Skills Training on:

Participatory 3-Dimensional Modeling (P3DM)

Participatory Geographic Information System (PGIS)

Raumoco Watershed

Lautem District, East Timor

Suco Fueloro, Sub Distritu Lospalos
Distritu Lautem

August 6-17, 2007

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Executive Summary

This is a report on the 10-day training on Participatory 3-Dimensional Modeling (P3DM) of the Raumoco Watershed and Participatory Geographic Information System (PGIS) conducted from August 6 to 17, 2007, in Lospalos, Lautem District, East Timor by Concern Worldwide and facilitated by the Green Forum – Western Visayas (Filipino NGO). The program was made possible through funding support from DIPECHO.

There were 28 participants in the training: 18 came from the communities of the Raumoco Watershed mainly representing their village disaster management councils, 4 from the local and national government agencies, and 6 from Concern's Staff and partner local non-governmental organizations (NGOs).

The Training has two components, P3DM and PGIS. The former was a hands-on training that produced a 3D relief of the Raumoco Watershed with 1:8,000 horizontal and 1:4,000 vertical scales. Important spatial information, such as extents of flood-prone, landslide, and local resource-use areas; and village location and boundaries were identified and color coded in the 3D model based on the local people's perspective. More than 100 people representing the villages of Afabubo, Baricafa, Kotamuto, Lakawa, Luro, Daudere and Serelau were consulted in group discussions for the information on the 3D map.

PGIS training provided basics on GIS, Global Positioning System (GPS) instrumentation and hands-on computer training on the production of base / working maps, heads-up digitizing of scanned images, and the lay-outing and printing of GIS maps. An actual field traverse was undertaken to further hone the skills of the participants in the handling of the GPS. This also provided the villagers as well as the project staff with the opportunity to locate the geographic positions of important landmarks which were used as geo-referencing positions for the 3D-model.

Over-all participation among the project staff and trainees was exemplary throughout the duration of the training. Not even the tense political situation could dampen the enthusiasm and creativity of the participants to finish the training.

The report gives a background on the training program; step by step account of 3D modeling; highlights of community consultations, and basic contents of the PGIS training.

Background

The Participatory 3-Dimensional Modeling (P3DM) of the Raumoco Watershed and the Basic Skills Training on Participatory Geographic Information System (PGIS) were held on August 6 to 17, 2007 in Lospalos, Lautem District as part of Concern Worldwide's Coordinated Actions for Disaster Risk Reduction Empowerment (CADRE) Programme. CADRE is a 15-month project funded by DIPECHO under its 5th Action Plan for Southeast Asia that is also a follow through of the Capacity Building for Disaster Risk Reduction Programme in Lautem District implemented from February 2005 to April 2006 under DIPECHO's 4th Action Plan.

CADRE aims to contribute in reducing the vulnerabilities of communities from disasters caused by floods and droughts through the development of sustainable, replicable, and coordinated preparedness and mitigation actions at the local, national and regional levels. Specifically, it works on improving the capacities and strategies of poor and vulnerable sectors and other key stakeholders for disaster risk reduction.

The Programme is currently focused in the Raumoco Watershed that is under the administrative jurisdiction of two sub-districts, namely Luro and Muro. The Watershed Divide covers nine (9) villages: Afabubo, Baricafa, Kotamuto, Lakawa, Luro, and Wairoke in Luro Sub-District; and Daudere, Maina II and Serelau in Muro Sub-District. Afabubo, Daudere, and part of Kotamuto suffer the brunt of annual incidents of flashfloods and all nine villages suffer food shortages caused by drought and the changing weather patterns.

P3DM is introduced as a tool for partner communities and other key stakeholders to understand better the physical and biological characteristics of their watershed and how hazards like flooding and drought impact their livelihoods and living conditions. The output 3D map will be used in planning, monitoring, and evaluating disaster risk reduction interventions in the Raumoco Watershed.

Hands-On P3DM Production (Step by Step Process)

The P3DM training started on the morning of August 6, 2007 with a brief message from Lautem District Administrator Olavio D. Jesus Monteiro He stressed the significance of grassroots planning to decentralization efforts as local communities know their needs better, thus they can formulate more relevant plans.

Fig. 1. Ms. Marrie-ann Merza, Program Manager of Concern East Timor; Lautem District Administrator Olavio D. Jesus Monteiro; Mr. Ashutosh Dey, Concern East Timor Disaster Risk Reduction Advisor; and P3DM Training Facilitator Melvin Purzuelo of Green Forum – Western Visayas.

A presentation of the video prepared by the ASEAN Regional Centre for Biodiversity Conservation (ARCBC) on the P3DM experience in Vietnam followed the introductory program. Participants were later asked about their reactions on the video and several commented that they saw people cutting papers, pasting the cartons and producing 3-dimensional map.

Why Map? Participants were asked why do they need to map or what are the uses of maps. Some said to know where things are, or what are in a place, or to give them direction and also for disaster risk reduction planning. The facilitator shared that maps are very powerful paper tools like in the colonial times when maps were used to claim territories. Land titles and other tenurial instruments are 'maps'. Constructions of buildings or houses also start with plans or sketches that are practically maps and hopefully the P3DM experience will allow communities to make use of the power of these maps for their own interests and welfare.

Basic map features of points, lines and polygons (areas) were explained. Participants were asked for particular points, lines and areas that they want to see in their map. They named houses, schools, springs, cemeteries, sacred grounds, clinics, evacuation centers, etc. for points. Rivers, roads, and boundaries for lines and forests, fallows, flood prone areas, landslide, grasslands and others for the area feature.

Fig. 2. The Working Map (A); explaining that the Working Map comes from existing Topographic Maps (B); illustrating how the 3-D map will "grow" with each contour line cut in a carton (C): and showing some of the materials needed like carbon paper, corrugated carton, glue, threads and pins (D).

Working Map (Fig. 2A) provides the basis or guide for the horizontal and vertical scale of the 3D map that will be produced. Working Maps contain contour lines of elevations at regular intervals and these are derived mainly from existing Topographic Maps (Fig. 2B). Topographic Maps on East Timor have been printed and distributed by the Indonesian Army Topographic Support Establishment in scales of 1:25,000 and 1:50,000 both with contour intervals of 12.5 meters. To produce a Working Map, the corresponding area in the Topographic Map is scanned,

geographically referenced (more discussions in the PGIS training), printed according to desired scale, and covered with transparent adhesive tapes for durability when tracing.

Digital datasets of East Timor topography are available the GIS Section of the Ministry of Agriculture and Forestry (MAF) with contour lines at 5 meter elevation intervals. For the Raumoco P3DM exercise, elevation intervals of 25 meters were used considering that the available corrugated cartons in Dili were 6.1 millimeters thick, which at 1:4,000 vertical scale is equivalent to nearly 25 meters. For the horizontal scale, 1:8,000 was used that produced a map with 1.9 meters in width and 2.8 meters in length.

Fig. 3. Cutting the corrugated carton to the sizes of the Working Map (A); taping the carbon papers to form a sheet similar in size with that of the Working Map and the carton boards (B and C); placing the Working Map on top of the taped carbon papers (D) and stapling them together (E); clipping a carton board with the stapled carbon papers and Working Map (F); and tracing the contour lines with ballpoint pens or pencils starting at the lowest elevation (H). Trace on a separate carton board for each of the contour line.

While most of the Working Map was printed in the Philippines using a plotter, a portion was not printed to illustrate to the PGIS training participants how to prepare using the 'tiled-printing' technique. This showed PGIS participants how to make a Working Map using an ordinary printer with A4 or A3 paper sizes.

Tracing Contours. Each of the contour lines will have to be drawn (traced) separately on a piece of corrugated carton board with the carbon papers. It is important to consider the quality of the carbon paper that does not tear easily when tracing.

To start, Working maps were divided to sizes that would maximize the given size of the carton boards. In this experience the Working Map was divided into two larger and one smaller part and the participants initially to 2 groups with each group working on a larger map. An estimated number of carton boards were sliced to the corresponding sizes of the Working Maps (Fig. 3A). Then the carbon papers were spread and taped into sheets with the same sizes of the Working Maps and carton boards (Figs. 3B and 3C).

The Working Maps are placed on top of the respective taped carbon sheets (Fig. 3D) and stapled (Fig. 3E). These are fastened to the carton boards using binder clips (Fig. 3F) that produce a 'sandwich' of the Working Map on top, the carbon sheet middle and the carton board at the bottom.

It is now ready for tracing contour line. Start from the lowest elevation with each contour line traced using ballpoint pen or pencil in separate carton boards (Figs. 3G and 3H).

After tracing the elevation contour, shorter broken lines should also be traced of the upper contour to serve as guide when overlaying the carton boards later. When finished tracing a contour line remove the board from the binder, mark it with the elevation of the traced contour, and put checks on the portions that will be retained to guide the 'cutters'. Replace carton board and repeat the process.

Fig. 4. Slicing of contour lines in the carton boards using blade cutters (A and B) and coping saws (C).

Care should be exercised when cutting contour lines using blade cutters (Figs. 4A and 4B). Coping saws are effective to cut the small zigzag spaces (Fig. 4C). Surgical scissors or scalpels may also be used.

Carton boards used in this exercise is the *double-wall* corrugated type that has good compression resistance. Other types are *single-wall* and *single-face* corrugated boards. The latter can be rolled thus it can be more easily brought to inaccessible areas but the downside is its poor compression resistance.

Another option to corrugated carton boards is rubber slices or sheets that are manufactured in several thicknesses. These can be rolled, sturdier and the finished 3D map can withstand more wear and tear. But these are relatively heavier and as per canvass prior to the training, was not available in Dili.

In the recapitulation of the first day's activities at the start of the second training day more discussions were made to understand the Topographic Map especially the representation of the contour lines (Fig. 5A). It was explained that the Working Map was just an enlarged copy (1:8,000 scale) of the existing Topographic Maps (1:25,000 and 1:50,000 scales). Instead of the 12.5 meters interval of the Topographic Maps, the Working Map used 25 meters interval.

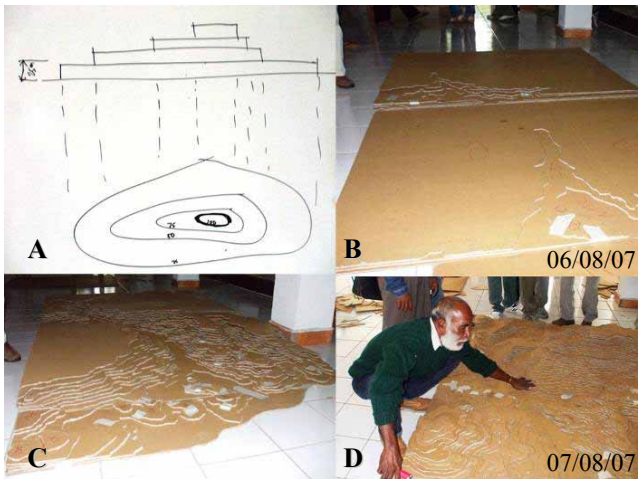


Fig. 5. Illustrating the principles of the contour that each line represent an elevation interval (A); temporary overlay of the carton boards with the sliced contours (B and C); and recognizing their rivers, hills, and mountains in the work on progress (D).

Other basic contents of the Topographic Maps were discussed like the date when the data and information were compiled, the scale bars, grid lines, projections used (more of this in the PGIS training), and the significance of the legends. Participants had the feel of the discussions with the ongoing illustrations provided by temporarily overlaying the finished boards. (Figs. 5B and 5C). This part of the exercise

emphasized the need to draw guides for the immediate upper elevation while tracing each of the contour lines. Later in the day, as contours took shape and the hills and mountains 'grow' out of the boards, participants were already identifying and naming places in the map.

Fig. 6. Preparing water-based glue, mahogany-boiled water, and tawas solution (A and C) and stripping and cutting to small pieces the liners of extra carton boards to coat the 3D map.

It was an enthusiastic group that decided to continue with the trainings even with the tense political situation at the time. They decided though to transfer venue from the Ministry of Education building to the nearby Don Bosco Orphanage.

Mahogany Tea and Tawas. It was observed from some 3D maps made of carton boards that after several years these were partly or wholly damaged by insects. The P3DM exercise in East Timor innovated by using traditional insect repellants like boiling mahogany barks on water to be mixed with the glue and then tawas (alum). It remains to be seen though how effective this concoction is as deterrent to infestation.

Fig. 7. Consolidating the layers by brushing the surfaces with glue and applying small strips of carton board liners.

The glue mixture should be enough that it is not very sticky so that it can be brushed easily but not very light also that the liner strips would not stick. Avoid needless moisture as it can affect the pace of the work and might compress the map out of proportion. Mix enough water that the glue would dry-up in about an hour.

Strip the liners of the excess carton cuttings and shred these into about 4 by 6 centimeters (Fig. 6B). The shredded liners placed one on top of the other will act as surface coatings or shell of the board layers (Fig. 7A and 7B). These liners will give strength to the 3D map and reduce also the terracing effect of layering the contours.

Fig. 8. Nailing the cartons with 1", 2" and 3" nails depending on the thickness of consolidated boards (A and B); and applying crepe paper over the surface as cover.

A heavy-duty staple gun may be used (Fig. 7B) to minimize the use of glue and thus reduce moisture in between layers. For compression, layers are nailed using 0.5, 1,

2 or 3 inches nails depending on the thickness of the layers (Figs. 8A and 8B). The layers are covered with shredded liners (Fig. 8B) and then with crepe paper (Figs. 8C and 8D).

