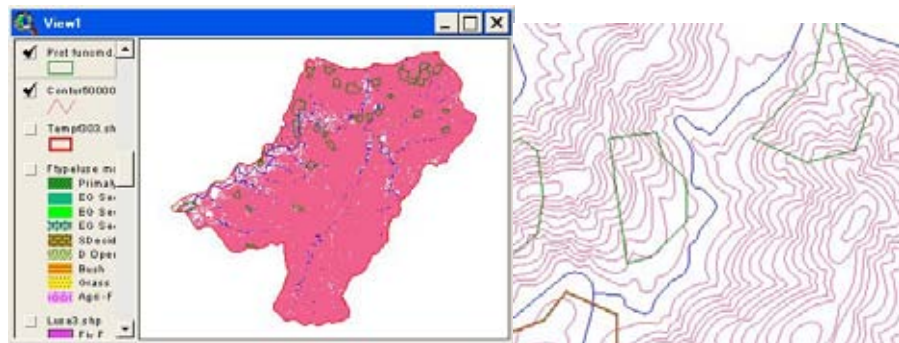
Sensitive areas for water, soil, and land conservation are examined on the study for the master plan on Kon Plong formation. Through the topographic analysis (mesh analysis) sensitive areas for each forest functions are analyzed and integrated three functions for forest operation. The results was stored on GIS, and clipped the area of Man Den forest enterprise as "prot func md.shp."



Basically these areas should be set aside from logging operation,

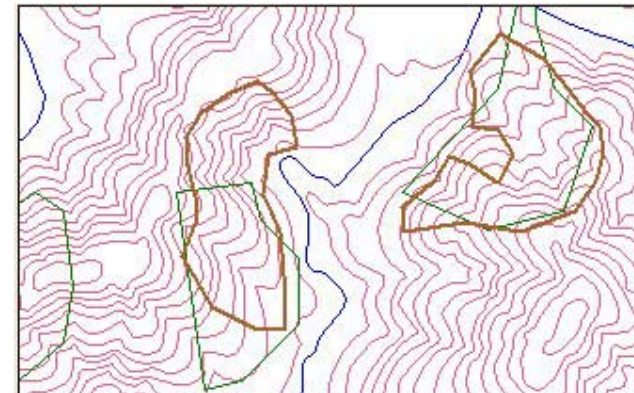
nevertheless, this analysis had done using 1/50000 topographic map, therefore, you need to reexamine the places to adjust more detailed map that are prepared by the JICA study team. The sensitive area is categorized as the area with several small channels, complicated land feature, and narrow steep slope with different direction. You show the contour line and polygons of “prot func md.shp” on your view screen. Then expand areas (z00m in). You can rearrange a new shape for defining the areas on the sensitive areas against logging operation as the scale level of 1/10,000.

Preparation: give to the “prot func md.shp” and “cont10000.shp”



View -> New theme -> Decide type of shape (polygon) -> Give filename (prot func md10.shp) and assign a folder Then start readjustment of the areas.

Following figure shows a sample for re arrangement.



To arrange every polygons of “prot func md.shp” to “prot func md10.shp” the new areas to be set aside from logging operation as the sensitive areas for water, soil, and land conservation is defined.

Using geo-processing “Intersect” land use and forest type shape (luseftypemdall.shp) by sensitive areas shape (“prot func md10.shp”), you can calculate the areas by the land use and forest type, and can valuate the size of effect for reduction of the logging areas. If the effects for reduction of logging size, you can reconsider the areas to be set aside.

Final results sample is below.

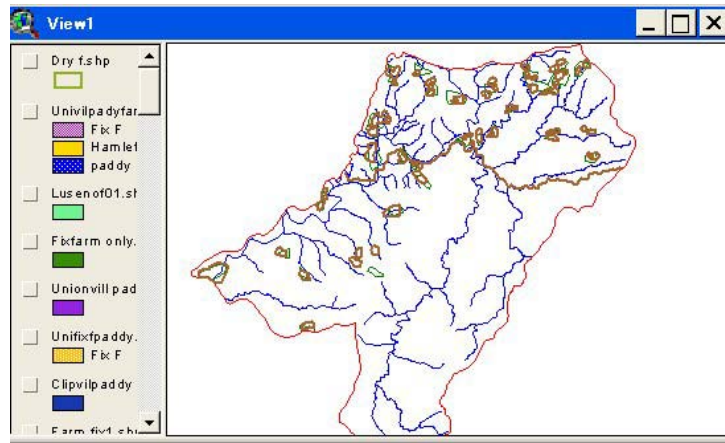


Table of the “prot func md10.shp” should be arranged. Two fields protect ID and “areafunc” are added, and fill records ID (F Func). Area is calculated using calculation button and “[shape].Retrnarea”.

Shape	ID	Protect ID	area func
Polygon	0	F Func	46393
Polygon	0	F Func	102021
Polygon	0	F Func	87940
Polygon	0	F Func	185533
Polygon	0	F Func	97972
Polygon	0	F Func	56745
Polygon	0	F Func	99388
Polygon	0	F Func	72522
Polygon	0	F Func	300798

3.2.2 Wild life conservation

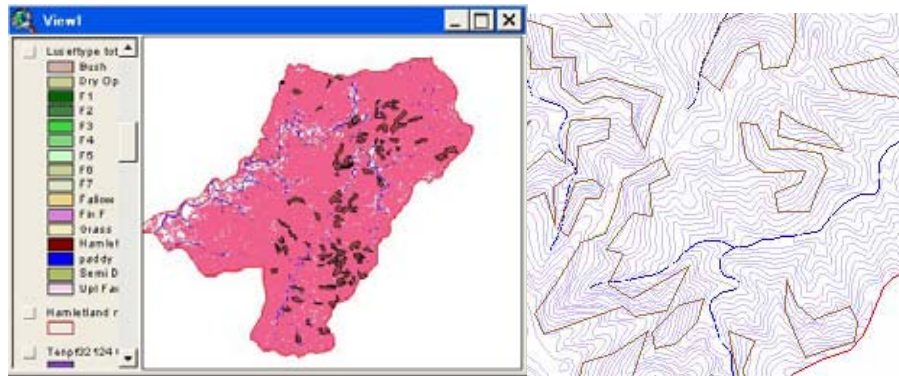
For wild life conservation, forest management planners have to consider

how important wild animals, insects, and plants existed in your management areas. If you recognize these wildlife/animal, you care where the nests place, where they get foods, how move around, then needed forest areas for nest, food, hiding place should be prepared as the protected forests. Forest operations should be take into account not to disturb their propagation (not threat their nests, avoid forest operation during propagating period on the surrounded areas from nests). Then such places should be identified and drawn on the GIS map to give special attention.

3.2.3 Fix the areas sensitive natural condition against logging operation

Fix the areas to be set aside from logging operation based on natural condition (steep, swamp, land slide, special soil pattern, high elevation, etc.).

