(i) DTM generation

DTM was generated automatically with 50m grid interval using automatic generation method. Then, DTM was edited on sections with lower accuracy of automatic matching, such as the shadowy parts of valleys, forests, water bodies, and etc. The trainees learned this process without difficulties. Generally, an experienced operator edits about 10,000 points; the number of points edited by the trainees was about 5,000 at the time of training. How much to lower the points at tree tops comes with experiences; the initial level of operation was not as fast as expected. For the break lines, rivers were instructed to be extracted. Trees were also present along rivers; heights were also carefully extracted. The trainees were more experienced in stereoscopic viewing at this stage; there were fewer errors in heights.

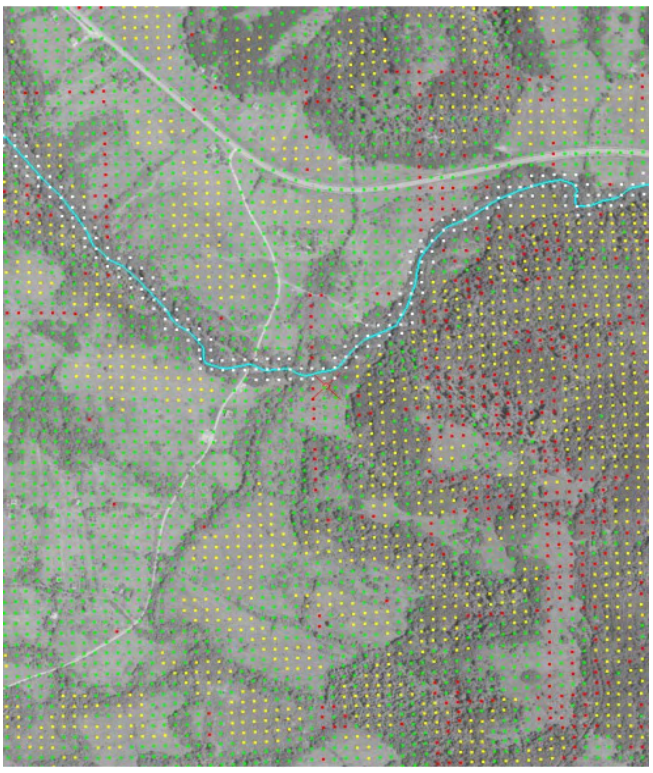

Figure 3-5 Break line and DTM Prepared by Trainees

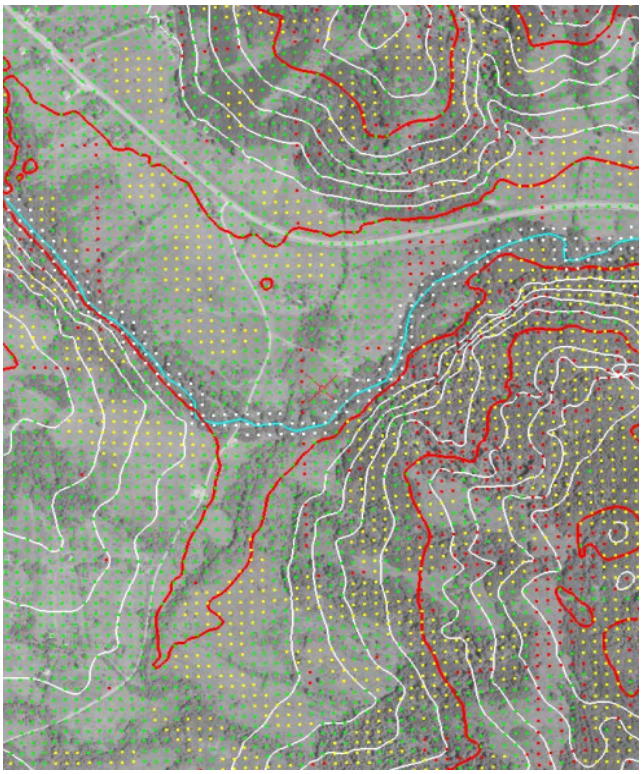

Figure 3-6 Contour lines generated by Trainees

(ii) Contour line drawing

The manual contour line drawing was included in one of the items to be transferred. The manual editing was more than a challenge, since generally it takes four or more years to produce respectable results of contour lines. Therefore, the method of contour line creation was focused on the editing of the automatically generated contour lines.

The index contour lines (100m) and the intermediate contour lines (20m) were automatically generated from corrected DTM and break lines. Then, the contour line data were put on the stereo images using "ImageStation" (superimposition), and the 3-dimensional inspection and data correction were conducted by viewing stereoscopic images.

3) Vector Data Editing

"MicroStation GeoGraphics" was used and plotting data were edited in the following procedure: 1) Inspection and correction on edges of adjoining plotting map sheets; 2)

Inspection and correction of data level, color and other referring to field identification results and existing survey maps; 3) Deletion of duplicated data, overlapping point, minute line, and minute polygon data; 4) Elimination of false notes and line thinning by attribute; 5) Segmentation of data by attribute; 6) Removal of gaps and dangles of data by attribute; 7) Inspection and correction of center points for polygon data preparation; 8) Polygon preparation; and 9) Data transfer to a dxf data format.

As shown in the plotting, the plotted results were edited. There are functions to edit gaps and dangles, but the instructor encouraged manual methods until the trainees get used to the operation and become capable of dealing with unwanted outcomes from automatic editing functions.

For contour line editing, contour lines did not come as smooth as they should have been. The instructor prepared, partially, contour lines of the trainees' OJT plotting areas. The instructor overlaid the results with the results from the trainees. The visual presentation of the differences of contour lines produced by experts and novice were clearly identifiable on screen. The trainees acknowledge the difference and practiced to edit the contour lines as in the sample of the exact location prepared by the instructor.

One trainee had higher mathematics' skills than the others. The instructor selected the trainee and gave intensive training on aerial triangulation so that the trainee will become a future instructor for aerial triangulation in Nicaragua. Still more experiences will be necessary to anticipate outcomes from certain point selection and to deal with unwanted outcomes as often the case with incomplete models.

For DTM generation and editing, the trainees attained the satisfactory level. There is room of improvement in efficiency of DTM editing. Simply more practice will be required; the instructor's guidance for this operation is no longer necessary.