Glue mixture is applied by paint brush on top of liners, then place crepe paper, brush glue on top of the crepe paper removing trapped air, cover with another crepe paper and apply glue again on top. About 3-4 crepe paper coverings are needed to add more strength and give the map a solid look and feel.

Fig. 9. Preparing the Table for the 3-Dimensional Map.

Fig. 10. Nailing and pasting carton boards for the lower portions of the 3D map (10A and 10B); carrying and placing the upper portions to their locations (10C, 10D, 10E, and 10F); finalizing the 'blank' 3D map (10G).

The Table for the 3D map has been ready by the afternoon of the training's second day (Fig. 9). It was made of wooden braces and plywood for the bed. In making the Table it is crucial that the dimensions of the door where the finished 3D map will pass should be carefully considered. There have been several funny incidents where the communities would find it too late that they cannot transfer their 3D map unless they break some portions of a wall.

Here the legs of the Table have been eventually cut shorter because if the map is added on top it could no longer pass the door even if tilted sideways. There was a suggestion to make it 'flat-bed' and have a separate removable stand that can be bolted to the braces so it would be easier to move the 3D map as needed. An option for very wide 3D maps is to divide its production into several parts so they can be moved easier to other areas for processing with communities, public consultations, strategic planning or information and education drives.

When the table was ready, the lower portions were glued and nailed to the table (Figs. 10A and 10B). The staple gun was extensively used to minimize on the glue.

Upper portions of the 3D map were separately formed thus these were placed and consolidated on their proper positions (Figs. 10C, 10D, 10E and 10F). By the afternoon of the third day, the 'blank' 3D map of the Raumoco Watershed has been practically finished (Fig. 10G).

The 'blank' 3D map is now ready for the data and information from the communities and other stakeholders. Participants were allowed some time to familiarize with the 3D map.

Discrepancies on the information of the Topographic Map, especially with places names, were noted. Participants were initially confused because they keep on referring with the Topographic Map to locate landmarks until they decided to disregard it and depend on their inherent knowledge about their place. Natural, cultural and historical landmarks were located and identified. Infrastructure facilities were drawn on the map with free, unstructured and informal discussions.

Fig. 11. Identifying physical, historical and cultural landmarks (A); plotting roads and other infrastructures and assigning categories like 4WD vehicle track, one-lane/two-lane sealed roads, footpaths, etc. (B and C); estimating land area using a 1.25 centimeters squares transparent plastic graph (D).

A graph of 1.25 centimeters squares was drawn on transparent plastic (Fig. 11D). Each square signify an hectare for horizontal scale of 1:8,000. To estimate area, put graph on the corresponding place in the map and count the squares. Participants were reminded that vertical scale is 1:4,000 thus calculating areas for steep places would need more complicated trigonometric functions, though they can still use the graph for very rough estimates.

On briefing of the fourth day (09 August), after reviewing the previous day's activities, it was reiterated that they are *the experts* of the 3D map. They know their place better, where things are, what happened, the causes and impacts of these changes.

Discussed was the concept of ecosystems in the watershed divide: mountains, hills, lowlands, rivers, estuaries, coastal and marine and the significance of the interrelationships of these diverse biological (life forms), physical and socio-cultural characteristics. The Philippine experience of 'watershed approach' in natural resource management was shared and the participants were amenable to study and try the applicable components of this approach. They mentioned that most of the administrative political boundaries were introduced during Portuguese and Indonesian times putting divisions where there used to be none.

Participants said that catching resources in the rivers used to be community-shared activities where the river is allowed

to 'rest' after gathering. Now everybody has unregulated and open access to the rivers that the resources dwindled and aggravated by soil erosion caused by forest denudation. They used to barter goods from the sea to those of the uplands but now because of the road they already meet in Lospalos.

The points, lines and polygons (areas) features identified on the first day were reviewed and assigned symbols – pins for points, threads for lines and water-based paints for areas. Colors and shapes differentiated the pins for houses, schools, springs, sacred

areas, clinics, etc., the same way with threads and paints (land-use). Their perceptions and understanding of the place translated into the 3D map by symbols using different media, shapes and colors (Fig. 12).

Information identified on the first day to be placed in the 3D Map corresponding to the Point, Line and Polygon features.

Titik (Points)	Garis (Lines)	Werlayah (Poligons)
Perumahan Sekolah Gereja Kantor Suco Hospital / Klinik Sumber Air/Mata Air Kuburan Tempat Keramat Monumen Tempat Evakuasi Merkado Telekom Kantor Kecamatan Kantor Polisi	Jalan Raya Jalan Setapak Pembukaan Jalan Raya Sungai Sungai Musiman Irigasi Batas Sub. Distric Batas Suco Das	Hutan Asli Hutan Sawah Padang Pengembalaan Danau Tanah Tandus Tanah Basah Daerah Banjir Tanah Longsor Daerah Konflik Kebun Lahan Kering Perkebunan Kelapa Mangruf Tanah Putih Laut Perbatuan

Fig. 12. Assigning symbols for points, lines, and polygons features of the map differentiated by colors and shapes.

Next step is processing (deepening) of data to analyze changes, trends, causes and impacts that would be helpful in action planning. It is essential for outside facilitators to deeply understand the socio-cultural and bio-physical environments by getting into their 'World of Meanings'. One of the methods is to investigate the significance of native words by exploring names of their landmarks

However, there was a limitation on the deepening exercise as it is their custom not to mention names of their sacred places unless they get the consent of environmental spirits through rituals and ceremonies performed by community elders. They believe rains will come or worse, harm could befall their family, if they don't have the permission of the spirits. It was agreed to consult first the elders and if needed, perform necessary rituals.

Interviewing the Map. Representatives from different villages were scheduled for discussions / consultations on August 13 to 15. Three Sucos per day with 20 target participants per Suco representing the Suco Council, elderly, women, farmers, hunters,

fisherfolks, and youth. The following were the schedules, August 13: Baricafa, Kotamuto and Luro; August 14: Serelau, Afabubo and Wairoke; and August 15: Daudere, Lakawa and Maina II. Wairoke and Maina II were not able to send representatives because of earlier village schedules.

Before each semi-structured discussion, the context of 'sustainable development' as distinguished from *rootless*, *futureless* and *ruthless* growth was given. That they should be critical of 'development' by considering their own experiences, environmental situation and their dreams for their children. Participants were told that they have to look at their current situation and learn from the past if they want to plan for the future.

Discussions by community representatives start with familiarization with the 3D model with their co-villagers (who helped produce the map) explaining the symbols and other information. Reactions vary from confirmation to correction of the information.

The areas of two villages (Wairoke and Maina II) were not color coded because they were not able to send their representatives. A common reservation is on the boundary delineation because they have traditional boundaries that were changed during Portuguese, Indonesian and Liberation times.

Conflicts between communities flashed from these arbitrary changes. Some elders said that there is no need to put the boundaries because traditionally and customarily they do not have boundaries but there were areas that say blood has been shed because of those conflicts and they should be given due considerations.

It was explained that it will take more time to settle conflicts and the P3DM facilitators were not the right persons to engage in these settlements but they can use the 3D map to start dialogue by delineating their respective claims and the background of such claims. A Council of Elders may be formed to discuss problems with Suco Councils and other officials.

Village representatives were asked to give reactions to the information in the map and describe their places before (Portuguese / Indonesian times) like their hunting grounds, resource base and livelihoods. Probing questions were raised on their perceived changes in their catch per similar gears and efforts on hunting, fishing (freshwater and coastal), and other resource uses.

Highlights of Community Discussions:

- In some areas natural forest lines retreated further and experienced decreasing catch in hunting wild animals, in other areas the patches of natural forests remain the same since Portuguese times;
- Sandalwood and other forest resources taken since Portuguese times;
- Villages moved downstream during Indonesian time but now returning to the uplands minus the traditional social structures of community elders in decision making;
- Observed heavy siltation and dwindling freshwater fishes and crustaceans / some areas now making livelihood out of gravel extraction from the river;
- Flooding problems with the bare mountains, saw the relationships of the activities in the uplands to the lowlands (impacts);
- Improved gears for coastal fishing (nets), before just catch fish with no gears;
- Serelau – related to traditional cotton weaving, amenable to reviving the tradition;
- Elderly woman: map is good and happy to hear stories told about their place
- Youth participant: taken interest to know more about their place and history
- Recognize need for watershed divide integrated approach on resource management.

Fig. 13. Community discussions: August 13, with the representatives of the Sucos Baricafa, Kotamuto and Luro (A and B); August 14, with the representatives of the Sucos Serelau and Afabubo (C); and August 15, with the representatives of the Sucos Daudere and Lakawa (D).

On the last training day (August 17), the map was to be presented for validation to representatives of the villages as a whole watershed, the national and district government officials, and other major stakeholders. However, due to heavy rains the whole day, participants from the uplands were not able to attend activity. National public officials were also not able to attend because of the tense political situation of the time.

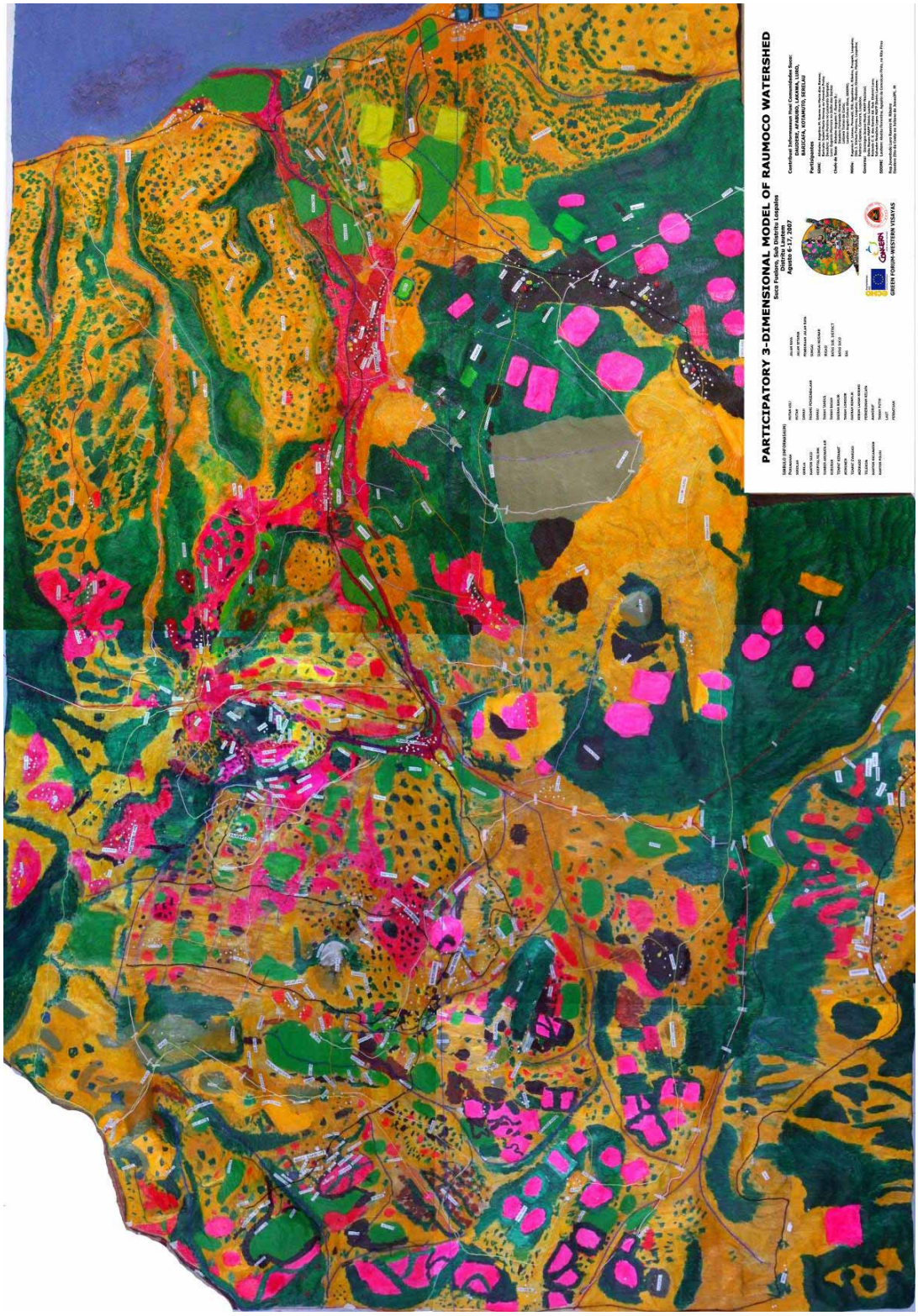
The validation activity started with Mr. Domingos Soares Mook of MAFP presenting the GIS capabilities and resources of their Office. He showed available thematic maps, like: hydrology, contours and slopes of the whole Timor Leste. These data and information can be accessed from their Office.