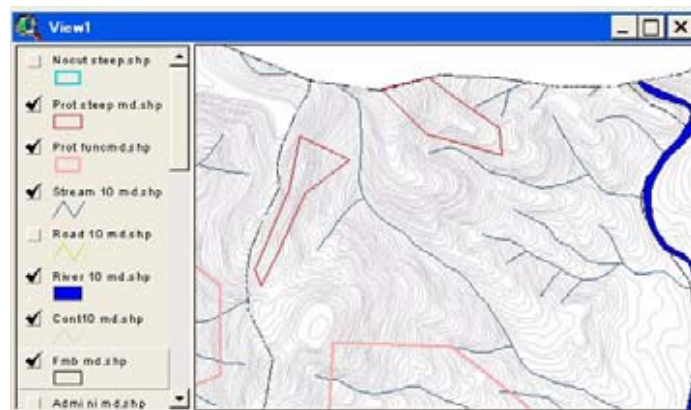
Steep areas identification method is almost same as previous section (5). Steep areas in Man Den area is initially marked in GIS using 1/50000 topographic map as “prot steep md.shp” below.



The polygons mentioned above should be rearranged/amended to meet the land condition described on 1/10000 topographic map.

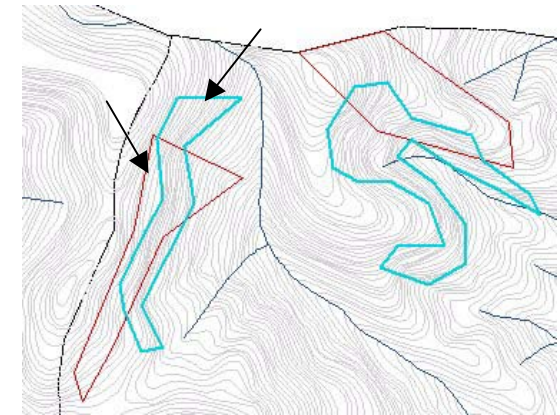
Procedures are follows:

preparation: Show on the view screen following shapes in same order.
 prot steep md.shp, prot func md.shp, stream 10 md.shp, river 10 md.shp,
 cont10 md.shp.



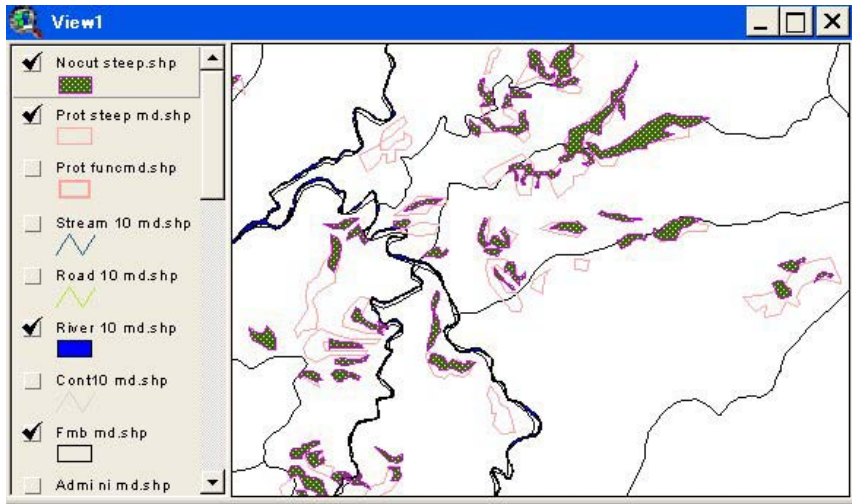
On view screen steep areas and protection for forest functions excluded from logging operation using 1/50000 topographic map are shown. The base map had changed from 1/50,000 to 1/10,000. The steep areas shown on this figure are not followed land feature shown by the new topographic map.

To create new polygons for steep areas rearrange to meet the new map land features.



View -> New Tehme ->
 Type of shape (Polygon)
 ->File name (nocut steep md.shp) -> Draw polygons (Edit -> drawing icon -> free shape)

Every polygon "prot steep.shp" are readjusted to meet land feature like the figure above right side. Then steep areas are fixed on the view screen under the file name "nocut steep md.shp".



Calculation of areas to be excluded from logging operation.

Select “nocut steep md.shp” -> Theme-> Start Edit ->Open table -> Add field -> Give field name “area steep,” number”, width “16” -> Select the field “area steep” -> Click calculation button -> [shape].Returnarea

Shape	Id	area steep
Polygon	0	178618
Polygon	0	151345
Polygon	0	32061
Polygon	0	36267
Polygon	0	23198
Polygon	0	48501
Polygon	0	118381

3.2.4 Fix the areas archeological and historical areas to be protected

Archeological, historical/cultural and scenic places protection is one of the important aspects to regulate forest operation. Cultural/tradition places

are especially indispensable place especially for the mountainous society, to maintain these area’s environment is forester’s duty. If such places you recognized, you have to exclude the areas from logging operation, and to help rehabilitation for the people. So, you mark these areas on your GIS as polygons. Procedures are same as mentioned to create a shape file, and draw polygons showing the border areas defined as archeological places.

3.2.5 Select the areas for villager support (target areas for agro-forestry and/or farm land development).

Villager support program is proposed on the master plan. Substantial activities should be decided discussion with villagers through RRA or PRA meeting and implemented collaboration with Forest enterprise, local authorities and villagers. The target areas for the substantial activities also will be nominated consultation with local habitats. How to organize participatory planning is explained on other technical manual in this sereas.

Forest management planner has to allocate forestlands for the activities when your management plan formulated. For the sustainable forest management, forest areas have to be maintained for the future, the demarcation line between agriculture lands and forestlands is bases for the management plan. How demarcate may can be decided through intensive consultation with people to adjust, to harmonize forest manager’s needs and people’s needs.

To support villagers for their daily life improvement is key factor to avoid uncontrolled encroachment, slash and burn. For this, to use slope lands for agro-forestry or silvo-pastoral is one of the solution to maintain forest function and to produce forest products including cash crops.

For allocate the forestlands to the villager's, first priority should be given these areas where traditionally used by the people (glass lands, upland farm, fallows). The size of these areas may be decided based on the socio-economic factors such as actually using, manageable size by a household, commutable location from the village day by day bases.

These areas can be nominated through GIS analysis. The analyzing sample is shown bellow.

On Arc View, you call shape files village area, land use and forest type, river and stream. Then calculate needed areas village by village (to be considered size of population, poverty households, traditional land use, land fertility etc.).