The result of the contour line editing could not be used directly without correction of the instructors. This does not mean that the trainees cannot acquire the skill. The instructors' assessment is that the trainees will be able to continue practicing without the instructors. With practice and experiences, the trainees will be able acquire the level of a professional.

(4) Introduction to GIS and Operations of ArcGIS

1) Structure and Schedule

The objectives of “Introduction to GIS and Operations of ArcGIS” were to acquire knowledge and skills on: 1) Concept of Geospatial database; 2) Functions and Capabilities of GIS; and 3) ArcGIS Software Operations. The course was designed for the staff of the Department of Geodesy & Cartography, and Geophysics in INETER. A total of Nineteen (19) trainees participated in this training course. This course consisted of four OJT sessions in Nicaragua, which was conducted during following period:

Along with the introduction to Geographic Information System (GIS), the OJT-1 focused on basic operations of ArcInfo for the trainees to familiar the software. The main theme of the OJT-2 was to introduce the ArcCatalog and ArcMap components of ArcGIS with their basic operations. The OJT-3 aimed to the advanced operations of ArcGIS. The main covered operations were about screen digitizing, and symbolization. The OJT-4 covered the conversion of dxf data to coverage step by step.

The trainings were designed to be practical as much as possible. For that purpose, the format of GIS Technology was divided into three parts: lectures, demonstrations, and hands-on sessions. For each class, a lecture was conducted first including all the attended trainees. Moreover, the hands-on sessions were designed for immediate practice for the trainees on the personal computer. Since there were more trainees than available personal computers with ArcGIS Software, all the trainees were divided into three

groups with further up to two sub-groups to arrange the practice sessions on two personal computers. The time for each group was allocated carefully so that all were able to use a terminal as much as possible. Following photographs show the training situation:

Photo 3-8 A Lecture Session of GIS Training

Photo 3-9 A Practice session GIS Training

The list of attended trainees is presented in following table:

Table 3-7 List of Participants (Introduction to GIS)

Name	Affiliation
Ramón Avilés Aburto	Department of Geodesy & Cartography
Mayra Silva Diaz	Department of Geodesy & Cartography
Dina Flores Huembes	Department of Geodesy & Cartography
Alberto Orozco Navarro	Department of Geodesy & Cartography
Francisco Pérez Pérez	Department of Geodesy & Cartography
Ramón Alonso Torrez Rodríguez	Department of Geodesy & Cartography
Nestor Rodríguez	Department of Geodesy & Cartography
Oliver Valladares Saballos	Department of Geodesy & Cartography
Fernando Osorio Salazar	Department of Geodesy & Cartography
Isidro Jarquín Vélez	Department of Geodesy & Cartography
Aaron Godoy Zamora	Department of Geodesy & Cartography
Ena Gámez Balmaceda	Department of Geophysics
Virginia Tenorio Bellanger	Department of Geophysics
Antonio Alvarez Castillo	Department of Geophysics
Edna Gómez	Department of Geophysics
Marisol Echaverry López	Department of Geophysics
Tupac Obando Rivera	Department of Geophysics
Armando Saballos	Department of Geophysics
Emilio Talavera	Department of Geophysics

Table 3-8 List of Participants to the Course on Introduction to GIS and Operations of ArcGIS

S. No.	Name of Trainee	Affiliation	Attendance			
			OJT-1	OJT-2	OJT-3	OJT-4
1	Isidro Jarquín Vélez	GC	●	●		
2	Mayra Silva Diaz	GC	●			
3	Ramón Aviles Aburto	GC	●			
4	Dina Flores Huembes	GC	●	●	●	●
5	Aaron Godoy Zamora	GC	●	●	●	●
6	Ramón Alonso Torrez Rodríguez	GC	●	●		
7	Emilio Talavera	G	●			
8	Marisol Echaverry López	G	●	●	●	
9	Armando Saballos	G	●	●		
10	Ena Gámez Balmaceda	G	●	●	●	●
11	Fernando Osorio Salazar	GC		●	●	
12	Alberto Orozoco Navarro	GC		●	●	
13	Oliver Valladares Saballos	GC		●	●	
14	Francisco Pérez Pérez	GC		●	●	●
15	Virginia Tenorio Bellanger	G		●	●	
16	Nestor Rodríguez	GC				
17	Antonio Alvarez Castillo	G			●	
18	Tupac Obando Rivera	G			●	

GC - General Management of *Geodesy and Cartography;* G - General Management of *Geophysics;*
● - *Means Attended*

Since many trainees participated during OJT-1 to OJT-3, they were divided into three groups with further into two sub-groups (two persons in each). During OJT-4, the trainees were divided into two groups with further into two sub-groups.

2) Content Description

(a) OJT-1

During OJT-1, the major items included were: 1) Introduction of GIS; 2) Introduction of ArcGIS Software; 3) Practice of Basic Commands at ArcInfo Workstation.

i. Introduction of GIS:

This was presented with emphasis on: What is GIS; Concepts of Geospatial Data; Why GIS is needed (its Benefits); Basic Functions of GIS; How GIS Works; What GIS Can Do; and Applications of GIS.

ii. Introduction to ArcGIS

ArcGIS is an integrated collection of GIS software products for building a complete GIS for an organization. This software, in combination with the geodatabase, provides the tools to assemble intelligent GIS. As presented in Figure 3-7, this software has wide range of products.

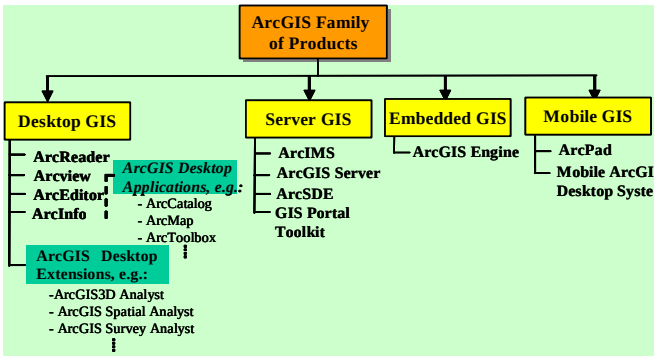

Figure 3-7 ArcGIS Family of Products

iii. Practice of Basic Commands at ArcInfo Workstation

The basic commands practiced during this trainig using ArcInfo Workstation were: ARCTOOLS, BUILD, CLEAN, CREATEWORKSPACE, CREATE, COPY, DESCRIBE, FREQUENCY, GENERATE, KILL, LISTCOVERAGES, LISTWORKSPACES, PROJECT, PROJECTDEFINE, QUIT, UNGENERATE, UNLOAD, WORKSPACE, and so on.