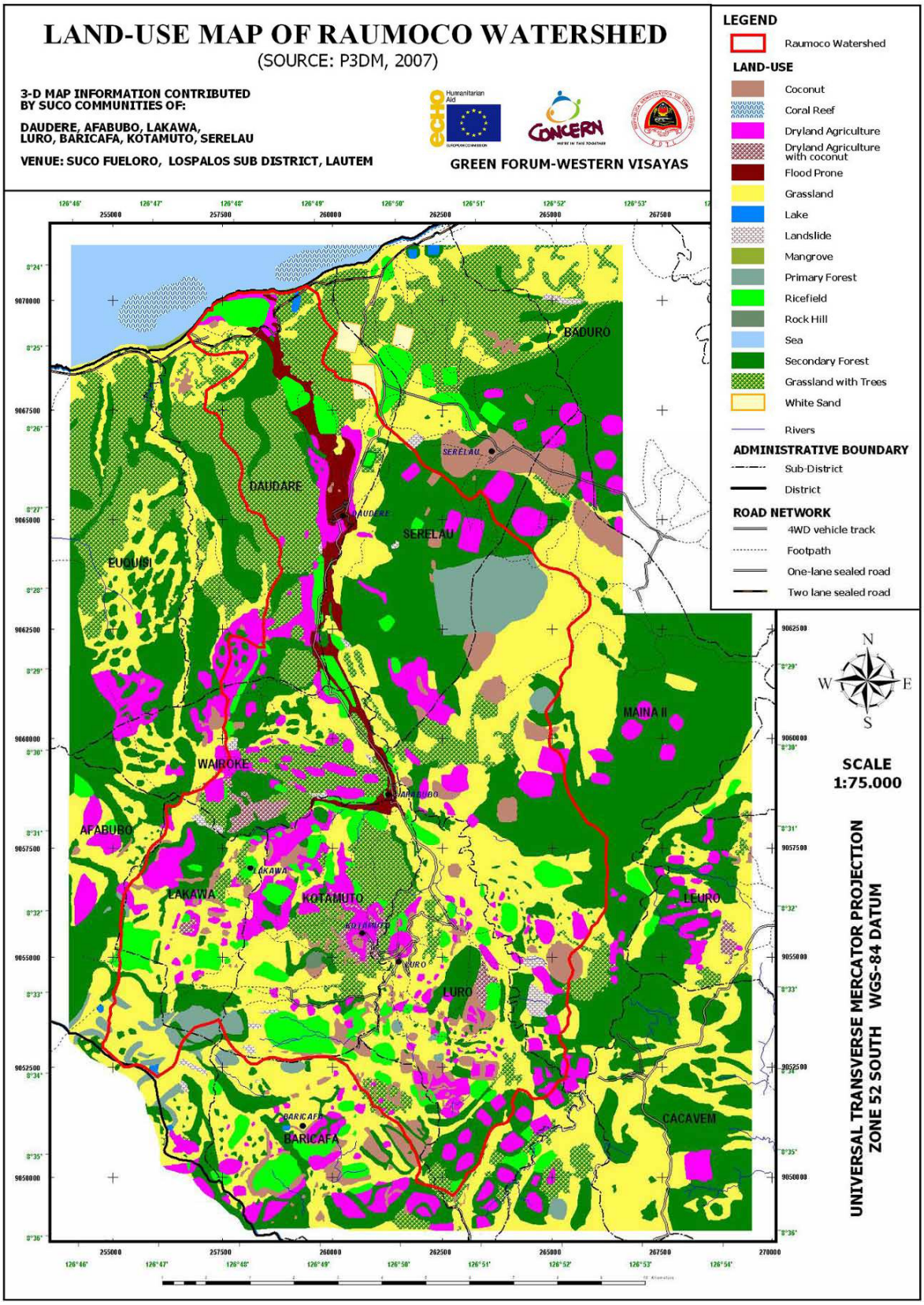
Present were Lautem District Administrator Olavio D. Jesus Monteiro and District Development Officer Lino Pereira. They appreciated the 3D model especially for the formulation of the district's land-use and infrastructure development plan. The District Administrator was interested in producing a 3D model for the whole district. He valued the technologies used and the diligence of the participants in making the model.

He said that learning the technologies would require university education and he called the participants 'geniuses' for having the gained the P3DM and PGIS skills.

Fig. 14. Validation activities with Luro Sub-District Administrator Rolando C. X. dos Santos, Lautem District Administrator Olavio D. Jesus Monteiro, and Lautem District Development Officer Lino Pereira. Community singing and dancing after the validation ceremonies.

Raumoco Watershed P3D Model




LAND-USE MAP OF RAUMOCO WATERSHED
(SOURCE: P3DM, 2007)
3-D MAP INFORMATION CONTRIBUTED BY SUCO COMMUNITIES OF:
DAUDERE, AFABUBO, LAKAWA, LURO, BARICAFA, KOTAMUTO, SERELAU
VENUE: SUCO FUELORO, LOSPALOS SUB DISTRICT, LAUTEM
GREEN FORUM-WESTERN VISAYAS
LEGEND
Raumoco Watershed
LAND-USE
Coconut
Coral Reef
Dryland Agriculture
Dryland Agriculture with coconut
Flood Prone
Grassland
Lake
Landslide
Mangrove
Primary Forest
Ricefield
Rock Hill
Sea
Secondary Forest
Grassland with Trees
White Sand
Rivers
ADMINISTRATIVE BOUNDARY
Sub-District
District
ROAD NETWORK
4WD vehicle track
Footpath
One-lane sealed road
Two lane sealed road
BADURO
SERELAU
DAUDARE
EUQUISI
WAIROKE
MAINA II
AFABUBO
LAKAWA
KOTAMUTO
LURO
FEURO
BARICAFA
CACAVEM
N
S
W
E
SCALE
1:75.000
UNIVERSAL TRANSVERSE MERCATOR PROJECTION
ZONE 52 SOUTH WGS-84 DATUM

On Basic Skills Training for Digital Mapping

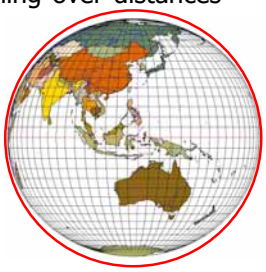
Map Projections and Geodetic Datum Transformations

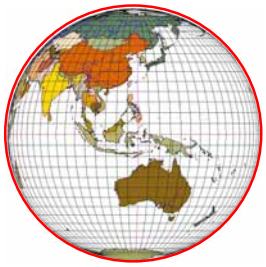
Definitions

Geodetic Datum - define the size and shape of the earth and the origin and orientation of the coordinate system used to map the earth

Several ideas evolve on describing the datum through geometric models or figure of the Earth. Some definitions are:

a. the earth as **an oyster** (The Babylonians before 3000 B.C.), **a rectangular box**, **a circular disk**, **a cylindrical column**, **a spherical ball**, and a very **round pear**
b. **Flat earth models** which are still used for plane surveying, defining over distances short enough so that earth curvature is insignificant (less than 10 kms).
c. **Spherical earth models** represent the shape of the earth with a sphere of a specified radius. Often used for short range navigation and for global distance approximations. Spherical models fail to model the actual shape of the earth. The slight flattening of the earth at the poles results in about a 20 kilometer difference at the poles between an average spherical radius and the measured polar radius of the earth.
d. **Ellipsoidal earth models** define an ellipsoid with an equatorial radius and a polar radius. Required for accurate range and bearing calculations over long distances. It is use by GPS navigation receivers to compute position and waypoint information. The best of these models can represent the shape of the earth over the smoothed, averaged sea-surface to within about one-hundred meters.

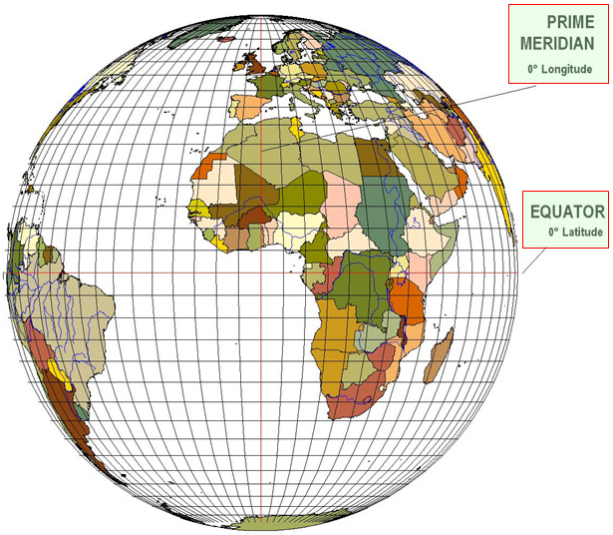




Coordinate systems - is used to specify locations on the surface of the earth. It is usually defined by a *map projection*, a *datum*, standard *parallels* and a *central meridian*.

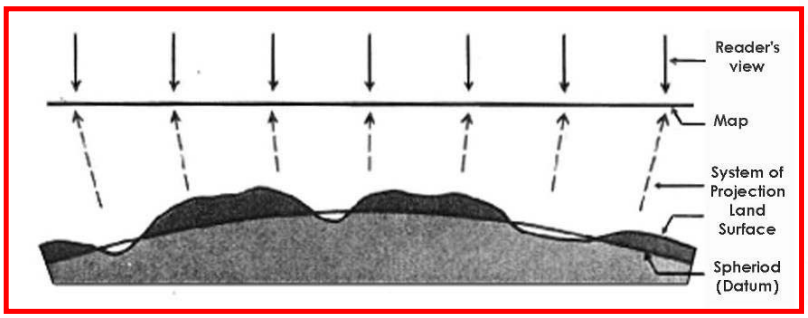
The most commonly used coordinate system is the latitude, longitude, and height system

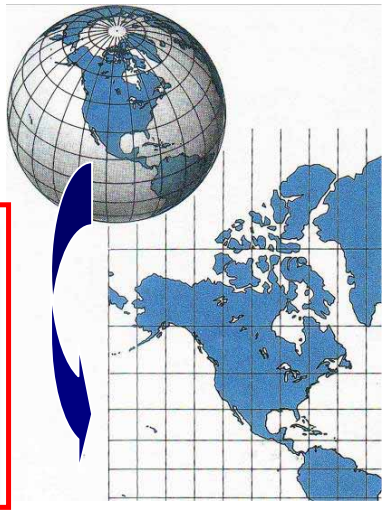
Prime Meridian and the Equator are the reference planes used to define Lat/Long



Map Projection - Allow areas on the surface of the Earth (a spheroid) to be represented on a map (a flat surface). It is a systematic arrangement of the earth's (or generating globe's) parallels and meridians onto a plane surface

Map projections are attempts to portray the surface of the earth or a portion of the earth on a flat surface. Some distortions of distance, direction, scale, and area always result from this process.



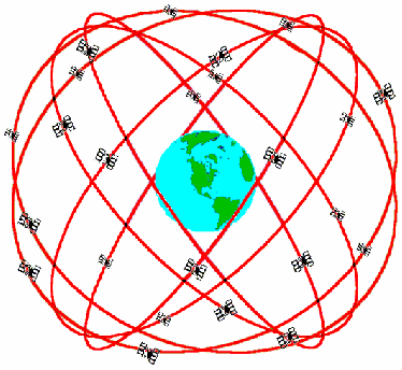


On Global Positioning System

Global Positioning System (GPS) is a satellite-based positioning system operated by the U.S. Department of Defense (DoD)**.**

GPS will provide all-weather, worldwide, 24-hour position and time information when it is fully deployed.

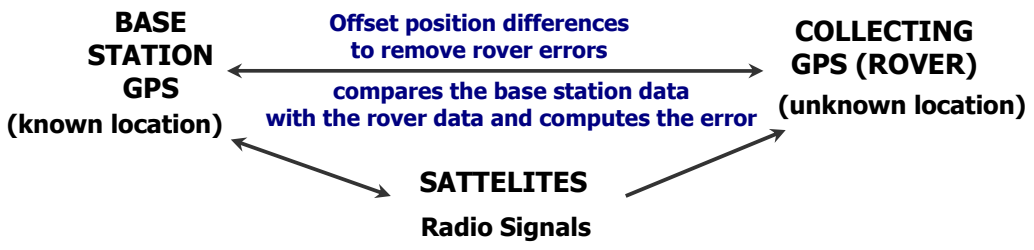
There are 24 operational NAVSTAR satellites orbiting the earth every twelve hours at an altitude of about 12,600 nautical miles (20,200 km).



Basis of the system:
Exact coordinates are calculated for any position on earth by measuring the distance from a group of satellites to the position. The satellites act as precise reference points.

Differential Correction - A data collection technique to increase the accuracy of GPS position.

This method are use to correct the error in GPS readings intentionally given DoD for some security reasons, etc. This utility removes errors in GPS data caused by Selective Availability and other factors. It improves the accuracy of GPS positions from approximately 100 meters to between submeter and five meters, depending on the receiver and data collection technique used.



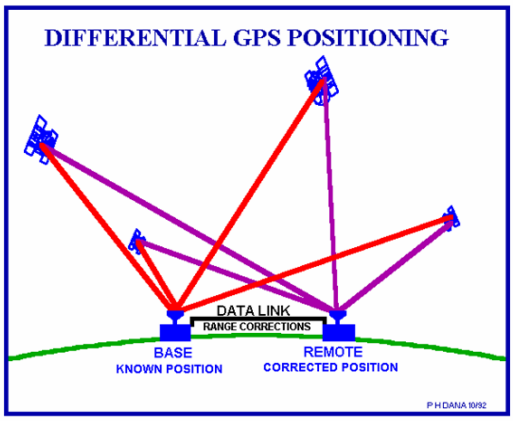
The GPS have 3 kinds, according to its accuracy:

- NAVIGATIONAL GRADE,
- MAPPING GRADE, and
- SURVEY GRADE

NAVIGATIONAL – the accuracy may have more than 10-50 meters margin of error

MAPPING – will give an accuracy of sub-meter or less than 1 foot

SURVEY – sub-centimeter accuracy



Application of GPS:

GPS mapping systems are used for a variety of applications. They create and update GIS databases in disciplines as diverse as *natural resource sciences*, *urban development and analysis*, *agriculture*, *social sciences* and many others.