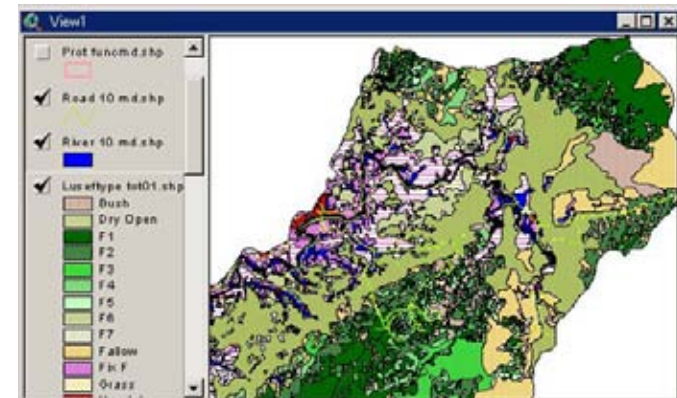
Draw areas as polygons for the initial target places for the villager support program/ agro-forestry land development. Calculate areas and to adjust polygons to harmonize the needed/expected size of areas.

To evaluate above three factors using GIS, Village location, distribution of existed farm lands, forest condition are base data. Following procedures is exsample.

Preparation

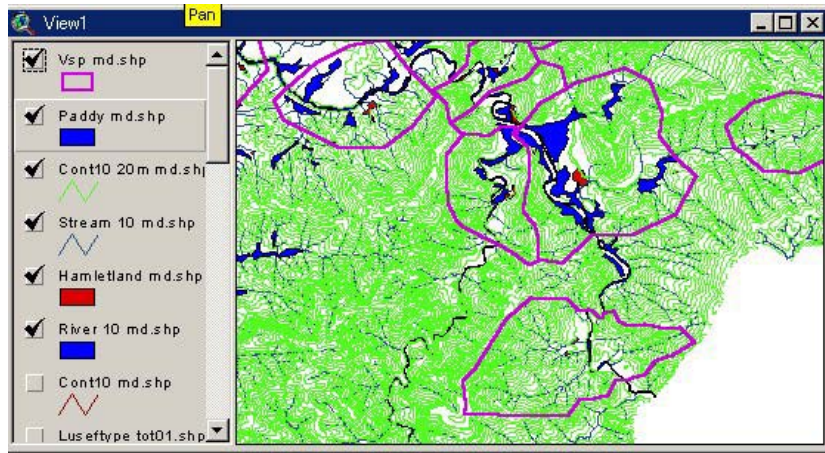
Show on the view screen following shapes in same order.

Village and hamlets(Housesmd.shp), Conter(Cont 10 md.shp) , Stream 10 md.shp),Land use(Luseftype tot md.shp)



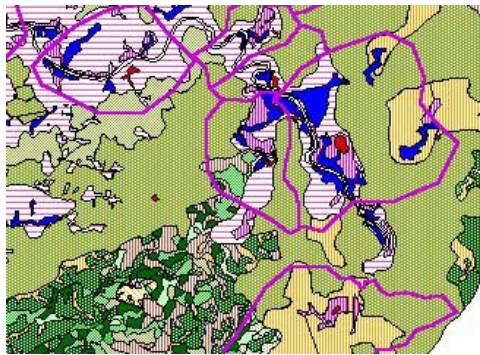
To identify traditional territory of a village/hamlet

The Villager support program connecting with land use change such as development for agro-forestry lands, etc (this will give effects for the total areas of wood production forest) will conduct within the areas where is belongs with the village's territory. These traditional area are recognized through village meeting and their resource map. Then the areas are transferred to the GIS. Following figure shows some sample to identify the village territories.



To fix target areas for villager support program

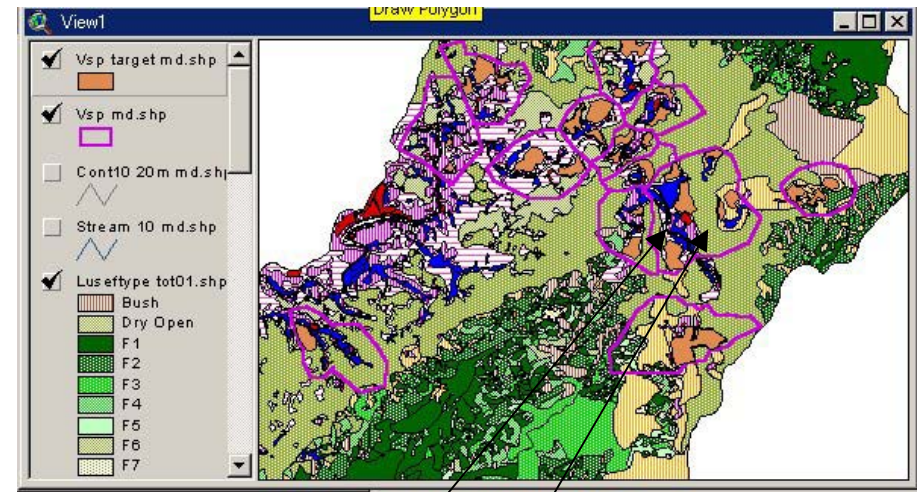
The target areas for agro-forestry activities development within the villager support program will be chosen within the village territory and old slash and burned cultivated areas such as grass land, bush, fallow.



This figure shows land use and forest type within the traditional village's territory

Finally the target areas for VSP (Villager Support Program) are selected to harmonize to the socio-economic situation of the villagers and forest

condition as following figures shows.



Village territory

Target area for VSP

3.2.6 Fix the areas needed for daily water source protection for isolated hamlets and paddy fields

Water source protection for villagers is defined as follows:

- a. Streams connected paddy fields should have significant water basin in the protected forest on upper basin as far as possible.
- b. If the stream is not connecting protected forest, small area of forest should be kept as the water source protection forest (200-400m length 200m wide).
- c. The water source protection forest is defined both side of the stream with in

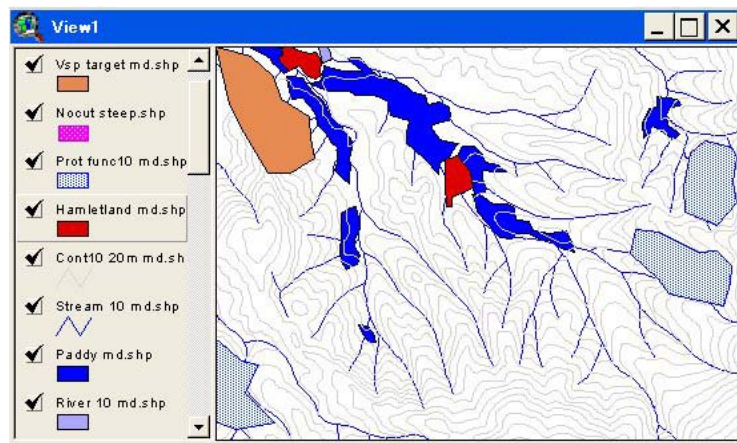
the water basin.