(b) OJT-2

Along with reviewing the contents of OJT-1, the Study Team included new major items during OJT-2. They were: 1) Introduction of ArcCatalog and ArcMap; 2) Data conversion; 3) DEM preparation; and 4) 3D & Spatial Extensions.

i. Introduction of ArcCatalog and ArcMap

Sample data were used and the basic functions and the operational approach to ArcCatalog and ArcMap were explained. The main points were as follows:

ArcCatalog:

- Start and end ArcCatalog
- Tool bar operation methods (copy, past, delete, icon operations, folder connection, zoom, pan, attribute value display, etc.)
- Display change method
- Metadata display method

ArcMap:

- Start and end ArcMap
- Data connection method
- Data display method, and tool bar operation methods
- Method to change the data depiction
- Data retrieval method
- Labeling method
- Map Layout method (Figure 3-8 Example of Map Layout)
- Method to save maps (.mxd preparation method)

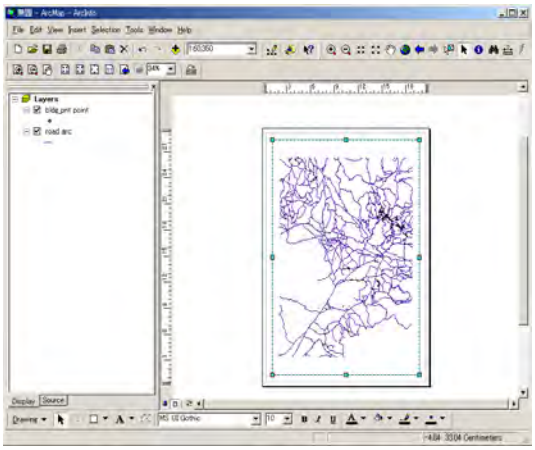

Figure 3-8 Example of Map Laying-Out Work

ii. Data Conversion

In INETER, since CAD data were mainly used, a mutual data conversion with the data format (coverage) of ArcGIS served as an important factor on practical use of data. Moreover, it was an item indispensable to data transfer with external organizations, also. Therefore, the CAD data format was set with the standard dxf format, as sure operation of data conversion and operation was kept in mind.

iii. DEM Preparation

Since there were various types of application in DEM (Digital Elevation Model) curiosity and expectation of the INETER side was high, some types of creation methods along with characteristics of each type were explained. Training on the method to output to the ASCII format from an internal format of ArcGIS etc. was added for the training to cover wider application of the technology. Since the counterpart requested a training session on data transfer from DTED1 (NGA format), it was included in the training.

iv. 3D & Spatial Extensions

This was explained using DEM created during the DEM training sessions. To deepen understanding and get used the operations, more time for practice was assigned to each trainee. An example of 3D shade map created from DEM is shown in Figure 3-9.

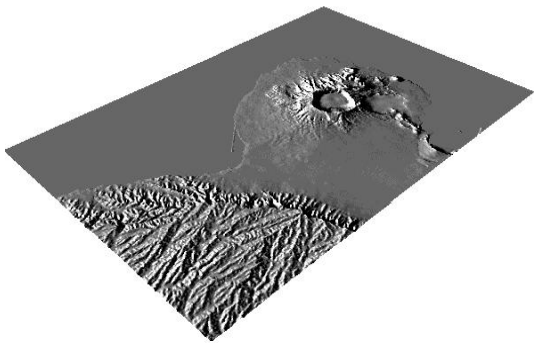

Figure 3-9 Example of 3D shade created from DEM

(c) OJT-3

Along with reviewing the contents of previous OJTs, included new major items during this training were: 1) Data Capturing and 2) Symbolization.

i. Data Capturing from Aerial Photographs

This exercise comprised all the steps of data capturing. The available color photograph (approximate scale 1/2 000) covering a part of the Managua area was used for the exercise. Over the sample area, Points (such as scattered tree, road crossing), Line (such as road), and Polygons (such as vegetation) were digitized. This was followed by operations like Cleaning and Building Topology, Labeling, adding other attribute data such as name of the feature, and so on. Figure 3-10 presents the digitized features (that carried out by a trainee) along with aerial photograph as background.

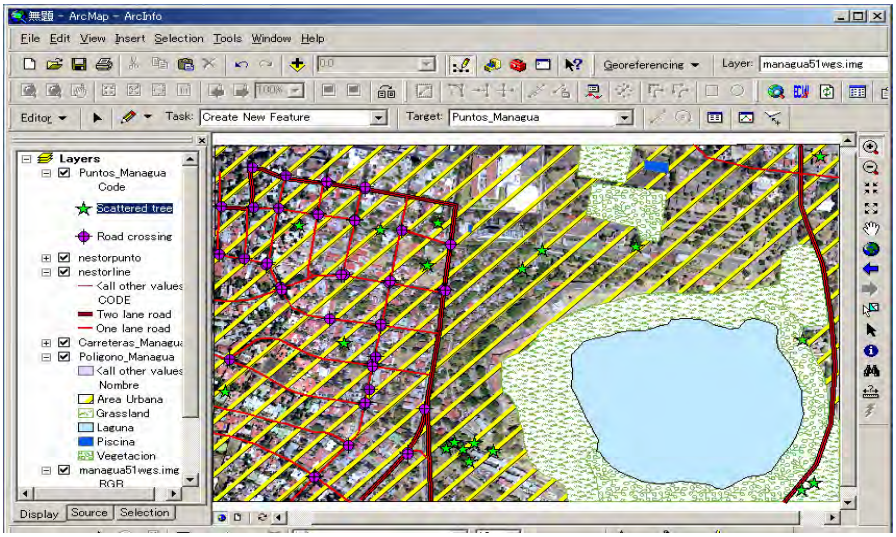

Figure 3-10 Data Capturing

ii. Symbolization

During this exercise, various options for selecting symbols that present in ArcGIS were presented. Moreover, training was also carried out how to modify the existing symbols as well as to create new symbol in ArcGIS or to import a symbol that was created using other software to ArcGIS.