In natural resource application, specialists like foresters, geologists, geographers, and biologist, use GPS mapping systems to record position and attribute information.

For example, foresters record attribute information about age, health, quantity , type of timber and survey timber stands for replanting.
Biologist locate wildlife habitats, map them, and record animal counts and other attributes.

Some other natural applications include floodlines, stream length, fish and wildlife habitats, changing coastlines, vegetation and climate zones.

There are 3 major procedures in generating GPS positions:

a) Before leaving the office, b) In the field, and c) Returning to office

Before leaving the office

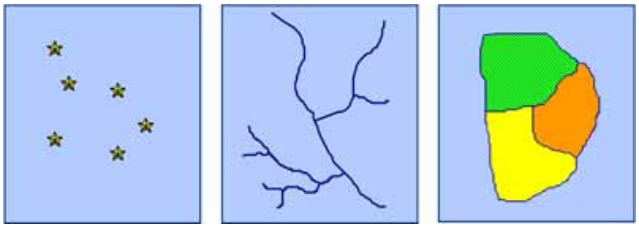
1. Establishing GPS Almanac – GPS will generate a file containing time and position information for GPS satellites needed to position the rover geographically.
2. Creating Data Dictionary - a tool for managing GIS data collection. It provides a data structure enabling efficient collection of feature and attribute information

On the training, the group were taught to use the field notes recording as a manual alternative for creating data dictionary.

Point #	Coordinate Location (Lat / Long or X,Y)	Description (Features/Attributes)	Time / Date Taken	Reference (Physical)
	GPS Unit:	**Surveyor:**		

Field notes Table

GPS stores information using 3 Geographic features: Point, Line and Area



In the field

1. Viewing position– moving to a location where GPS have a clear view of the sky and start tracking of visible satellites then the current positions calculation begins if at least 4 satellites send strong radio signals to the GPS
2. Viewing GPS status - provides information about the satellites and the positions you are collecting as you record data as well as getting an indication of accuracy
3. Recording files through data capturing using Data Dictionary - after viewing a good GPS status, data capturing comes in.

   On this part, participants use the field notes as for the recording of geographic coordinates along with the features and attributes.

Returning to office

1. Downloading geographic data to PC– the capture data is transferred to PC by using GPS interface cable.

   With the absence of the cable, participants manually inputted data using the Notepad and Microsoft Excel
2. Differential Correcting – done to increase accuracy.

   This step is not followed because we are using a non-differential GPS

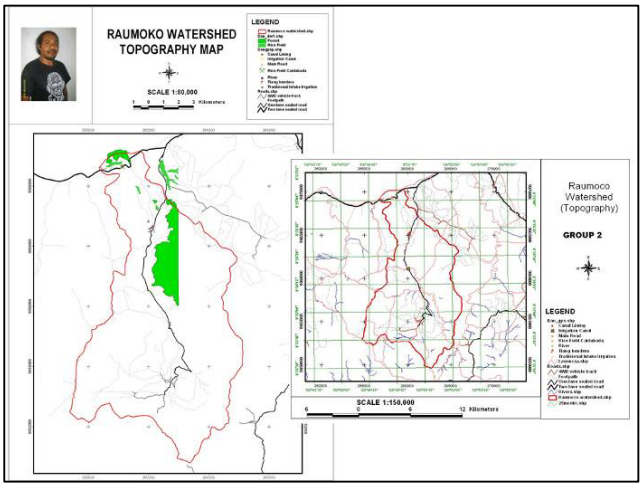
Pathfinder Office software is used for inputting waypoints of GPS position listed in the field notes to be imported to CartaLinx. We switch to Lat/Long coordinate system and WGS-84 datum setup in Pathfinder because the GPS is using the same reference system as the standard and default for downloading even it was preset from other system.
After the waypoints are created, we switch the coordinate system again to UTM-52 South. This coordinate system will be used to blend the reference system of the published topographic map and for digitizing georeferenced bitmaps in CartaLinx

The process procedure modes are use to receive data inputs in CartaLinx during the training:

XY Input - create data by XY coordinate pairs manipulation**;**

Georeferencing - defined location of an image or vector file by a known coordinate referencing system**;**

Project - procedure for converting any reference system to another.



From top, clockwise:

1. PGIS team lecture and training on basic GIS concepts and GPS instrumentation;
2. Hands-on heads-up digitizing of the Raumoco river systems and watershed divide and taking 'aerial' photographs of the P3D model; and
3. Sample of the participants output maps.

Introduction to CartaLinx

This Operations Manual aims to introduce CartaLinx, its capabilities as a tool for building spatial data, and to provide practical techniques to adapt data inputs in varied formats and standards not covered in the CartaLinx manual.

Objectives:

1. To identify the appropriate process procedure in inputting available map data, such as: maps without coordinate system (i. e., spot maps), georeferenced topographic maps, etc.
2. To enhance digitizing skills and techniques using screen *(Heads-up)* digitizing.
3. To develop skills in integrating external database (Excel or other format) into the CartaLinx coverage maps.
4. To exercise establishment of geographic map proiection standards by transformation procedure called reprojection.

What is CartaLinx?

CartaLinx is a Spatial Data Builder — a digital map development tool that serves as a companion to a variety of popular Geographic Information System (GIS) and Desktop Mapping software products, such as Idrisi32, Idrisi 16-bit, Arc/Info, ArcView, MapInfo, and so on.

With CartaLinx one can:

a) digitally encode geographic data from existing map sheets using any of over 300 popular digitizing tablets;
b) digitize geographic information using any NMEA interface-compliant Global Positioning System (GPS);
c) on-screen digitize from image data such as satellite images, digital photographs or scanned aerial photographs, (sometimes referred to as heads up digitizing);
d) digitize positions based on Coordinate Geometry (COGO) bearing and distance specifications.
e) facilitate field data collection (such as ground truth information) using image and map data in conjunction with the real-time GPS interface and CartaLinx's integrated waypoint facility;
f) build and edit attribute data for geographic features using CartaLinx's integrated Microsoft Access™-compatible relational database engine;
g) perform füll reference system conversions including map projection and geodetic datum transformations;
h) export data to other GIS and Desktop Mapping software products using a variety of file
i) formats, such as ArcView Shape, Arc/Info GEN, MapInfo MIF, and Idrisi vector format;
j) extract subsets ofcoverages based on attributes (filter) or spatial location (clip).

CartaLinx uses a full topological editor/digitizing system with capabilities for;

a) automatically building vector topology (connectivity between nodes, arcs and polygons);
b) automated generation of polygons and assignment of ID's by means of polygon locators (label points);
c) insertion, deletion, or movement of nodes, arcs or arc vertices;
d) real-time projection/datum transformation of digitizer and GPS input data to meet mapping reference system specifications;
e) feature filtering and extraction to new spatial databases based on feature attributes (filter) or location (dip);

Finally, while CartaLinx is primarily intended as a Spatial Data Builder, it also has significant analytical and mapping capabilities, including:

a) relational database query support: produce custom maps based on specific feature attributes;
b) support for mathematical modelling: create new derivative data fields using mathematical operations on existing fields;
c) interactive feature inquiry: instantly display attribute data for any feature by simply clicking on that feature;
d) real-time route monitoring using a GPS unit with an image backdrop;
e) text placement with scale-sensitive sizing;
f) füll printer output support.

CartaLinx Spatial Database Model

CartaLinx uses a vector graphics model for the digital description of spatial data. With the vector model, geographic features are defined by a series of point locations, recorded as X, Y coordinate pairs, that describe either the position (in the case of a point feature), course (for a linear feature) or boundary (for an area feature). This description forms the spatial frame (or simply frame) of a spatial database.

The vector model links a spatial frame to a relational database of attributes that record the character or nature of those objects. In the vector model, spatial frames and attributes are linked by means of feature identifiers (ID's).

The linking of any specific attribute and a spatial frame then produces the most basic element of a map composition — a map layer — an elementary theme or collection of objects that are displayed and analyzed as a group. For example, the linking of a property parcel spatial frame to a land use attribute creates a land use layer.

The entire collection of layers described by a single spatial frame and associated attribute data tables then constitutes a coverage, while the total set of coverages for a region constitutes a spatial database. For example, a coverage based on a property parcels spatial frame might also contain table entries for land value, owner name and address allowing multiple layers to be formed. However, a complete municipal spatial database might also contain coverages based on sewer lines, roads and lighting standards (each of which is based on a different spatial frame, and each ofwhich may be used to construct multiple layers).

The Structure of CartaLinx Coverage

A spatial frame and its associated data tables constitute a coverage. A coverage represents a collection of geographic features and their attributes. Thus, for example, one might construct a soils coverage, a property parcels coverage, a census tracts coverage, and so on.

Coverages are to CartaLinx what a document is to a word processor. When you work with CartaLinx, you are constructing a coverage, which is stored in two separate data files. The first contains the spatial frame and has an ".lnx" file extension. The second contains its associated attribute data tables and has an ".mdb" extension. Thus, for example, if you were to construct a coverage for census tracts and called it "census_tracts", it would actually be stored in two data files:

census_tracts.lnx
census_tracts.mdb

CartaLinx always understands that these two files belong together, and will generally refer to them as if they were a unified whole. However, if you move coverages from one location to another on your hard disk, be sure that both data files are moved together.

The structure of the spatial frame is not directly accessible. However, the attribute tables can be directly accessed and extended. In the structure, the attribute database file consists of three tables — a Nodes Table, an Arcs Table and a Polygons Table. In each of these tables a default set of fields exists for the indexing and inter-relating of spatial features. In addition to the default fields, the user may add fields.

The CartaLinx interface consists of six components: the Main Menu, a Tool Bar, a Display Window, a Table Window, and a Status Bar, and a Cursor Pop-Up Menu. CartaLinx also has a special dialog box that allows for the entry of all preference settings.

The CartaLinx Main Menu
The CartaLinx Menu has five drop down menu items: the File Menu, the Coverage Menu, the Digitize Menu, the Tables Menu, and the Help Menu.

The CartaLinx Tool Bar
The Tool Bar provides quick access to some of the more commonly-used CartaLinx operations.

The Display Window
The Display Window displays a graphic rendition of the currently-open coverage.

The Tables Window
The Tables Window displays the contents of three relational database tables (Nodes Table, Arcs Table, Polygons Table) that are always maintained by CartaLinx. These tables contain important information about the topological links associated with coverage features. However, by adding additional fields, they can also be used to store feature attribute data.

The CartaLinx Status Bar
The status bar appears at the bottom of the CartaLinx screen and displays a variety of information and messages.

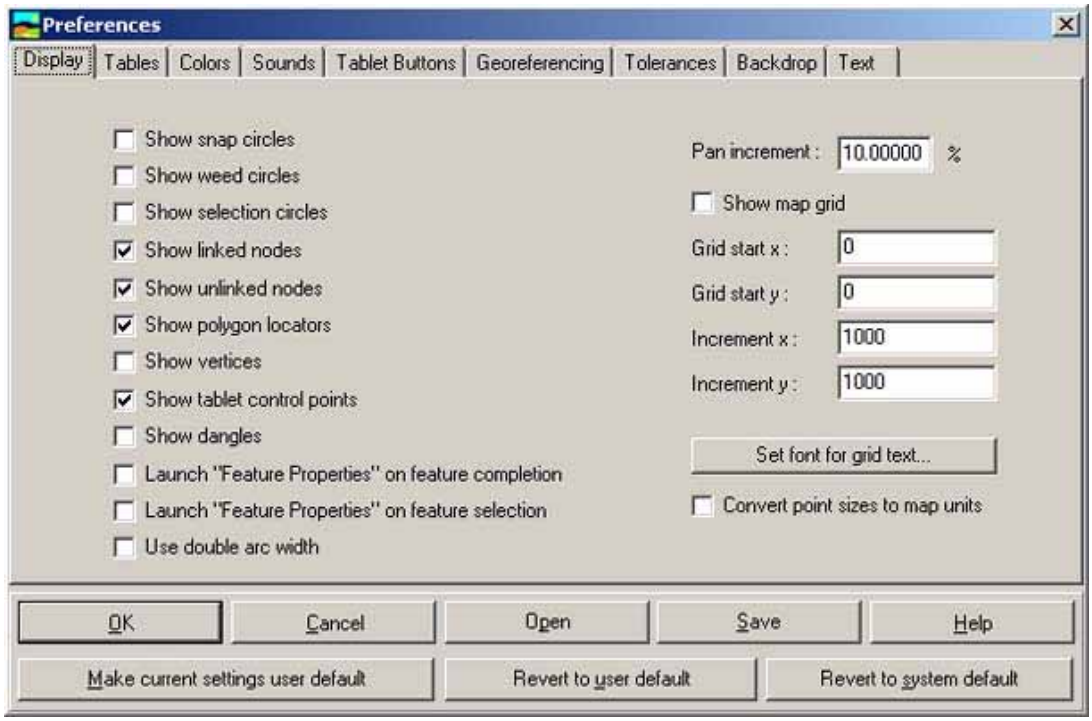
The Cursor Pop-Up Menu
Tht Cursor Pop-Up Menu can be activated when the mouse is within the display or tables Windows by clicking the right mouse button.

The Display Window Cursor Pop-Up Menu:
This is the primary way of interacting with CartaLinx while in the Display Window. The Cursor Pop-Up Menu contains a variety of functions such as Beginning Arcs, Ending Arcs, Building Polygons, and so on. The contents of the menu changes according to the last operation performed.