To fix this area is carried using the function buffering of the GIS. First to define the important streams for water supply to villager's drinking water or paddy fields not connected to the protected forest. Then draw line shape on the streams upper place with paddy field. Define the protection forest zone for the stream using a function GIS "Buffering" (area 100m from a line polygon is picked up as a polygon). The Buffering polygon is harmonized with landscape (to remove the parts outside of the basin). Then areas of the polygon should be calculated. Procedures are follows.

Preparation

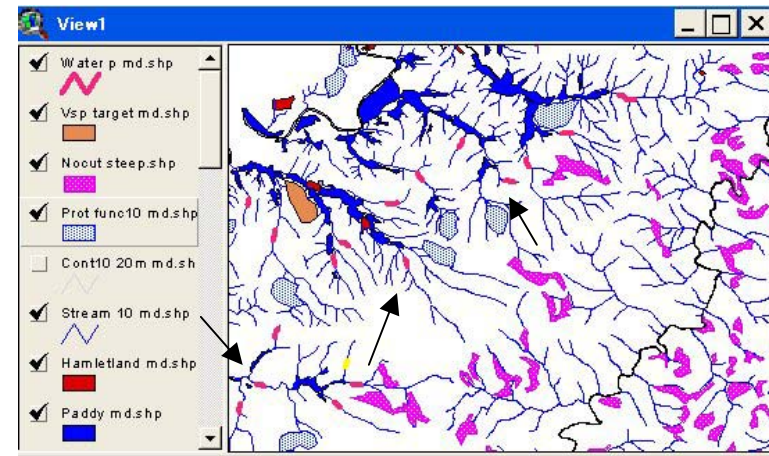
Show on the view screen following shapes in same order.

Village and hamlets (Housesmd.shp), Conter(Cont 10 md.shp) , Stream 10 md.shp),Paddy field(paddy md.shp)



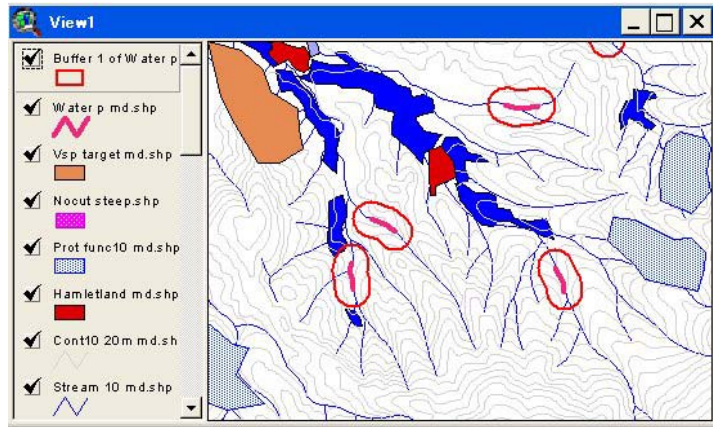
Create line shape for the place to be protected stream

Theme-> New theme -> line (Type of shape) -> Give file name and folder ("Water P Md.shp" and name of folder as you defined) -> Draw line trace the stream line

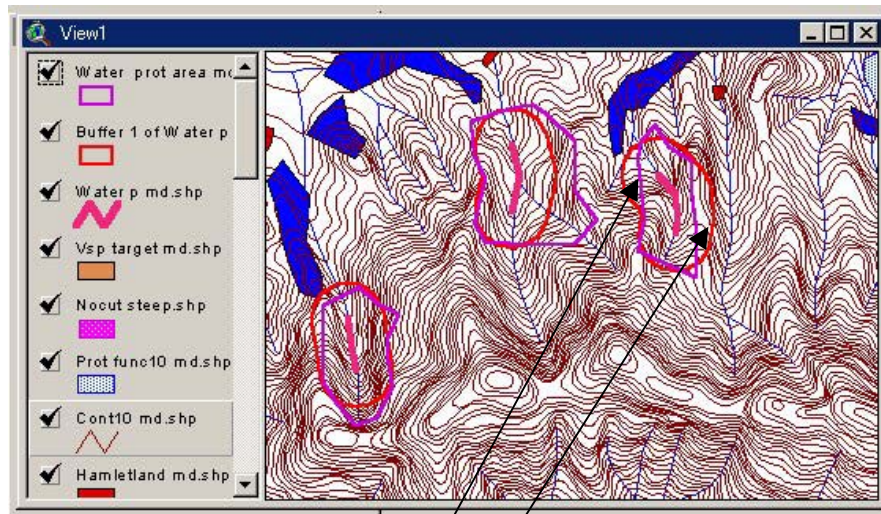


(Length of the line is shown left side down of the view window. The buffer area is automatically created from both points of the line, therefore, if you want to make 100m both side of the stream, the starting point should be selected roughly 50m interval from paddy field is better.).

Create protected areas for water protection by buffering
Set scaling (See Section I 2.12) -> Put the line shape as selected condition
-> Theme -> Start editing -> Theme -> Create Buffers -> Give distance (100m) ->Give file name and folder (Water P buff Md.shp)



Arrange the polygons to meet landscape (Delete areas outside of the water basin.). This work is conducted to trace the buffered polygon line and adjusted within the water basin by creating new polygon file (Water prot area md.shp).



Area created by buffering

Area adjusted landscape

To calculate areas creating new field on the table linked with the shape.

Shape	ID	Wp area
Polygon	0	80718
Polygon	0	58102
Polygon	0	68448
Polygon	0	85954
Polygon	0	69591
Polygon	0	70498
Polygon	0	62865
Polygon	0	67431
Polygon	0	68818


4 Fixing logging operation area (LA)

The areas for logging operation is defined as “Total matured forest – total arias where to be set aside within the matured forest”.

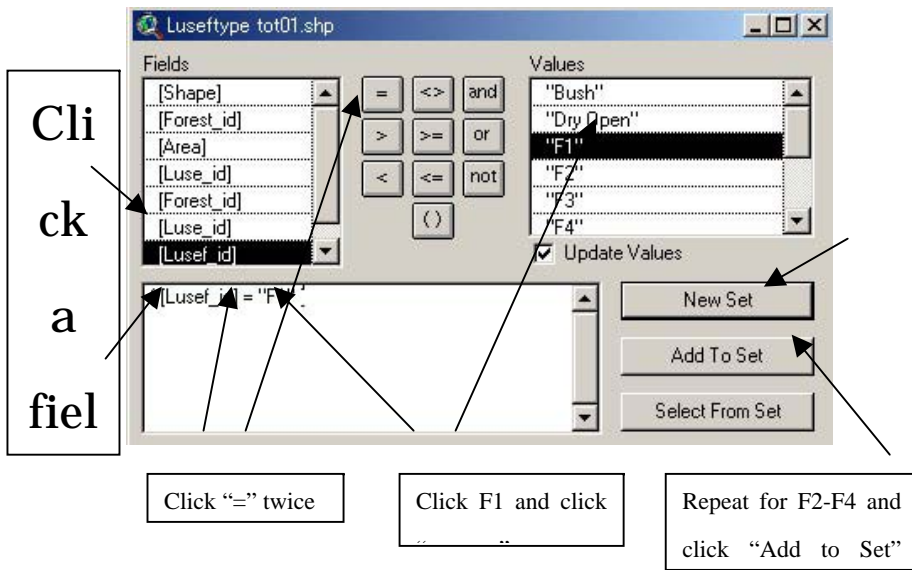
To fix matured forest (Forest exceeded yielding standards, DBH, age, crown density, etc.)