(d) OJT-4

i. Conversion of dxf data to Coverage:

Considering the fact that in this project, the source data format for creation of GIS Database was dxf, the final format of plotted digital data, this exercise was conducted to practice with the procedure of converting dxf data to GIS database. This exercise was carried out with the 2852-I map sheet of 1/50,000 (Nagarote), for which plotting was also carried out by counterpart personnel.

This exercise was carried out in step by step along with detail discussion at each. Thus, the included major steps were as follows:

- Reviewing of GIS Database Specification
- Creation of GIS Database Schema
- Creation of Empty Coverage based on schema
- Checking and conversion of dxf data to coverage
- Preparing the converted coverage for further processing
- Transferring the data from the converted coverage to empty coverages
- Checking and applying necessary process to the coverages with transferred data.

Thus, at last GIS database for Nagarote Map sheet was created with data in the respective coverage, referred to Figure 3-11 carried out by a trainee).

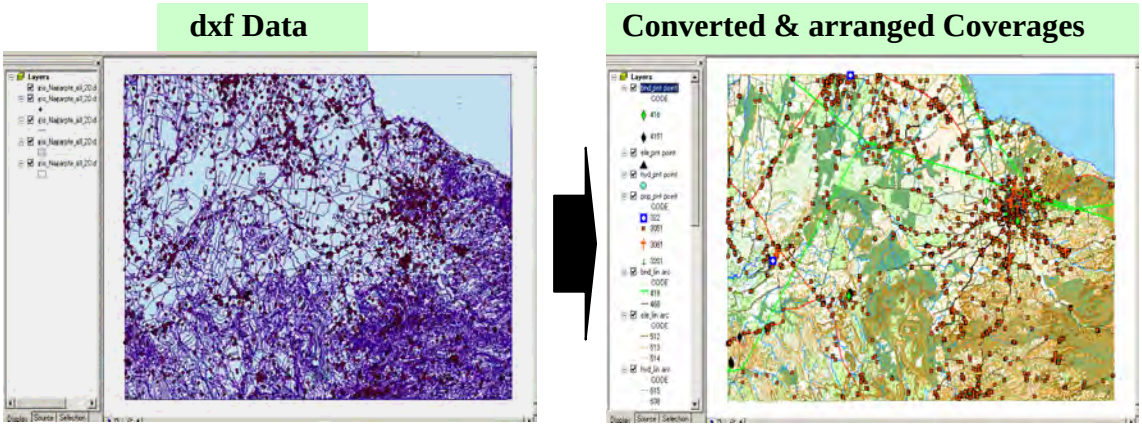

Figure 3-11 dxf Data to Converted and Arranged Coverage Data of 2852-I (Nagarote) Map Sheet

ii Introduction to data processing of coverage for GIS Analysis

OJT-4 on "Introduction to data processing of coverage" for GIS Analysis was conducted from 11th November to 9th December, 2005. During this session, some of the data processing method for GIS analysis was covered in step by step. Especially on this time, not only about overlay for GIS analysis but also AML programming for repetitive and time taking routine data handling work was introduced. The training was conducted with the same format as conducted during previous OJTs and it was divided into three parts: lectures, demonstrations, and hands-on sessions. For each class, the lecture was conducted at once including all the attended trainees. Topic of GIS analysis is as follows:

3) Results

This training course being attended by larger number of trainees, there were some challenges, which were resolved with the optimum efforts. These are listed below:

i. Various levels of technical experience:

The attended trainees had various levels of technical experience and understanding. Thus, during practice, some of trainees used to do more mistakes and also repeating of same mistakes. This was resolved by demonstrating the required functions (operations) repeatedly.

ii. Various levels of Understanding of English Language:

Trainees were diversified with respect to understanding of English language. The ArcGIS Software being in English language, the trainees with higher level of English understating used to pick up the methodology faster compared to those with lower level of understanding. Communicating through translator; repeating the demonstration; watching their practice activity intensively; and promoting them to take note of operations were some of the measures taken to resolve the challenge. .

iii. Tight schedule:

Along with the task of attending this training course, the attended trainees had also to do their regular task. Thus, some of trainees despite of their willingness to attend were unable join some of the training classes. After returning with such discontinuity, it was a little hard to make up the missed items. Arranging additional hands-on sessions for them to make-up the missed items resolve this difficulty.

Qualitative evaluation with some approaches was carried out to know the understanding level of trainees. One approach was to decrease the amount of instructor's demonstration during the hands-on sessions. This, wait and see approach, was good to read their mental

move. Considering the vast contents of training course, they were found relatively doing more amounts of mistakes during the early sessions, which was natural one. But, the amount such mistakes was drastically decreased with the advancement of sessions especially during OJT-3 and OJT-4. Moreover, most of the commands and operations so used during OJT-1 and OJT-2 being repeated during these last two OJTs, this approach also helped to know how well they had grasped the contents of OJT-1 and OJT-2.

Another adapted approach was asking them to prepare the manual of previous hands-on sessions so that their understanding level could be checked. Some of them were unable to complete the task because of other regular tasks; some of them managed to follow the requirement.

Thus, these indicated that the trainees understood well about not only the concept of GIS but also how to operate ArcGIS software for creation of GIS Database as well as using the created database for various application purposes. A few trainees, having reached to a higher level in the ArcGIS operations, could become key persons in this field. Hereafter, it would be very important for the counterpart agencies to establish a system for maintenance and updating of GIS database.

(5) Introduction to ERDAS Imagine and its Operations

1) Structure and Schedule

The objectives of "Introduction to ERDAS Imagine and its Operations" course were to acquire knowledge and skills on: 1) Concept of Raster Data; and 2) ERDAS Imagine Software Operations. The course was designed for the staff in INETER; however, two personnel from the Moviterra (UNAN, León), an affiliated agency of INETER had also joined the course. A total of twelve (12) trainees participated in this course.