The Tables Window Cursor Pop-Up Menu:
Whenever the focus is on the Table Window (as a result of some mouse or cursor activity in the Tables Wmdow) a right mouse click will activate the Tables Window Cursor Pop-Up Menu with entries that are context specific to table use. For the most part, these entries duplicate items available through the main menu system. However, several are unique, such as the items that allow one to enter or exit table Edit Mode.

The Preferences/Properties/Options Dialog Box

The Preferences/Properties/Options dialog covers a large group of settings related to the manner in which CartaLinx operates. These include display characteristics, tables options, colors, sounds, tablet buttons, georeferencing, tolerances, backdrop and text options. The options you set with functions from this dialog box will be saved with the coverage. Thus it is possible to set up very different preferences for different coverages. It is also possible to save any set of preferences to a file and use those saved settings for any other coverage. In addition, any specific configuration can be saved as the user default.



MAP DATA INPUTS

There are at least five (5) process procedure modes use to receive data inputs in CartaLinx namely: **COGO** (Coordinate Geometry), for distance and hearing calculations; **XY Input,** create data by XY coordinate pairs manipulation; **Resample** function, registering from old reference system to a new reference system; **Georeferencing,** defined location of an image or vector file by a known coordinate referencing system; and **Project** or reproject, procedure for converting any reference system to another.

Before using these input data and process procedure modes, one should analyze first what map data input be digitized. How can a spot map or not projected map, unscaled map or no coordinate reference system map be digitized since CartaLinx normally use grid coordinates in metric system standard measurements? So, for instance, map is projected in Universal Transverse Mercator (UTM) - Zone 51, and wanted to reproject it into Philippine Transverse Mercator (PTM) - Zone 4, initially consider the coordinate system used by UTM which is also in metric system, in CartaLinx, reprojection **(Project)** process is used and the transformation has no conflict or problem because both uses same coordinate system. Other type of map data inputs has corresponding process procedure modes use in order to digitize into CartaLinx. Refer to fhe following Table shown below.

INPUT DATA PROCESS MODE can be access through:

COGO and XY INPUT

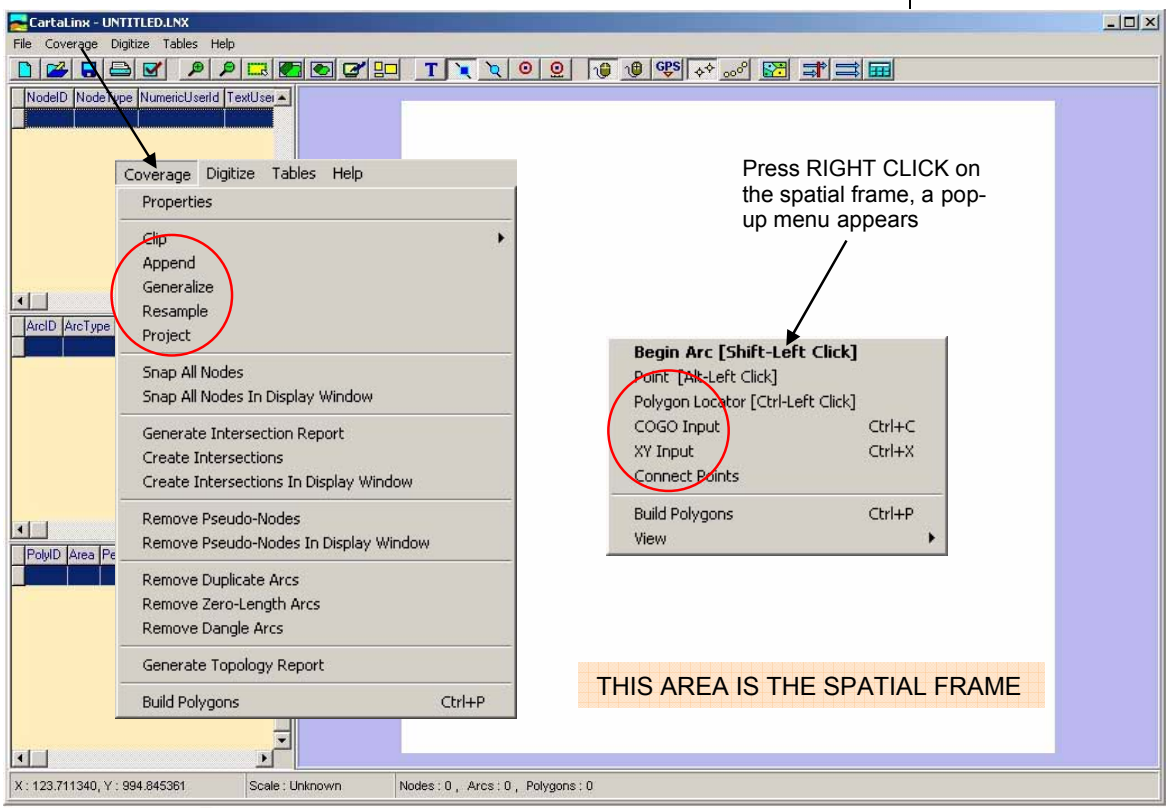
STEPS

1. Right click on the spatial frame
2. Select either COGO Input or XY Input; a keyboard shortait corresponds in each selection

You can directly press the shortcut without right clicking on the spabal frame

Resample and Project *STEPS*

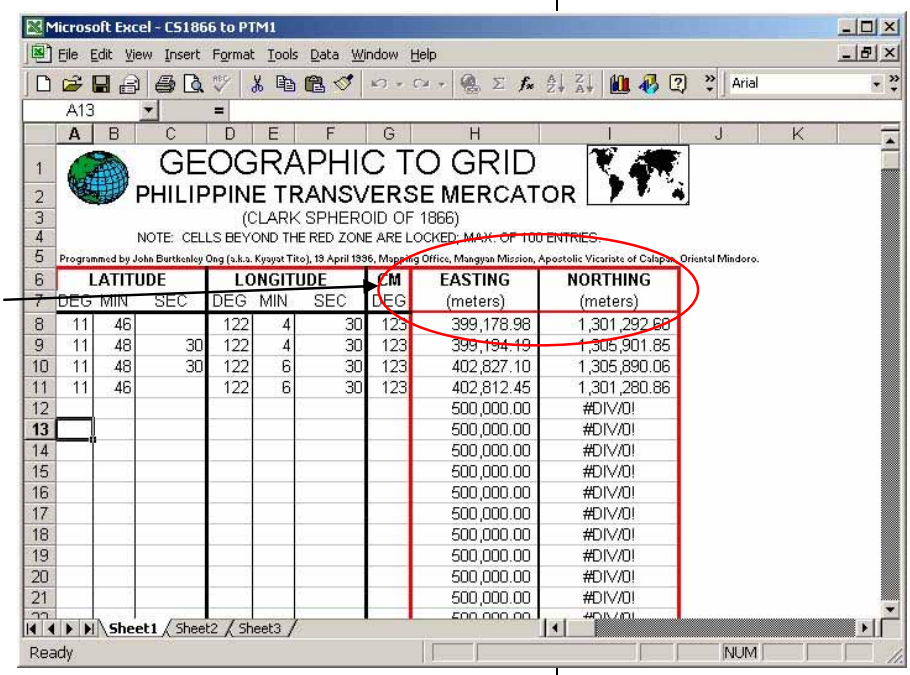
1. Select on the main menu by click Coverage, a pull-down menu appears
2. Click either Resample or Project, or you can press the first letter to select



	TYPE OF MAP DATA INPUT	INPUT DATA PROCESS MODE
1	Plane Coordinates wim seale in metrie: ex. Cadastral Map	**Resample**
2	Spot Map, Sketch Map with no seale	**Resample**
3	NAMRIA Topographic maps, other topographic maps with coordinate system	**Georeferencing (Backdrop)**
4	Administrative Map: Municipal, Barangay Boundary with Technical Description, without coordinates system	**XY Input or Resample**
5	Technical Descriptions (bearing and distance), no map: ex. Municipal waters, Presidential Proclamation (watershed land area, natural parks, etc.)	**COGO Input**
6	Technical Descriptions (Coordinates-Lat/Long or grid), no map	**XY Input**
7	Projected Maps Itke UTM reprojected to PTM, vice versa	**Project**

Note:
A shortcut should be created för the converter (Geographic to Grid Converter) for easy access.

The map data input types 3,4 and 6 needs an extemal converter program, a macro file in Excel, named Geographic to Grid Converter which only particular to the Transverse Mercator projected maps like UTM and PTM. It converts Lat/Long coordinate system (geographic) into Grid Coordinates (Northing. /Easting), which uses the metric system. Scanning the map should be done using a scanner before digitizing thcse maps in a heads-up technique.



Types l, 2 and 7 must first be digitized before applying input data process mode while Type 5 can be directly inputted either with maps or no maps

But Type 7 should also be digitized initially according to its map projection. Reprojecting affects every detail of a map, so all geographic features appearing on the map should be thoroughly digitized.

The Type 5 and all input data process modes are explain on the succeeding separate topics

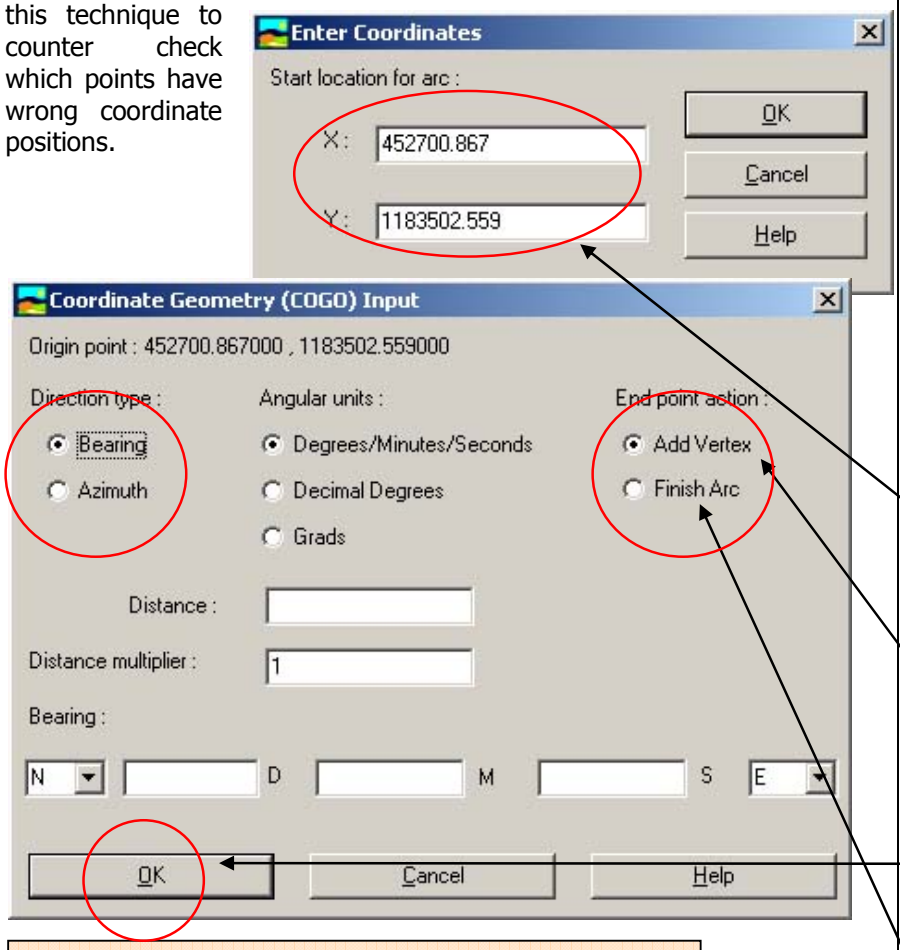
Allow the two program windows active (CartaLinx & the Converter) simultaneously in the monitor (screen) in order to cross-check the technical descriptions with the map data appearing in the spatial frame

COordinate GeOmetry Input

COGO (Coordinate Geometry) is a distance andbearing calculations to specify the the location ofthe next vertex or node.

In digitizing using CoGo Input you will need to start with a node of a known coordinate location. This starting location could be a node you digitized from a map, bitinap backdrop, GPS position taken on-ground or from scratch by opening a new coverage. The latter should specify the X and Y coordinates using the converter if you refer to the first point that uses a Lat/Long coordinates.

In a Technical Description, you have the option skip the first point, start from the last line or in the middle provided you have a known reference point which is part of the technical description. Some case where technical description, does not close the area or polygon, you can use this technique to counter check which points have wrong coordinate positions.



Direction Type

Options are provided to specify the direction as either an azimuth or a bearing. An azimuth is an angle measured clockwise from grid north ranging from 0° – 360°. Bearings, on the other hand, range from 0° – 90° as departures either from North or South. Thus, for example, a direction with an azimuth of 260° would be specified as a bearing of S 80° W.

COGO input can be accessed from the Display Window Cursor Pop-up Menu or by pressing the "CTRL" and "C" shortcut keys simultaneously.

INPUT FLOW ON A TECHNICAL DESCRIPTION WHERE POINT 1 HAS A REFERENCE POINT. *CONTROL POINTSLIKE BLLM, WHICH COORDINATE LOCATION IS KNOWN, ARE ALWAYS USE AS REFERENCE.*

STEPS

1. Get the Lat / Long coordinate of the reference point
2. Convert it to grid (x, y) coordinates using the Converter
3. On the spatial frame, press right click, or use the shortcut keys
4. On a Dialog Box appeared, enter the output coordinates from the Converter
5. The COGO Input Dialog Box to let you enter the bearing and distance from the technical description by following the sequence, point by point (choose the Add Vertex for the End point action), Press OK at every point entered
6. At the last point of the Technical Description, select Finish Arc and press OK to end. This will close the Dialog Box as well.