Matured forest had defined as primary forest, secondary forest I and II by the Master Plan. These forests are categorized into F1, F2, F3, F4 on the shape of “land-use and forest type (Luse Ftype tot.shp)”. The total areas of matured forest are selected from the shape file “Luse Ftype tot.shp” and converted to a new file “matureF md.shp” then drawn on the View screen.

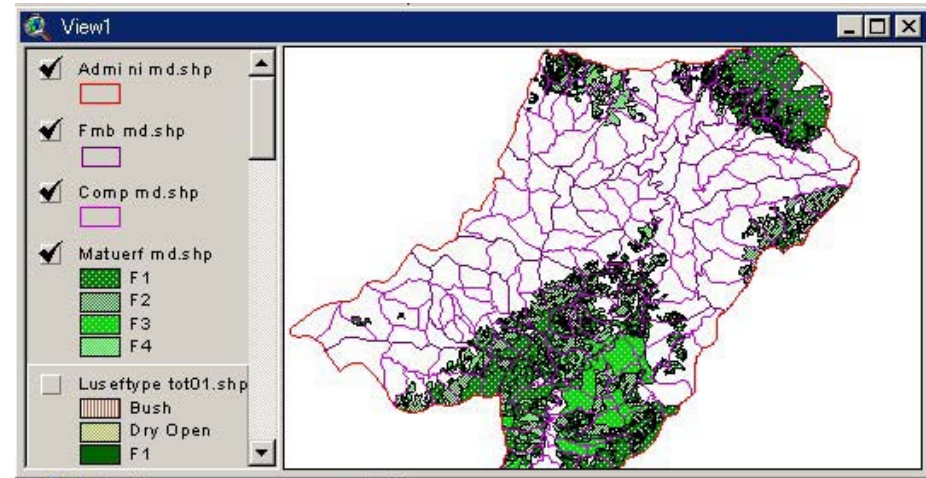
Precedures are follows:

Put the shape file “Luse Ftype tot.shp” on the selected condition. ->Click query icon  to call query builder box. -> Set the condition to query

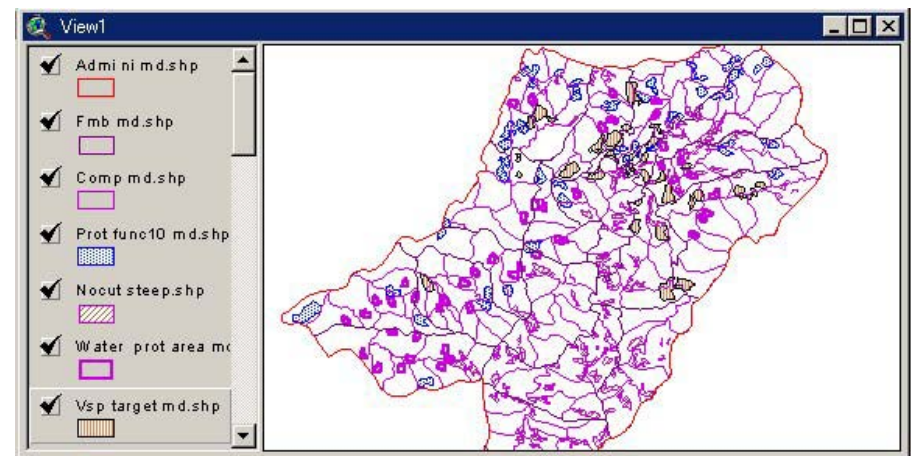
(Lusef id=F1) -> Click "New Set" -> Give next condition from F2 to F4 and
 Crik "Add to set" -> Close query builder box. -> Theme -> Convert to shape
 -> give file name (maturef md.shp) and folder. -> OK



Then figure below is shown on your view screen selected only matured forest area.



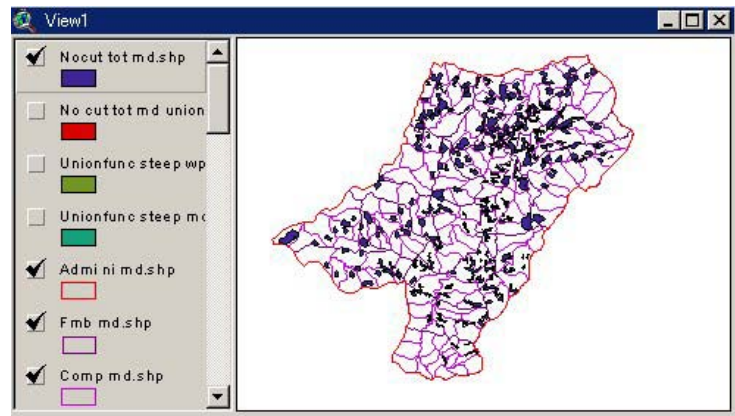
To fix areas to be set aside from logging operation (five factors, forest function, steep area, water source protection, VSP and others such as wildlife protection, archeological and historical places if any)



This figure shows every categorized area to be set aside from logging operation. Nevertheless, the shape is consisted different shape files,

therefore, these shape files have to combine into one shape file. The works for combining are carried using “Geo-processing” “Marge”. Procedures are follows:

Set the function Geo-processing (File -> Extensions -> Give check mark to Geo-processing) -> View ->Geo-processing -> Marge -> Give shape file names to marge (Select files on the pull down window list) then give a new file name (nocut tot.shp) and folder name. -> finish



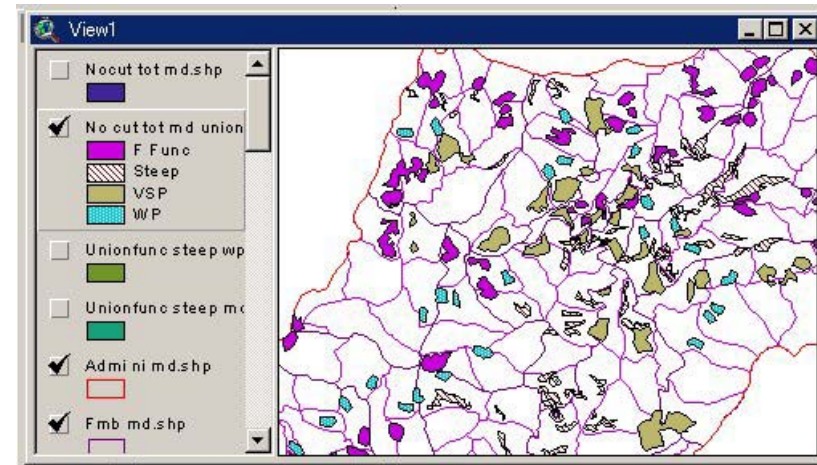
Attributes of Nocut tot md.shp

Shape	Id	Protect id	Area_func
Polygon	0	F Func	48502
Polygon	0	F Func	128109
Polygon	0		178618
Polygon	0		151345
Polygon	0		32061
Polygon	0		36267
Polygon	0		23198
Polygon	0		48501
Polygon	0		118381
Polygon	0		110051
Polygon	0		153875
Polygon	0		20000