Table 3-9 List of Participants (ERDAS IMAGINE)

Name	Affiliation
Josué Donado Figueroa	Department of Geodesy & Cartography
Uberne Rueda Padilla	Department of Geodesy & Cartography
Francisco Pérez	Department of Geodesy & Cartography
Noel Ramírez	Department of Geodesy & Cartography
Ramon Alonso Torrez	Department of Geodesy & Cartography
Isidro Jarquín Vélez	Department of Geodesy & Cartography
Marisol Echaverry	Department of Geophysics
Ena Gámez	Department of Geophysics
Armando Saballos	Department of Geophysics
Virginia Tenorio	Department of Geophysics
Eddy García	Moviterra *
Ena Reyes	Moviterra *

*Note: Moviterra is an institution which is collecting the real-time-volcanic-activity data around León City, and was taken as the candidate institution of training in response to the request of INETER.

The trainings were designed to be practical as much as possible. For this purpose, the format of trainings was divided into three parts: lectures, demonstrations, and hands-on sessions. Moreover, the hands-on sessions were designed for immediate practice for the trainees on the personal computer. Since there were higher number of trainees (nine in OJT-1 and five in OJT-2) compared to a single personal computer with ERDAS Imagine, all the trainees were divided into groups (with one or two trainee in each) to arrange the practice sessions. The time for each group was allocated carefully so that all were able to use a terminal as much as possible.

Since some of trainees of this course were the same who had to attend the ArcGIS course, the lecture of this course had to carry out at other time to avoid conflict with the lecture time of ArcGIS course. Thus, it was conducted only twice a week during OJT-1. Similarly, during OJT-3, the instructor being the same for this course and ArcGIS course, it could be conducted only for two weeks with three classes a week. The detail schedule of this course is listed in the following tables.

All the attended trainees, having technical background, were well familiar of using the Personal Computer and some of them had experience of working with a photogrammetry Software named MicroStation. However, these were their first opportunity of getting training regarding ERDAS Imagine. Despite that, they showed good desire to learn the contents of the training. For smooth communication, all lecture sessions and some of hands-on sessions were conducted with the help of Spanish Translator.

Table 3-10 List of Participants (ERDAS Imagine)

S. No.	Name of Trainee	Affiliation	Attendance	
			OJT-1	OJT-2
1	Josue Donaldo Figueroa	GC	●	
2	Ramón Alonso Torrez Rodríguez	GC	●	
3	Marisol Echaverry López	G	●	
4	Ena Gámez Balmaceda	G	●	●
5	Francisco Pérez Pérez	GC	●	●
6	Virginia Tenorio Bellanger	G	●	●
7	Antonio Alvarez Castillo	G	●	
8	Ana Reyes Zavala	M	●	
9	Eddy García Padlla	M	●	
10	Isidro Jarquín Vélez	GC		●
11	Uberne Rueda Padilla	GC		●

GC - General Management of *Geodesy and Cartography;* G - General Management of *Geophysics;* M - Moviterra (UNAN, León); ● - Means Attended

2) Content Description

(a) OJT-1

The main included training items were as follows:

i. Introduction to Raster Data and ERDAS Imagine

After introducing about the Raster Data, menus and general functions of ERDAS Imagine were explained. A file importing method from external file formats to the Imagine format (.img) was also demonstrated.

ii. Image Rectification

In this session, the geographic-coordinate-attachment method to a scanned image was demonstrated. Moreover, the expert showed that this function could be used to create the background image for the existing map digitizing, and application to the real situation was explained also.

iii. Image Sub-setting (Clipping)

Generally this function is applied to images of targeted areas of work, and there are several types of approaches, such as AOI (Area Of Interest) and the masking methods. In the training session, several methods were explained and practiced. Figure 3-12 shows an example of clipping using an AOI file (showing the boundary of necessary area).

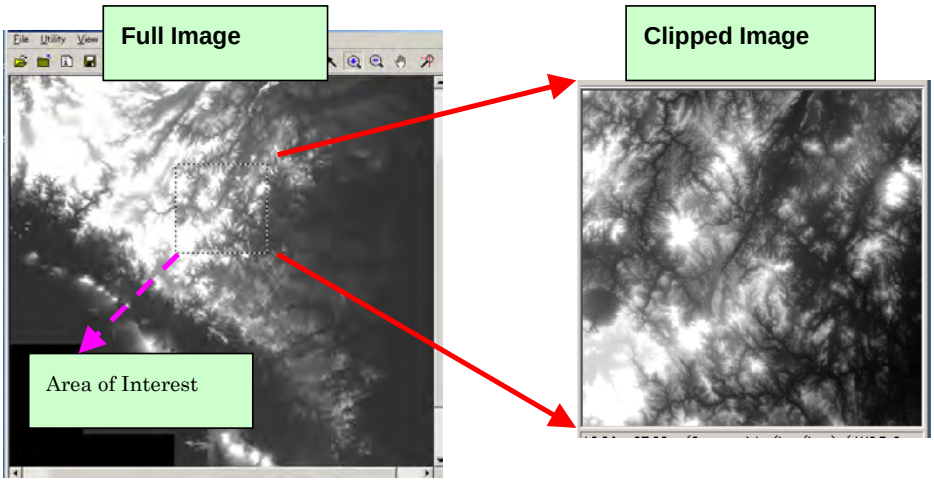

Figure 3-12 Example of Clipping Using an AOI as Clipping File

iv. Introduction to Image Enhancement

v. Mosaicing

Through this function, methodology of combining two scanned images with identical coordinate system was shown and practiced.

vi. Map composition function

Through this function, designing layout of the image data as a map, and outputs it from a printer were shown and practiced.

vii. Export function

This function was practiced to export a file with IMG format to other formats such as GeoTIFF and GRID.

(b) OJT-2

The main items covered during OJT-2 were: 1) Ortho-rectification; 2) Generation of Anaglyph and 3) Topographic functions.

i. Ortho-rectification

This was carried out using a sample of scanned aerial photograph of part of Ometepe Island of the Study area. The contour data of this Study was used to create DEM, which was used to assign Z value for the Ortho-rectification. The following photograph shows the conversion of contour vector data to DEM (Digital Elevation Model) data. An example of scanned aerial photo and ortho-rectified aerial photo is shown in Figure 3-13. The difference in orientation can be easily noticed in the both photos.