SAMPLE CONVERSION BETWEEN AZIMUTH AND BEARING OPTION

You can select whether you would like your direction type to be Bearing of Azimuth. Most Technical Description are in Bearing and Distance format but the Azimuth option is easier because the range only counts from 0°-360°. In Bearing option, 0°-360^0 direction is divided into four (4) quadrants going clockwise and each range from 0°-90°. For example, the Azimuth of 110° is equivalent to S70° 0°E. See the orientation chart on inset.

Azimuth --	Bearing
100°	S80°E
90°(Due East)	N90° E, S90°E
180° (Due South)	S0° E
320°	N40° W
240°	S60° W
360° (Due North)	N0° W, N0° E
15°	N15° E
270° (Due West)	N90° W, S90°W

After you have selected the direction type, you must select the Angular ü tits to be used. The choices are Degrees/Minutes/Seconds, Decimal Dgrees, and Grads. Grads or Gradient means an angle measurement w lere 360° equais 400 grads.

Then choose the end point action. Ifyou choose Add Vertex a vertex wi11 be added, when you press the OK button, to the specified location and the COGO Input dialog box will remain open so that digitizing can be continued. The Finish Arc option will place an end node at the location specified and close the COGO Input dialog box, when you press the OK button.

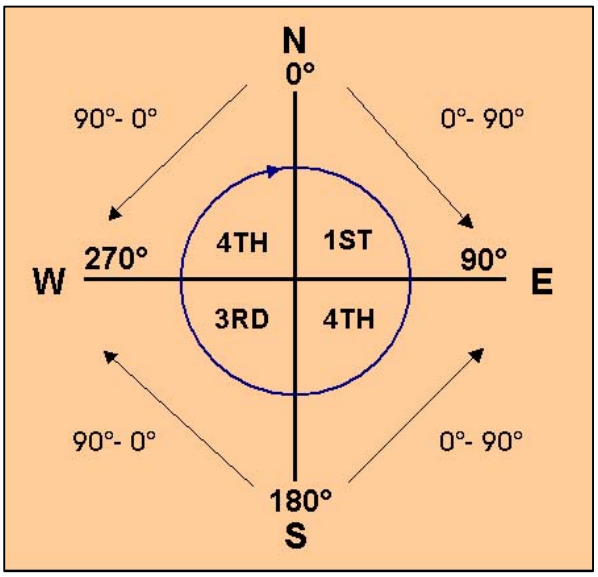
NOTE

If you wrongly entered the direction in following the sequence, you can reverse it by assigning the opposite hearing direction.

For example, the right direction is N15° 30" 18' E, but you entered N45° 30" 18' E, in order to correct it, you reverse this by changing the N to S and E to W, then COGO Input will retum to the last point location.

If you have encountered a Technical Description that is not readable or portion of it are missing, you can reverse the sequence of the description by changing the direction starting from point 1 back to the last point of the description.

The Distance Multiplier can be usefül for a variety of reasons. For example, you might want to add data using COGO Input to an existing CartaLinx coverage. However, the distance units of the survey map you want to use for COGO Input are in feet while the distance units of the existing CartaLinx coverage are in meters. The distance multiplier option allows you to enter the conversion factor between feet and meters, thereby allowing you to enter your survey data to the pre-existing CartaLinx coverage. So from feet to meter, you would enter a distance multiplier oi .303030303030.



Distance Multiplier option

Allows you to create a line segment that is a multiple of the value in the Distance Box.

After you entered all variables, pressing on the OK button will accept the specifications entered into the COGO Input dialog and digitize accordingly. This process iterates until all points in your Techincal Description entered.

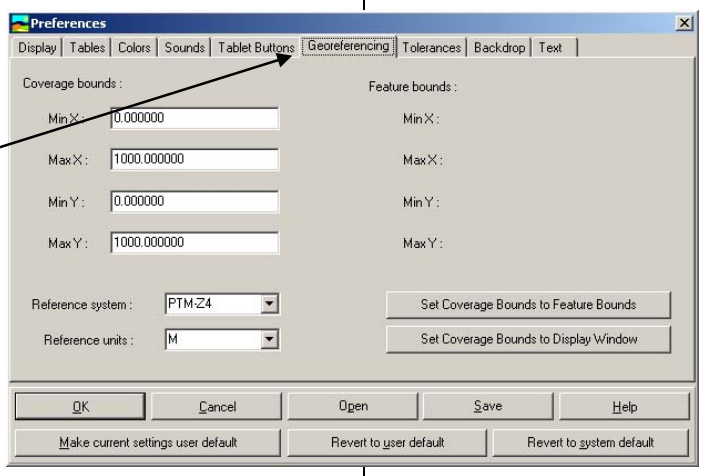
XY Input

The XY Input function enables you to create features through the manipulation of specific XY coordinate pairs. The features may be given user-defined attributes once they are constructed. XY coordinates may be entered manually or read from an existing ASCII file. These two input options may be used simultaneously in the same session but most users will typically use just one of the input modes during a single session.

XY Input can be accessed using the Display Window Cursor Pop-Up Menu or by simultaneously pressing the CTRL and "X" keys

For this reason, the two modes are discussed separately below.

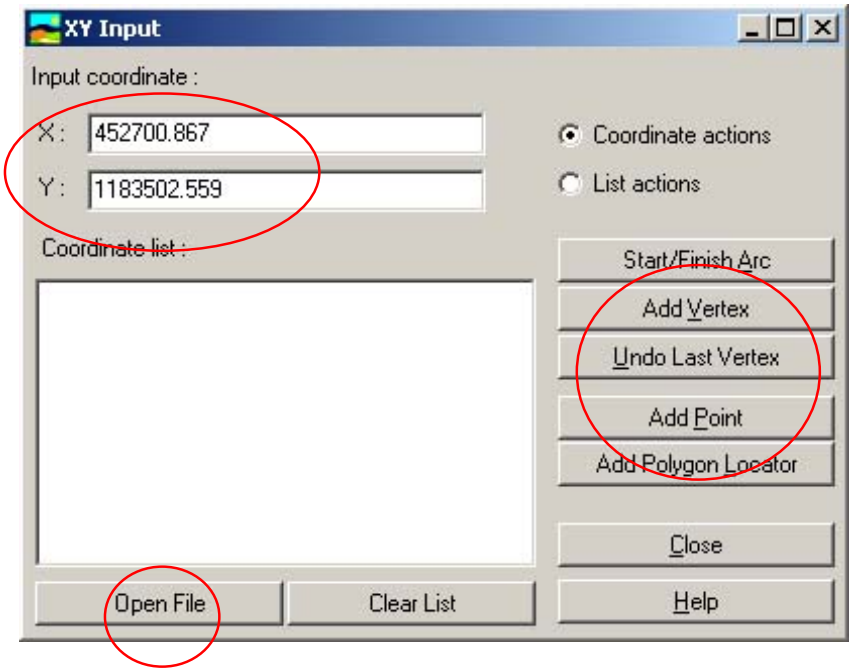
Before you begin make sure that the Coverage Bounds are specified so that they include the coordinate pairs used during XY Input. The Coverage Bounds can be set within Preferences from the Georeferencing Tab. By doing this each newly created feature can be immediately be seen in the Display Window.



Manual Input:

I. Once in the Coordinate Actions radial button. 2 Enter the XY coordinate pair in the Input coordinate box. Once this box is filled, the user may choose to use this coordinate pair to;
   a. Start an arc,
   b. Create a point, or
   c. Create a polygon locator.

NOTE
Manual Input
CartaLinx does not create a list of the coordinate pairs entered manually. The Coordinate Ust Box is only used for imported files. Therefore, if you wish to choose from a list of coordinate pairs, it is recommended that you first create an ASCII file with a text editor, and then open this file within XY Input.



If the user chooses to start an arc, the next set of logical options for the next XY coordinate pair is:

a. Finish an arc
b. Create a vertex
c. Undo last vertex
c. Create a point
d. Create a polygon locator

The groups of options listed above are not exclusive for any specific coordinate pair. For example, you may wish to use a coordinate pair to start an arc in addition to digitizing a point as long as the coordinate pair is stiil listed in the Input coordinate box, the user may use it for any of the listed digitizing options.

File Input:

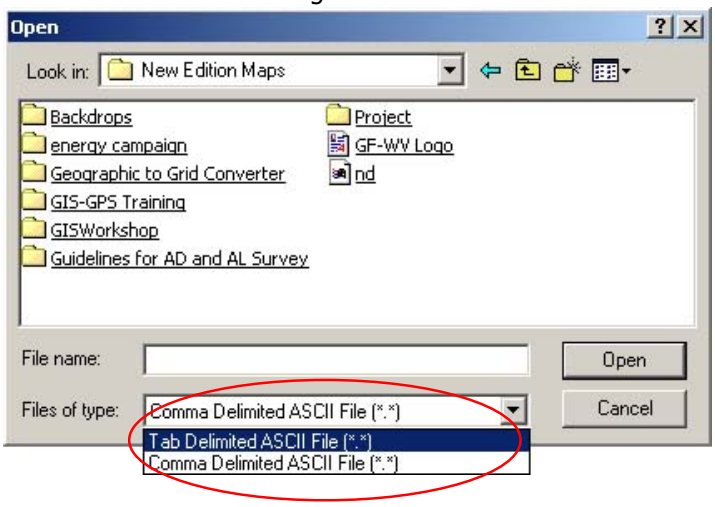
l. Once in the XY Input dialog use the Open File button to open the ASCII file containing the XY coordinates pairs you would like to manipulate. The required file format for ASCII coordinate pair files follows: X coordinate, Y coordinate.

Example ASCII Coordinate Pair Files:

452903.551, 1184999.456 (Comma delimited)
452752.248, 1189033.215

452903.551 1184999.456 (Tab delimited)
452752.248 1189033.215

2. Once the file has been loaded, you may choose to perform List actions or Coordinate actions by selecting the proper radial button. The List actions create the specified feature from the entire list. You have the option to Add as an Arc, Add as Points, or Add as Polygon Locators. For example, if you choose the Add as an Arc button, the entire list will be used to construct a single arc. Once a List action has been applied to the list of displayed coordinate pairs, the function will be disabled (grayed out) in order to prevent the accidental creation of duplicate features. If you wish to duplicate features, the file may be re-opened to enable all List actions again.



NOTE
If the coordinate pairs are attributed, you should consider using the Delimited ASCII file option under Import. This function will create point data with multiple attributes.

Sample
If you have a Technical Description, that is not in Bearing and Distance form, which has a Lat/Long on every point location, these XY Input process can be use:

STEPS

1. Convert all Lat/Long to grid (x, y) coordinates using the Converter
2. Copy it to a new Sheet by pasting in values option using Paste Special option in Excel
3. Then copy that again, paste it to the Notepad program, save as an ASCII text file in your working directory. Assign an appropriate filename which describe its contain
4. In Cartaljnx, press right click in the spacial frame or you can use the shortcut- (Ctrl+X)
5. The XY Input dialog box appears, press Open File button

The Coordinate actions work the same way on files as they do when you use Manual Input. The only difference is that you have the option of using the mouse to select the desired coordinate pair from the coordinate list to be placed in the Input coordinate box. As a default, CartaLinx will automatically start with the first coordinate pair in the coordinate list and increment to the next coordinate pair after an action has been performed. You may over-ride this default by jumping to any coordinate pair in the list. CartaLinx will begin incrementing from the last coordinate pair you selected in your list.

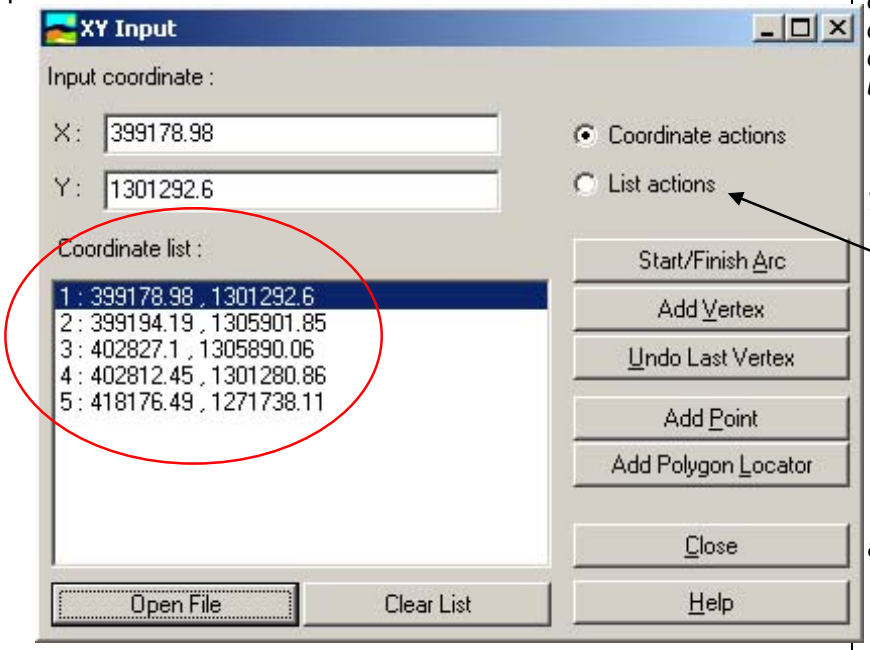
6. You wjll be prompt to select the text fite you created, press the Files of type pull down selector, choose the Tab Delimited ASCII File, then go to your working directory, select that file and press Open

Finishing XY Input

The XY Input function may be closed at any time. You do not need to finish an arc to close this dialog box. As a result, several other input functions can be used to complete an arc including COGO and on-screen digitizing. If XY Input is accidentally closed, opening it again will restore its previous state.