Polygons ids to identify the reason for exclude from

This process (to merge) will unitize polygons on same factor; therefore, all polygons old id such as steep, function, etc. are deleted. If you want to

maintain these ids for new shape file “nocut md.shp” you had better to use function “Union” of geo-processing. To create new file “union” you can make new file only two shape files to union. You need to union one by one, and give polygons if on a new or existing field by copy and past one by one record. Then you can make following figure categorizing polygons into factors.



Attributes of No cut tot md union.shp

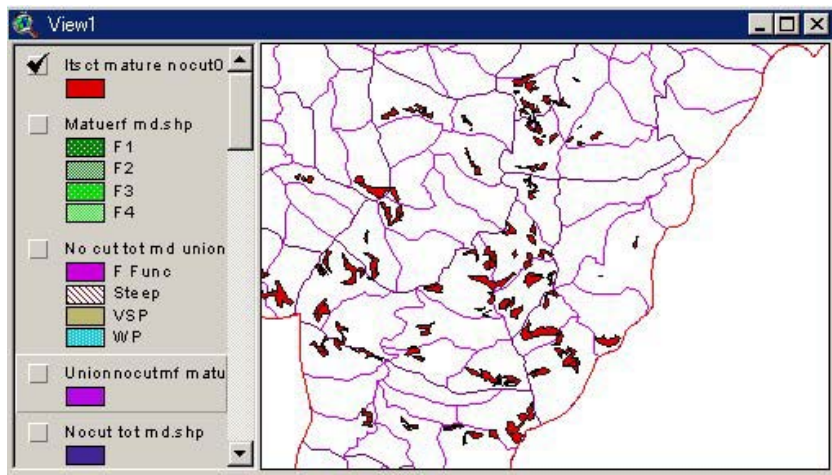
Shape	Protect id	Area_func	Wp area	area steep	area no cut
Polygon	Steep	0	0	36862	7176
Polygon	Steep	0	0	7796	7796
Polygon	Steep	0	0	21255	7836
Polygon	VSP	0	0	0	10198
Polygon	F Func	49046	0	0	12832
Polygon	Steep	0	0	21255	13419
Polygon	Steep	0	0	13965	13965
Polygon	Steep	0	0	14088	14088
Polygon	Steep	0	0	15456	15456
Polygon	Steep	0	0	15798	15798
Polygon	Steep	0	0	16796	16796
Polygon	Steep	0	0	18615	18615

To delete protection areas from matured forest

This work is done geo-processing “intersect” to pick up no cut parts within the matured forest. Then union the new shape with matured forest, and delete the polygons that have protect id (Steep, VSP, F Func, WP). Procedures are follows:

- Step 1

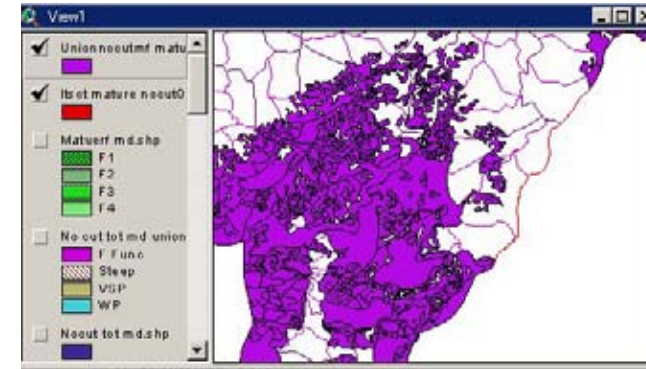
View -> Geo-processing -> Intersect ->Give input theme (No cut totmdunion.shp) ->Give overlay theme (MatureF md.shp) -> give file name (itsct mature nocut01.shp) and folder name -> Finish



This figure shows excluded areas within the matured forest.

- Step 2

View -> Geo-processing -> Union -> Give input theme (itsct mature nocut01.shp) and overlay theme (MatureF md.shp) -> Give file name (Union nocutmf mature.shp) and folder. -> Finish

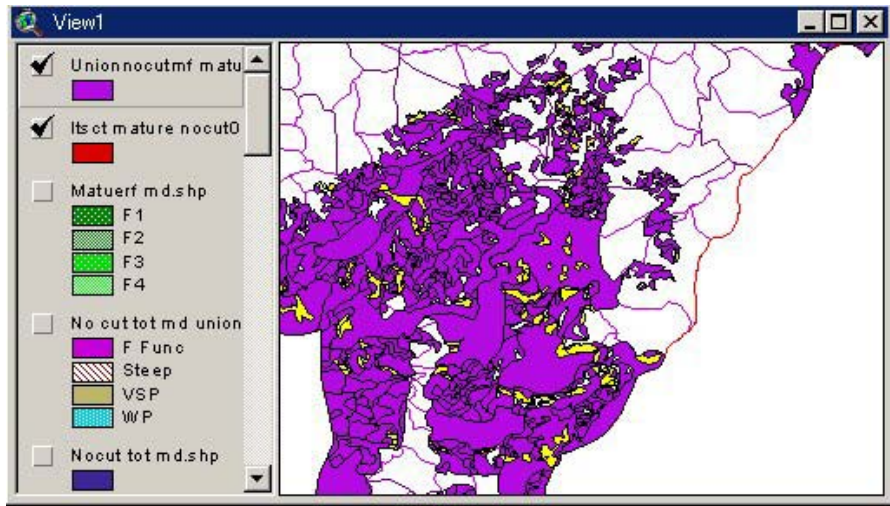


This figure shows nocut areas polygons planted into Mature forest. The table below shows polygons/records that have id (the places to be set aside from logging operation).