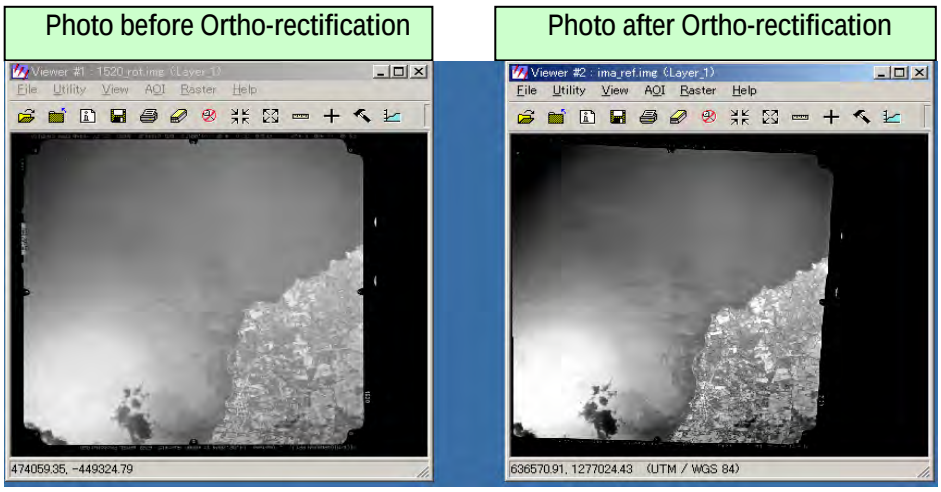

Figure 3-13 Aerial Photographs before and after Ortho-rectification

ii. Generation of Anaglyph

Anaglyph is quite permissive in viewing an image in 3D, which makes it much easier to interpret the data and to pick out the details, such as the comparative height of neighboring peaks and where the valleys run. Moreover, the Anaglyph Generation tool of ERDAS Imagine provides a simple means of producing a color anaglyph simulation of the terrain in 3D using a DEM and an image. For this exercise, the Ortho Photo and DEM of Ometepe Island were used. As the result, it created the image as shown in Figure 3-14.

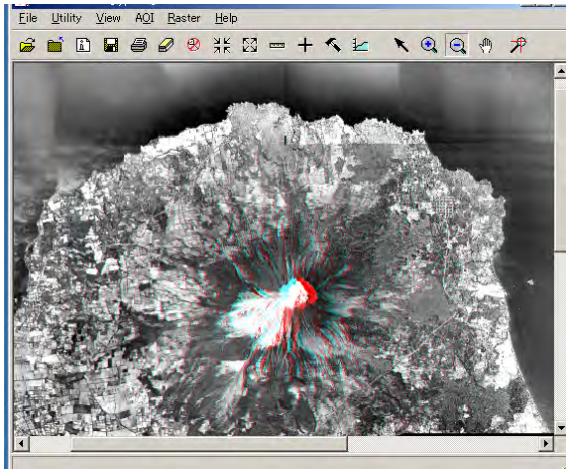

Figure 3-14 Anaglyph of Ometepe Area

iii. Topographic functions:

The topographic functions such as creation of slope, aspect, and relief were carried out under this exercise. For example, the painted relief created using the DEM of Ometepe area is presented in Figure 3-15.

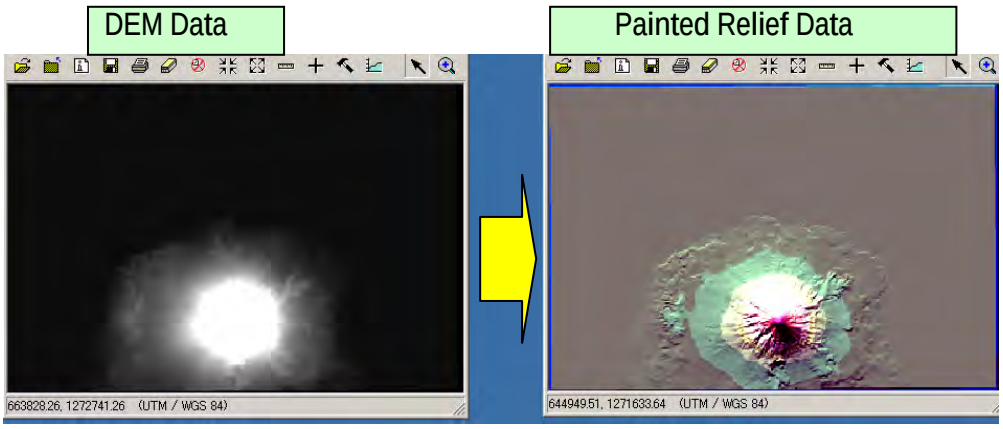

Figure 3-15 DEM and Painted Relief of Ometepe Area

3) Results

Qualitative evaluation with some approaches was carried out to know the understanding level of trainees. One approach was to decrease the amount of instructor's demonstration during the hands-on sessions. This, wait and see approach, was good to read their mental move. It was found that the amount went on decreasing level with the advancement of sessions. Another adapted approach was asking them to prepare the manual of previous hands-on sessions, which despite of their busy schedule some of them could do so as well.

Thus, these indicated that the trainees understood well about not only the concept of raster data and operations of ERDAS Imagine Software. A few trainees, having reached to a higher level in the ERDAS Imagine operations, could become key persons in this field. Hereafter, it is very important for the counterpart agencies to establish a system for maintenance and updating of GIS database.

(6) Map Symbolization

Map symbolization of technology transfer aims to attain certain level of understandings symbolization from plotted vector data to cartographic symbols and on creation of complete printing map files.

1) Structure and Schedule

Four trainees took part in the map symbolization OJT. The names and their affiliations are listed in Table 3-11.

Table 3-11 List of Participants (Map Symbolization)

Name	Affiliation
Isidro Alberto Jarquín Vélez	Cartography Section
Dina Del Carmen Flores Huembes	Cartography Section
Aaron Anastasio Godoy Zamora	Cartography Section
Fernando José Osorio Salazar	Cartography Section

The software used was Adobe Illustrator version 10 or 11. The training was conducted from 24 of October to 25 of November, 2005. The major items of training were: (a) Document setup and preference setup; (b) Preparation of spot colors and modification of swatches pallet; (c) Preparation of map symbols and pattern; (d) Data import or conversion for map editing with Adobe Illustrator; (e) Map Symbolization for each features as line, point, polygon and text; (f) Marginal design, grid and grid numbers completion; and (g) Methodology of checking for completed printing maps.