Pasting the output of the Converter into the Notepad is always tab delimited, so we well seldom encounter an ASCII file delimited in commas unless you directly input GPS coordinate positions that use commas

If



7. Once the file is loaded, all XY coordinates appear in the Coordinate list, choose List action, and press the Add as points button, a sound could be heard as it automatically digitized all paired coordinates

8. Close the dialog and press the Zoom to feature bounds button to zoom into the new features

duplicate arcs are accidentally created with XY Input, the Remove Duplicate Arcs function located under the Coverage Menu may be used to ielete the duplicates.

It is very easy to create duplicate node azimuths when using XY Input. This most commonly occurs when selecting coordinate pairs from an opcned ASCII file. This will only be a problem if you intend to build polygons from these

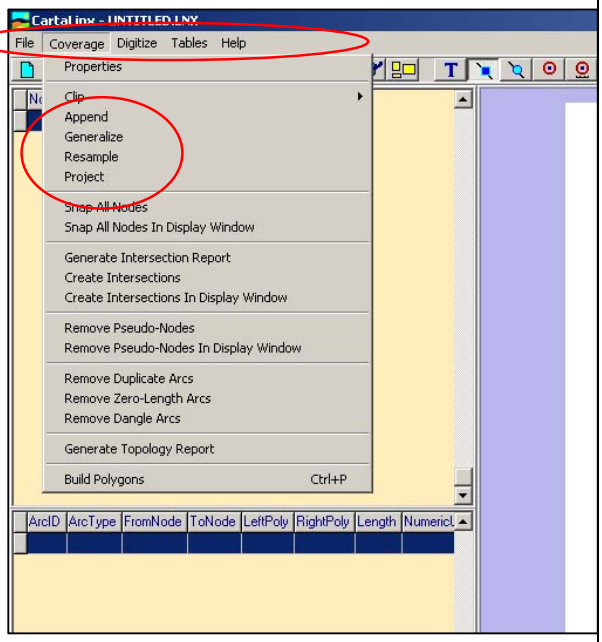
Resampling a Coverage

The Resample function will perfbrm a linear registration ofan arbitrary plane reference system to a new reference system though a least-squares fit of the arbitrary system to a set of control points which define the relationship between the original reference system and the new reference system. This procedure is only used in cases where a map has been previously digitized using raw board coordinates, or the reference system is unknown.

Resampling a coverage:

l. The Resample function requires information for a well-distributed set of points about their position in the old grid system and the position they should take in the new one. This information is provided in a correspondence file.

A correspondence file is an ASCII text file with a ".cor" extension that may be created in any word processing program. You need to have at least three points in your correspondence file to perfbrm a Resample.



The first line of the correspondence file should contain a single whole number to indicate the number of control points for which data are being supplied. What follows is as many lines of data as there are points. Each succeeding line contains two sets of X and Y coordinates for each control point, the first set from the original reference system, and the second set from the new referencing system.

A file may contain a mixture of coordinates that are whole numbers or real numbers with decimal places. One or more spaces must separate each coordinate.

The control points may be listed in any order, but the coordinates for each control point must always be in me following order: original X, original Y, new X, new Y.

To determine these coordinates, open the coverage you want to resample and read the X and Y coordinates off the status bar by pointing at the control points with the cursor. The following is an example of a correspondence file with four control points:

You can select the Resample function under the Main menu of CartaLinx by choosing the Coverage menu option

Sample
Plane Coordinates with a map seate in metric: ex. Cadastral Map

STEPS

1. Scan the map using any graphic editor like PhotoShop

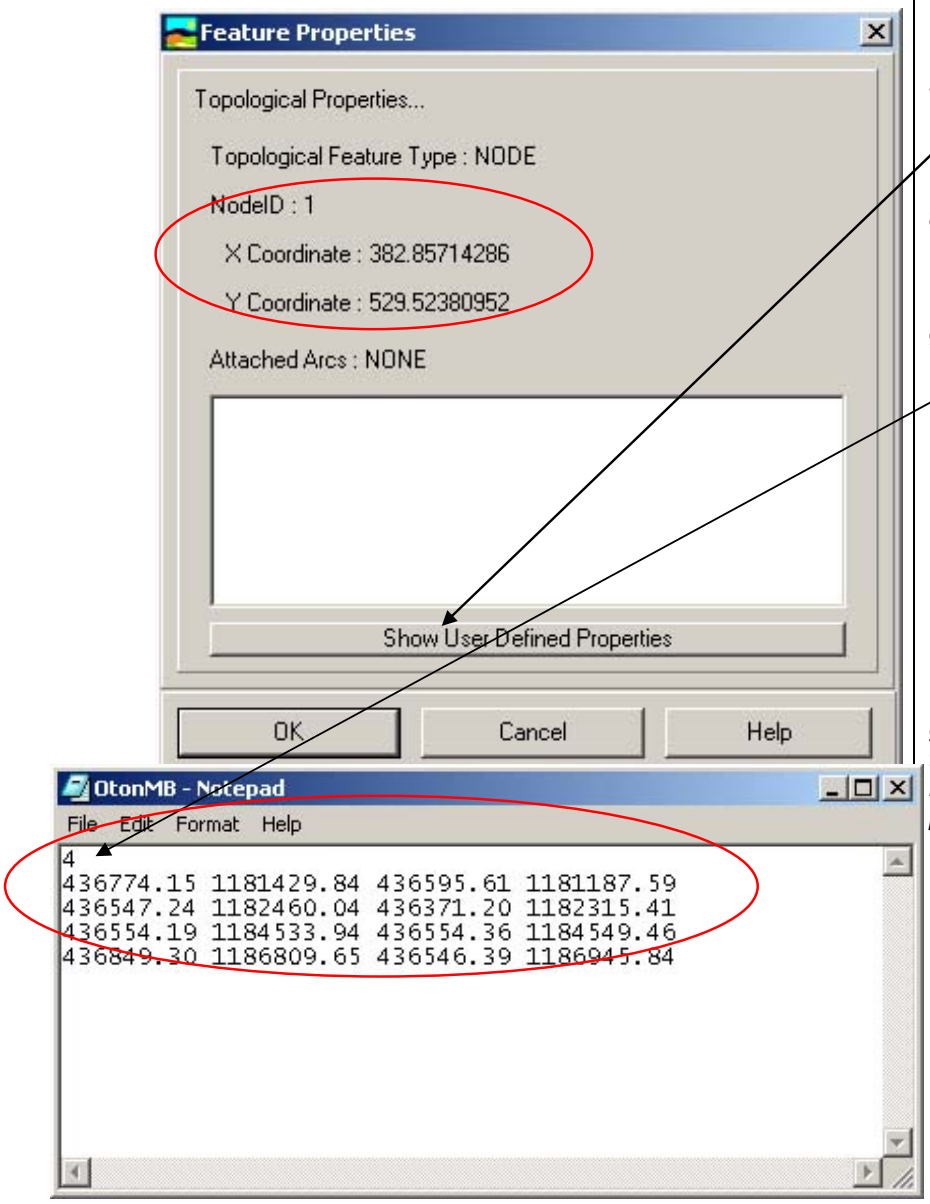
Map to Graphic scanning process is induded and discussed in Georeferencing function topic

2. In CartaLinx, open the Preferences option button and in Georeferendng tab, set the reference system to PLANE and change the unit in meter

If the location of the map is known, choose directly the map projection. In our sample, we can select PTM-Z4

3. Digitize first the cadastral map, every feature plotted on the map should be digitized
4. After digitizing, save that coverage, then select at least 4 coordinate locatton
5. Select the nodes, linked node or point as your starting coordinate locatton in one direction, clockwise or counter-clockwise manner

2. After you have created a correspondence file you will be ready to resample a coverage. Access the Resample function from the Coverage Menu. A dialog box should appear asking for the correspondence file that will be used to perform the resample.



This dialog will allow you to select the path and directory of your correspondence file

3. After you have selected the correspondence file and pressed the open button, the transformation will automatically be performed

Do not select your control points in random manner

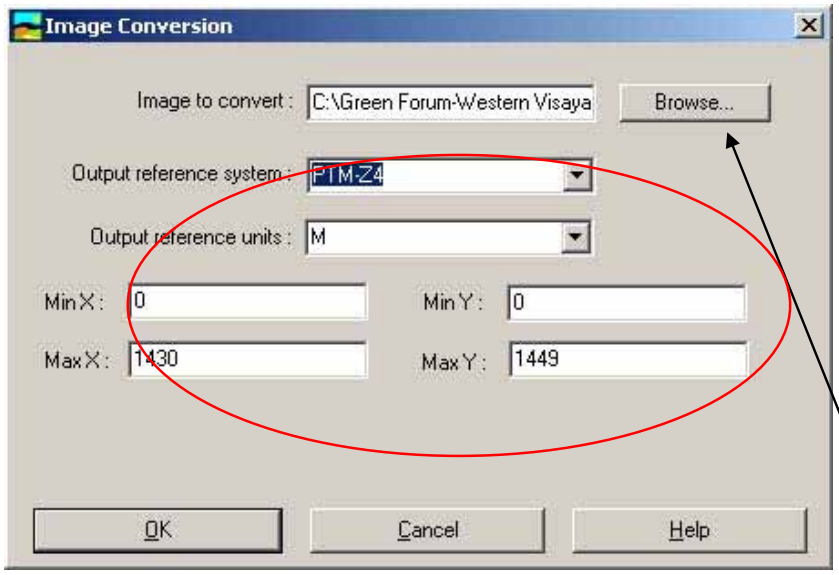
6. Copy each coordinates location by pressing F11 or right clicking on the node and select Features Properties
7. Click on the Show Topographical Properties button, the XY coordinates displays
8. Open and create a correspondence file in Notepad and enter the copied coordinates
9. First line should contain a single whole number to indicate the number of control points. In our sample, enter 4.
10. Enter the old reference XY coordinate pair separated by a space, then another space before entering the new reference XY coordinate pair

Usually, we refer to a georeferenced backdrop as the basis for the new reference XY coordinate pair

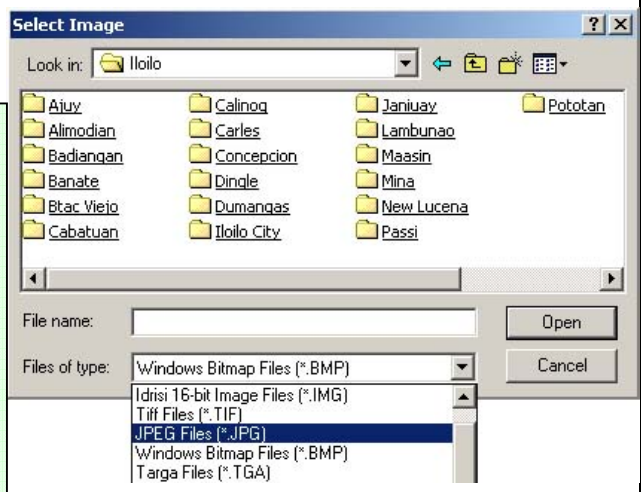
11. Repeat until you entered all 4 lines of paired coordinates
12. Save the correspondence file as an ASCII text file with a ".cor" file extension.
13. In CartaLinx, select the Resample function to execute the process

GEOREFERENCING

This process introduces the Heads-up digitizing technique with CartaLinx through its function called Image Conversions. It incorporates with the ability to use bitmap images as backdrops to the digitizing and editing process. A variety of bitmap graphic formats are supported, which melude: Idrisi, 32-bit files, Idrisi 16-bit files, ArcView Worid file, TIFF Bitmap (.TIF), files, JPEG Bitmap (.JPG) files, Windows Bitmap (.BMP) files, Targa, files (.TGA), Windows Clipboard (.CLP) files, Portable Network Graphics (.PNG) files, .DCX files, PC Paintbrush (.PCX) files, and Windows, Metafiles (.WMF). The critical issue is that CartaLinx actually



requires a georeferenced bitimap consisting of two files - - a Windows BMP graphics image and a .GBM documentation file. Even if the bitmap is aiready in a BMP format, it should be run through the Image Conversions function so that an associated .GBM file can be created. After a file has gone through the Image Conversions function, you can then import the image into your coverage, either as part of the New Coverage operation if a new coverage is being created, or by means of the Backdrop Tab of the Properties/Preferences/Options dialog



Note

In Step 7, you can use the Converter to get the minimum and maximum XY coordinates if you are using NAMRIA's topographic maps by looking on the Lat/Long reference label