Shape	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area
Polygon	0									0	F1	211622	F1	F1					
Polygon	0									0	F2	263205	F2	F2					
Polygon	0									0	F3	422178	F3	F3					
Polygon	0									0		169588		F4					
Polygon	F2	233295	F2	F2	F Func	300798	0	0	300798	F2	233295	F2	F2						
Polygon	F2	233295	F2	F2	F Func	300798	0	0	300798	F2	233290	F2	F2						
Polygon	F2	233295	F2	F2	Steep	0	0	26644	26644	F2	233295	F2	F2						
Polygon	F2	233295	F2	F2	Steep	0	0	26644	26644	F2	233290	F2	F2						
Polygon	F2	31159	F2	F2	Steep	0	0	21118	21118	F2	31159	F2	F2						
Polygon	F2	31159	F2	F2	Steep	0	0	21118	21118	F1	9941	F1	F1						
Polygon	F2	33256	F2	F2	F Func	300798	0	0	300798	F2	33256	F2	F2						

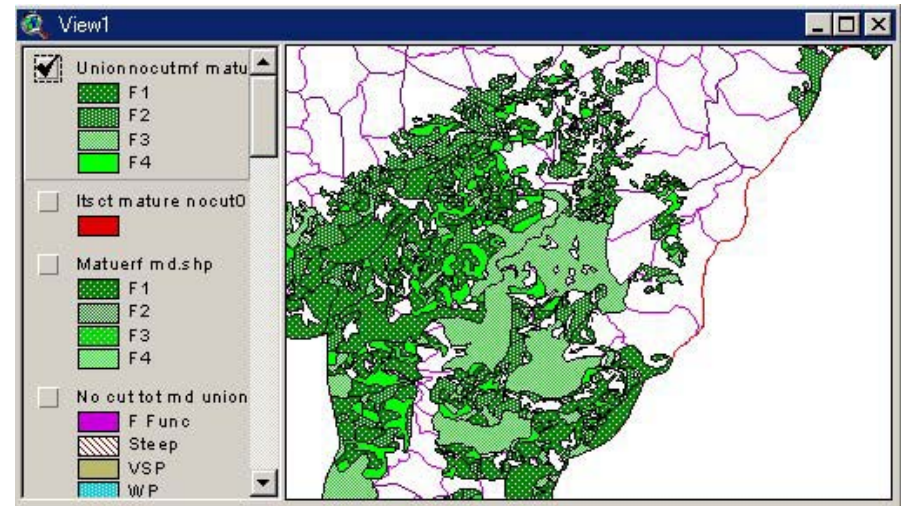
To define logging operation forest

Above table shows if the record that have id in the field “protect id” is the area to be excluded from logging operation, therefore, to delete these records, remained record/polygons shows the real target areas for loggingoperation. Following figure shows remaining parts of the matured forest to meet yielding criterias. Then final result has obtained



This figure shows selected condition for areas to be set aside logging operation within the matured forest. This view screen is made automatically when you select records on the above table.

Following figure shows final results to fix the target forest for logging operation. These forests are divided into yielding period groups by 5 year terms of management/logging operation plan based on sustainable yield (growing stock, economical harvesting plan for logging road net work and other social factors).



Area calculation for logging operation forest by forest type and by Block and compartment

For calculation of areas for logging operation forest by block and compartment the polygons above figure should have keys to identify where the polygon belongs in a block and a compartment. For this the shape file "Union nocutmf mature.shp" and shape file compartment "Comp md.shp" are needed to combin.

View -> Geo-processing -> Intersect -> Give input thema (Comp md.shp) -> Give overlay theme (Union nocutmf mature.shp) -> Give new file name (LoggingF Fmb comp.shp) and holder name -> Finish

Note: Before the geo-processing, to simplify the table of “Union nocutmf mature.shp” delete unnecessary fields, and recalculate areas of the records.

Shape	Area	Layer	Code	Compartment
Polygon	218	F2	487	1
Polygon	22909	F2	487	2
Polygon	26819	F2	487	11
Polygon	20469	F2	487	5
Polygon	1648	F2	487	6
Polygon	23511	F2	487	1
Polygon	4078	F3	487	11
Polygon	5104	F3	487	1
Polygon	13301	F3	487	2
Polygon	72934	F1	487	1
Polygon	1259	F1	487	1
Polygon	20220	F1	487	1

Then all polygons defined block name and compartment name. To calculate totaling, export this table to Excel. And total the areas using pivot table function of Excel. Result shows on table below.

Area of the Logging operation forest by block (ha)

Block/Ftyp	F1	F2	F3	F4	Total
487	111.93	154.80	63.49	104.80	435.02
488	38.78	5.56	0.00	172.75	217.09
489	552.77	135.69	33.83	56.26	778.54
525	1054.56	55.17	141.07	16.29	1267.09
527	9.88	7.80	2.23	2.44	22.34
528	48.63	19.27	1.11	72.14	141.15
529	37.86	487.72	29.71	0.00	555.30
530	7.17	64.16	1.19	0.00	72.52
531	51.62	140.98	16.02	9.08	217.69
532	341.95	280.42	194.88	237.77	1055.02
533	167.82	56.79	116.95	50.37	391.94
534	363.69	161.83	582.52	109.30	1217.34
537	548.84	116.28	475.95	216.19	1357.25
538	46.85	111.29	3.77	0.00	161.91
542	104.77	65.18	98.72	4.31	272.99
543	183.71	209.68	14.12	109.65	517.16
Total	3670.83	2072.61	1775.56	1161.35	8680.35

Appendix Contents of the attached CD

Attached CD store all connected data (shape files and other related files) explained in this manual. You can follow the explanations in this manual using these files by Arc View. The structures of folders and files show below.

Root directory	Sub-directory	Sub-directory or file name	explanation
aGIS Practice	GIS MD	a Project MD b Sape basic MD b Sape process MD c Legend MD e Table MD	This folder stores shape files for practice on Man Den FE area
	Trial		Connected with section I
aMaster Plan Kon Prong	a Shap Basic b Shap Process c Legend d Temp stock		This folder stores shape files for the master plan (Kon Prong)
bManage Plan Mang La	aShapeBasic bShapproces JanLegend Temporary stock		This folder stores related files for the Management Plan on the Moder area (Mang La)
Digital Map FEs	Dak Ruang Man Canh I Man Canh II Man Den Mang La Tan Lap		This folder stores Digital maps (1/10,000) on each areas of the Forest Enterprises in Kon Plong district.
Detail file name list is below			
aGIS Practice	Trial	logging.dbf logging.shp logging.shx	

		newpaddy0.dbf newpaddy0.sbn newpaddy0.sbx newpaddy0.shp newpaddy0.shx	
		newpaddy1.dbf newpaddy1.sbn newpaddy1.sbx newpaddy1.shp newpaddy1.shx	
		try admini.dbf try admini.sbn try admini.sbx try admini.shp try admini.shx	
		try protstream.dbf try protstream.shp try protstream.shx	
		trycommune.dbf trycommune.sbn trycommune.sbx trycommune.shp trycommune.shx	
		tryfe.dbf tryfe.sbn tryfe.sbx tryfe.shp tryfe.shx	
Continue			
		trycommunfe.dbf trycommunfe.shp trycommunfe.shx	
		tryfecommlanduse.dbf tryfecommlanduse.shp tryfecommlanduse.shx	