(a) Document setup and preference setup

In this session function of Adobe illustrator “Document setup” and “Preference” were explained. Those functions are concerned to set up art board size (sheet size) and units of drawing.

(b) Preparation of spot colors and modification of swatches pallet

It was instructed that the five colors specified are strictly followed. As a preparatory training, a method of preparing spot colors was explained. By registering the spot colors to the swatch pallet, unwanted mistakes can be avoided. The method of registration and the use of the pallet were instructed.

(c) Preparation of map symbols and pattern

Using the brush function makes operation efficient. The Study Team explained how the operation can be more efficient on converting point data to symbols. Registration of the symbols already specified it the specifications to the brush pallet and the methods of using the brush functions were explained. For vegetation symbols, the same principle applied. The methods of registering the symbols to the swatches pallet and of using the pallet were explained.

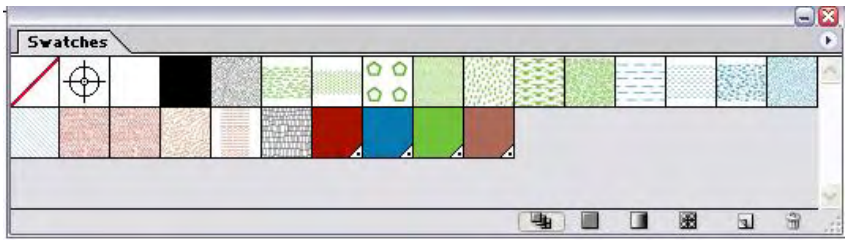

Figure 3-16 Colors and Patterns Registered in Swatch Pallet

(d) Data import or conversion for map editing with Adobe Illustrator

The data format provided or acquired in INETER is dgn files produced using MicroStation. Illustrator files are not compatible with the dgn files; therefore, the files cannot be imported directly. It was explained that the .dgn formatted files needed to be converted to compatible files so that the files can be imported to Illustrator. The process of conversion is shown in the following diagram; the technology was transferred to the counterpart.

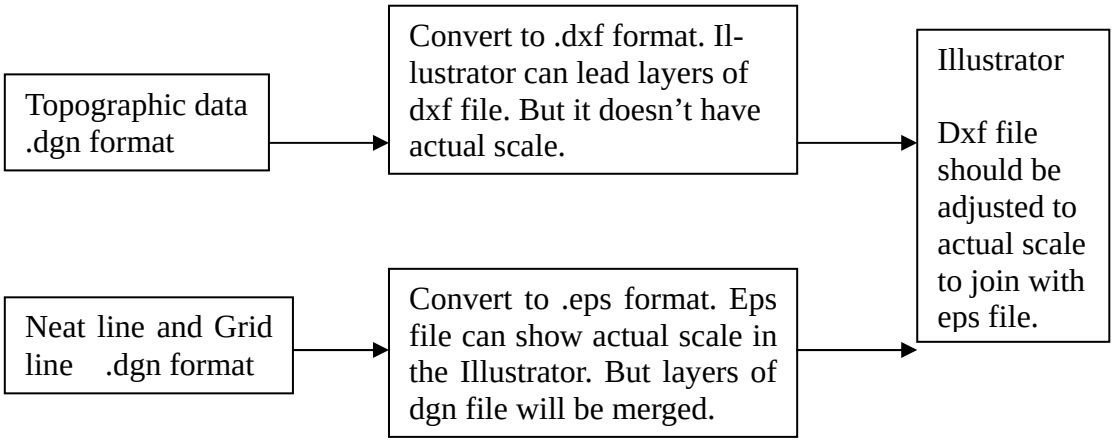

Figure 3-17 Process of Data Format Changes

(e) Map Symbolization for each features as line, point, polygon and text

The editing process is necessary before symbolizing. Various types of editing were instructed. After the editing training, training on symbolization was conducted.

(f) Marginal design, grid and grid numbers completion

In this session completion of Marginal design, grid number, Boundaries box, Elevation guide, Adjoining sheet and etc. were explained.

(g) Methodology of checking for completed printing map

Methods of inspection and proofing on usages of colors and fonts were instructed. Two trainees were selected from the Section of Cartography: Mrs. Dina Del Carmen Flores Huembes and Mr. Aaron Anastasio Godoy Zamora. They are versed cartographers. They have knowledge of mapping based on "Mapping Specification of Defence Mapping Agency USA". Mrs. Flores Huembes has fifteen years of experience in cartography. She has been working on digital mapping in recent seven years. Mr. Godoy Zamora has six years of digital mapping experience. Both of them have received training on Adobe Illustrator from February to March 2005.

2) Results

The trainees already had experience in making print files using MicroStation. Making print files for offset prints was first time for them. Different methods of making print files between MicroStation and Adobe Illustrator were somehow confusing for them.

(a) Data Transfer from MicroStation to Adobe Illustrator

We tried to edit the data which were plotted by OJT trainees of digital plotting in the Section of Photogrammetry first. The data did not have any problem when they were printed from a printer. But the data required modification for easier editing with Adobe Illustrator. The trainer explained reasons of problems one by one when the trainees found errors in symbolization. The Study Team decided to have a workshop with OJT trainees of digital plotting after the trainees for symbolization understood causes of problems. At the workshop, solution of data transfer was explained by OJT trainers and solutions associated with data were discussed among trainees for plotting and symbolizing. Agendas for the workshop were follows: Methodology of data transfer MicroStation to Adobe Illustrator; and flow of data transfer from plotting to editing--dgn to dxf to ai.

Table 3-12 Data Type for Adobe Illustrator

Data type	Scale	conversion	Level cg to	Text	Remark
Neat line	actual	dgn to eps	File name		
Grid line	no	dgn to dxf	Layer name as utm_grid text_utm ll_grid text_ll	coordinate text	
Lines	no	dgn to dxf	layers		Required join
Contour	no	dgn to dxf	layers	value	Required join
Points	no	dgn to dxf	layers		Required simple symbols(cell) as or
Building 3051	no	dgn to dxf	Layer 3051		Required rotated shape
Spot height and BM,	no	dgn to dxf	Layers 508 to point 508t to text	elevation	Required simple symbols(cell) as
Polygons	no	dgn to dxf	layers		Required closed polygons
Plantation	no	dgn to dxf	Layers 707 to point 707t to text	Kind of plants	Required closed polygons
Other data					
Admin boundary	no	dgn to dxf	layers		Clipped by each neat line
Annotation	no	dgn to dxf	Layers name as level Example: level1 to point Level 1t to text	yes	Clipped by each neat line

* All of data required to attaches neat line.