		tryInduse.dbf tryInduse.sbn tryInduse.sbx tryInduse.shp tryInduse.shx	
		tryprotatream01.dbf tryprotatream01.shp tryprotatream01.shx	
		trystream.dbf trystream.shp trystream.shx	
GIS MD	a Project MD		Empty
	b Sape basic MD	admi ni md.dbf admi ni md.sbn admi ni md.sbx admi ni md.shp admi ni md.shx	
		commun md.dbf commun md.shp commun md.shx	
		comp md.dbf comp md.sbn comp md.sbx comp md.shp comp md.shx	Compartment
		cont10 md.dbf cont10 md.shp cont10 md.shx	1/10,000
Continue			
		cont 50000md.dbf cont 50000md.shp cont 50000md.shx	1/5,000
		fmb md.dbf fmb md.shp fmb md.shx	Forest management block
		hamletland md.dbf hamletland md.shp hamletland md.shx	Land for houses and backyard farm/garden

		housesmd.dbf housesmd.shp housesmd.shx	Houses separately
		mangd_build.dbf mangd_build.sbn mangd_build.sbx mangd_build.shp mangd_build.shx	
		meshfunc md.dbf meshfunc md.shp meshfunc md.shx	Mash analysis data table is linked
		p roadmd.dbf p roadmd.shp p roadmd.shx	Provincial road
		paddy md.dbf paddy md.sbn paddy md.sbx paddy md.shp paddy md.shx	
		prot funcmd.dbf prot funcmd.shp prot funcmd.shx	Areas sensitive for water, soil, and land
		prot steep md.dbf prot steep md.shp prot steep md.shx	Areas steep for logging operation
Continue			
		river 10 md.dbf river 10 md.shp river 10 md.shx	River, water body (1/10,000)
		road24md.dbf road24md.shp road24md.shx	Natioal road
		road 10 md.dbf road 10 md.shp road 10 md.shx	All road and foot pass
		sat img md.dbf sat img md.shp sat img md.shx	2001 satellite image





































		stream 10 md.dbf stream 10 md.shp stream 10 md.shx	Stream (1/10,000)
	b Sape process MD	agrivegi.shp clipvilpaddy fixf.shp dry f.shp dry o f1.shp f1 01.shp f101.shp f201.shp f301.shp f401.shp f701.shp farm fix1.shp fixfarm only.shp forest vigi01.shp grass other.shp	Only listed shape files Used for analysis. Result tempolally stocked by geo-processing.
		grassvegi.shp itsctlus1.shp luse03.shp luse4.shp luse ftype 01.shp	
Continue			
		luse nof01.shp luseftype tot01.shp mepadvilag.shp	
		pick upf insedf.shp prot func10 md.shp semid fo1.shp	
	c Legend MD	fluse forest1.avl gridcodetm.avl llusefypetot.avl luse5.avl luse6.avl luse ftype tot.avl vigiocode.avl	Legend album for analysis on Man Den

	e Table MD	l use vil pad l use vil pad.dbf l use final01 l use final01 l use final01.dbf l use nonf 01 l use nonf 01.dbf nd paddt paddy paddy.dbf uni v p fix uni v p fix2.dbf uni v p fix.dbf	Tentative tables for analyzing areas for various categories.
aMaster Plan Kon Plong	a Shap Basic	Adminikp.shp comunekp.shp cont50000kp.shp corrid kp.shp fe kp.shp fmb kp.shp Fmukp.shp ftype luse kp.shp Houseskp.shp mesh kp.shp	
Continue			
		n road24kp.shp p road kp.shp prot func kp.shp prot steep kp.shp Riverkp.shp Satimgkp.shp Streamkp.shp	

	b Shap Process	aug10 grass planzone .shp aug10 village area.shp aug11steep veget fmb.shp corrid fmb func steep aug10.s fmb fmu protrod.shp funcnocutaug06.shp grass bush fmb aug10.shp newpadfmb01.shp newpublicroad.shp slashburn2001.shp thon name.shp Wildzone.shp	
	c Legend	commune bw.avl commune02.avl fe 01.avl fmbprodprot.avl func integrat.avl func w c level.avl funclevel.avl gridcode01.avl ni img vege code aug09.	
	d Temp stock		Empty: folder prepared for temporarily stock
Continue			

bManage Plan Mang La	a Shap Basic	a fmb ml.shp apl26 logged area.shp b compert ml.shp b subcomp.shp c nocut area.shp cftype luse ml.shp cont 10 20m mangla.shp cont 10mangla.shp cont10 50m manla.shp feb06 new burn.shp ftyp comp.shp ftype comp nocut vol.sh hamlet mangla.shp loggingroad.shp principalpoint2001.shp road province.shp road rute24.shp stream mangla.shp subcomp nocut.shp survey point ml.shp wildzone manla.shp zmesh ml.shp	
	b Shap Process	apl22ftype01.shp apl27watereseve pdf me comp ftypejun24.shp f type tot book01.shp ftyp comp.shp ftype comp nocut vol.sh ftype prd mangla.shp grass pdf mgl.shp landuse pdf mg may04.s log ope area01.shp	
Continue			

		logging order01.shp prdmd fmb.shp prodsfunc50.shp prodsteep.shp protectareatot may06.shp rehabil natural isolate.sh rehabili by fe.shp road net plan.shp s comp ftype func vol.shp scomp villsp.shp sub c func ftyp 02.shp vil territory pdf mgl apl29 vill sup area.shp vill territory.shp vilsupportma01.shp waterprotectbuff1.shp waterprotectline.shp yield cycle unit.shp	
	c Legend	degrade01.avl farmdevop.avl fid logging01.avl forest01.avl ftype apl23.avl ftype apl27.avl land use f typ01.avl non f.avl nonforest01.avl plantzone thin aug10.a veget nishi no line.avl vigi nish dec12.avl	
	d Temp stock	Empty: folder prepared for temporally stock	
Continue			

 Digital Map FEs	 Dak Ruang	 cont 10 dakruong.shp  dak ruang fmb.shp  dakruong fe admi.shp  river 10 dakruong.shp  road 10 dakruong.shp  stream 10 dakruong.sh	
	 Man Canh I	 cont 10 mancanh i.shp  mancanh1 fe admi.shp  river 10 mancanh i.shp  road 10 mancanh i.shp  stream 10 mancanh i.shp	
	 Man Canh II	 cont 10 mancanh ii.shp  river 10 mancanh ii.shp  road 10 mancanh ii.shp  stream 10 mancanh ii.sh	
	 Man Den	 admi ni md.shp  cont10 md.shp  river 10 md.shp  road 10 md.shp  stream 10 md.shp	
	 Mang La	 cont 10 10mangla.shp  janfmb mangla admi.shp  road province.shp  road rute24.shp  stream 10 mangla.shp	
	 Tan Lap	 cont 10 tanlap.shp  river 10 tanlap.shp  road 10 tanlap.shp  stream 10 tanlap.s	