The counterpart had experiences of offset printing on topographic maps of 1:250,000 compiled from the former edition of digitized 1:50,000 topographic maps that were symbolized using MicroStation. Moreover, since the counterpart had the experience in producing the digitized topographic map of 1:50,000. It was well versed on the edit regulation of DMA required. There was any problem in editing. The counterpart did possess full knowledge of the expected final results. Therefore, taking advantage of the functions of Adobe Illustrator to the maximum extent for efficient editing and symbolization was the main theme of the OJT.

It was the trainees' general impression that the results from Illustrator were more graphically appealing that those of MicroStation. Also the trainees understood that using functions like brush, cutting or offset lines, time-consuming process of symbolizing such as tics could be converted efficiently. The trainees experienced all the process of editing and symbolizing within a limited schedule.

There was no opportunity to use Adobe Illustrator since OJT in February. During the training some functions and operations learned needed reviewing. It is a concern that there is a possibility that the software may not be used as often as they should to keep the technology. Even after the completion of the Study, it would be necessary to continue using the software. For this purpose, continuous learning system would be necessary for better and efficient map symbolization.

The specifications on the map symbolization were based on the DMA. It was created in 1980 for the analogue symbols. Some of the symbols were unnecessarily complex for digital symbolization. The specifications need to be amended for more efficient symbolization.

(7) Field Completion

1) Structure and Schedule

The purpose of field completion is to investigate unidentifiable features during the field identification performed previously. Unreasonable parts, inconsistencies, questionable features compared to existing source materials are examined and confirmed. All field completion work was completed using draft maps. Handy GPS receivers which were introduced for technology transfer were also used during the work. The field completion survey was performed by the following five INETER counterparts.

Table 3-13 List of Participants (Field Completion)

Name	Affiliation
Isidro Jarquín Vélez	Geodesy and Cartography
Oliver Valladares Ramón Avilés Aburto	Geodesy and Cartography
Alberto Orozco	Geodesy and Cartography
Javier Hernández	Geodesy and Cartography
Fernando Osorio	Geodesy and Cartography

The field completion was carried out from October 31 to November 26, 2005. Arrangement of the field work results was carried out from November 28 to December 9, 2005. In INETER, the results were examined. The unknown places were reexamined in the phase of examination and organization of the results.

In the field completion, the following items were focused for investigation.

1. Planimetric feature

Omitted of planimetric features (especially point data) were extracted using Handy GPS and recorded onto the draft maps.

2. Annotation

Spelling, location, type, etc. were checked in the field.

3. Secular change

Special attention was paid in areas where the intense changes were recognized. Location data were correctly acquired using Handy GPS.

Photo 3-10 Location Check on Monument

Photo 3-11 Location Check of District Office

Photo 3-12 Location Check on School

Photo 3-13 Location Check of Bridge

Figure 3-18 Field Completion Map Indicating Coordinates from Handy GPS

2) Results

The chief engineer of INETER and the Study Team discussed methods of field work implementation. The chief engineer had an experience in field work in the former Soviet Union. He had adequate knowledge of quality control on field completion. The draft maps and map symbols and their application rules were given to the field team. The chief engineer instructed the guideline to the field team in accordance with the specifications. Five field teams were organized and areas to be verified were divided into six (6) regions as shown in Figure 3-19.

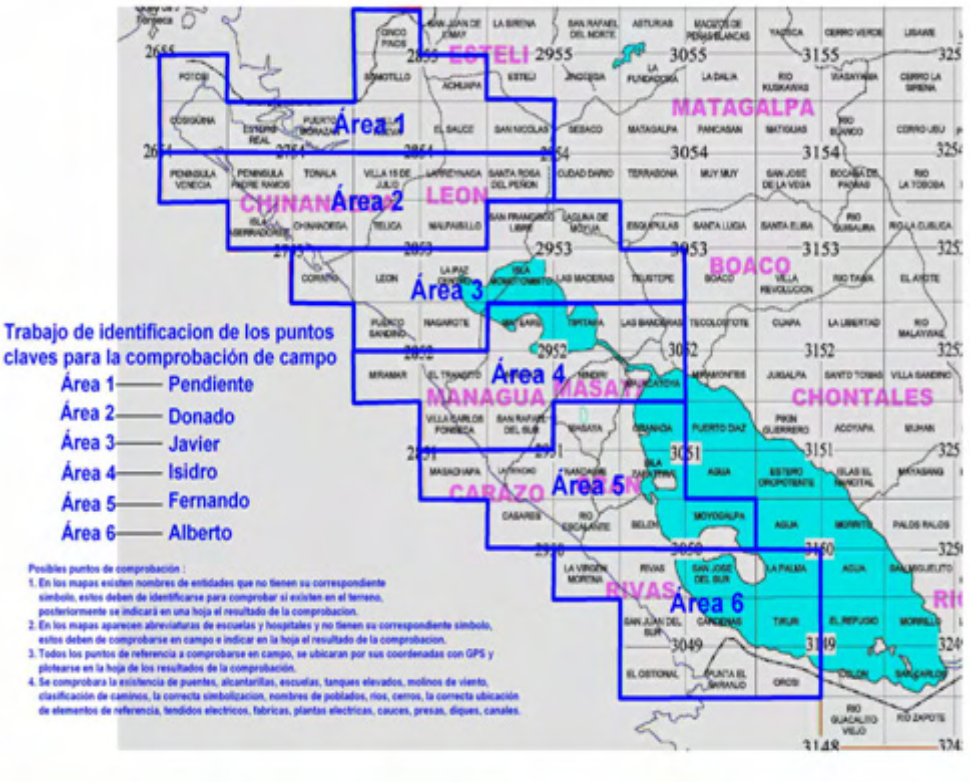

Figure 3-19 Division of Field Completion Area