Converting Rastar file like .JPEG to a georeferenced bitmap

STEPS

1. Scan a map with or without reference coordinates using a graphic editor like PhotoShop

Crop or clip the scanned map using the tick marks for standard topographic maps

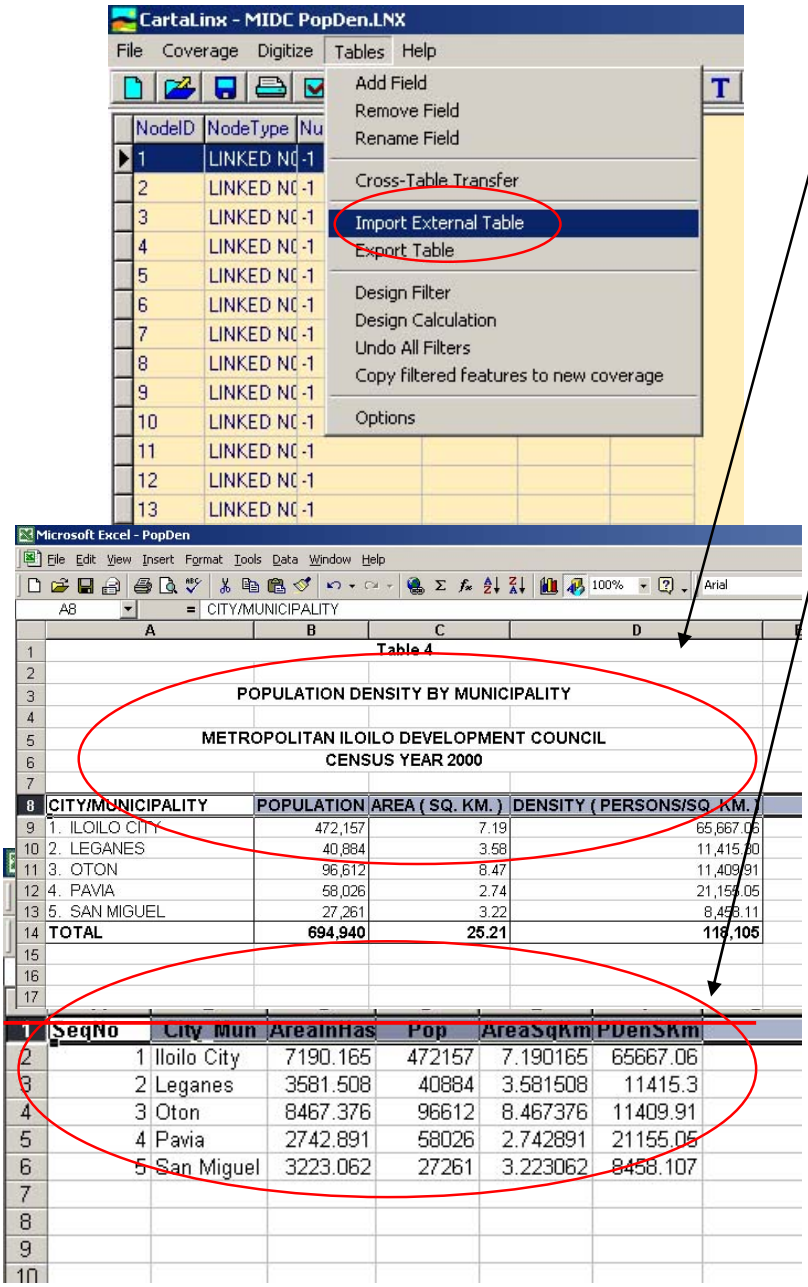
2. Save it in .JPEG file graphic format
3. In CartaLinx, select the Image Conversions function from the File Menu, then a dialog box will appear
4. Enter the name and directory of the scanned image file (.jpeg) you would like to convert.
5. A Browse button allows you to select from a list the name, drive, and directory of the file that you would like to open
6. Select the reference system and reference units associated with this image

Images that has no coordinates to refer, skip step 7, you can apply the Resample function instead..

7. Enter the Minimum and Maximum X and Y for the coverage
8. Press the OK button and the Image file will be converted. After the conversion, you will have two new files: a .BMP file and a Georeferenced Bitmap Metadate (.GBM) file.

Integrating external database into a Coverage

This process introduces the technique called integration of external table with CartaLinx through its function called Import External Table function. It either appends, merges and does the combination of last two (Merge/Append) with the external table (outside data tables of CartaLinx). Sources can vary, either hard coded or digitally encoded.
The technique is very useful if you need to enter data attributes into coverages that are already established. Population Density is one example. If you have the actual map coverage in CartaLinx, you do not need to manually encode all data. Using this technique will shorten the process.



Importing External Tables into CartaLinx coverage

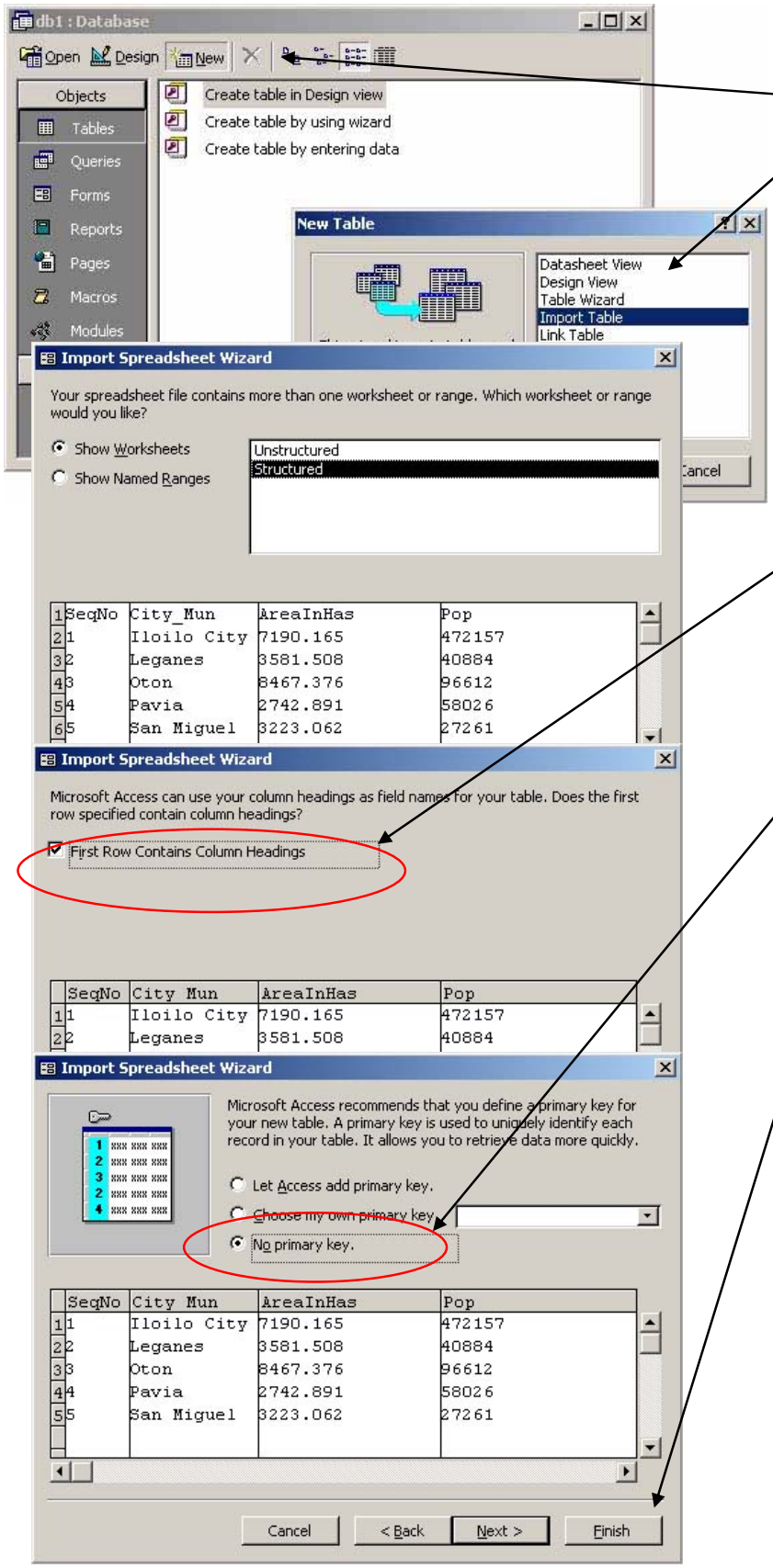
Note
Microsoft Excel is used for this process

STEPS

1. Open the source file. Set the source data into a structured format by rearranging or deleting unnecessary text code.
2. Copy necessary data to a new sheet
3. Make columns for each data and give a heading on it.
4. Give a descriptive name or rename each heading by not putting any spaces. In case of long names or it has more than 1 word, truncate or abbrebrate it into 10 character or less

Most external data source are in a Spreadsheet program like Excel

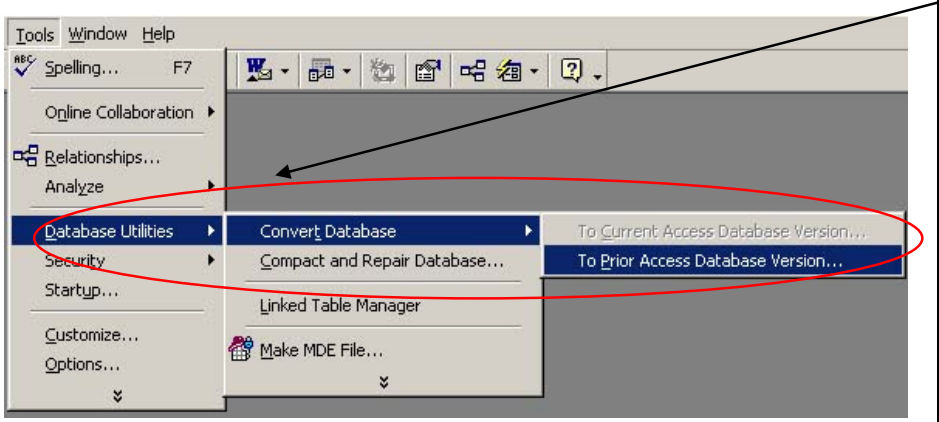
5. Save the file to a new separate Excel file.



6. Open a new file in Microsoft Access.
7. Select the New menu then choice the Import Table option

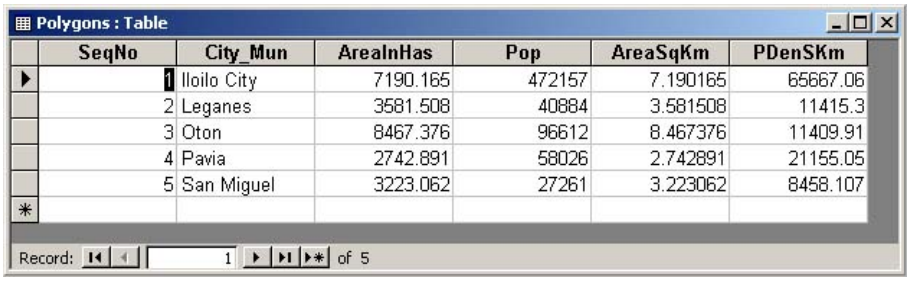
Microsoft Access will let you choice what file format you will import. In this case, we use the Excel format file which we set into a structured one lately.

8. Check the First Row Contains Column Headings. The first row in our structured file will be use as field names for the Access table.
9. Set no primary key since we have a sequence number field (seqno) which will eventually link to the CartaLinx coverage later on.
10. Press Finish and name the table as 'Polygons'. Then our Access table should look like this:



11. Go to the Tools menu. Select the Database Utilities, then select Convert Database, then To Prior Access Database Version.

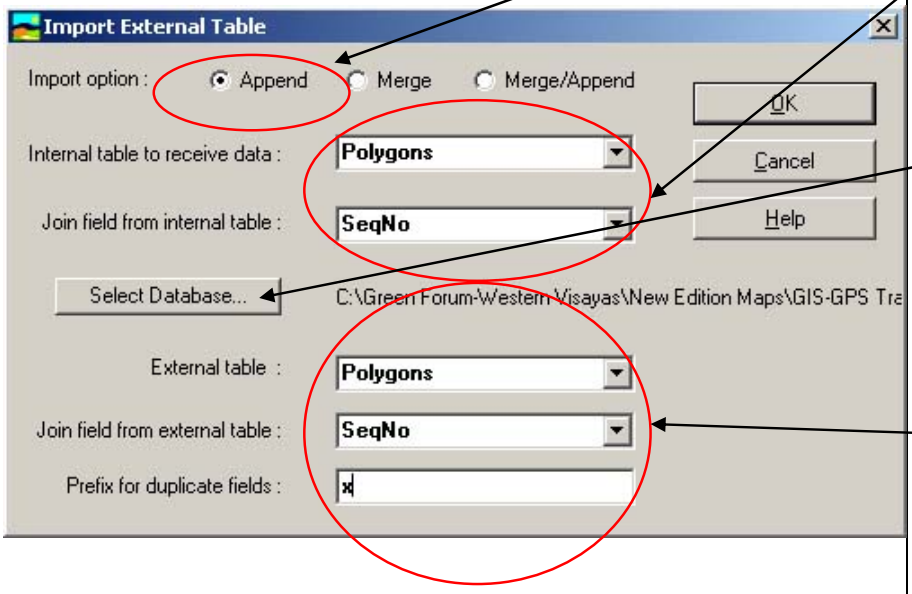
This step is required because CartaLinx cannot recognize the Access file created by the new Microsoft Office versions. It should be saved to a prior Access version



SeqNo	City_Mun	AreaInHas	Pop	AreaSqKm	PDenSKm
1	Iloilo City	7190.165	472157	7.190165	65667.06
2	Leganes	3581.508	40884	3.581508	11415.3
3	Oton	8467.376	96612	8.467376	11409.91
4	Pavia	2742.891	58026	2.742891	21155.05
5	San Miguel	3223.062	27261	3.223062	8458.107

12. Then in CartaLinx, Press Table in main menu then select Import External Table. A pop-menu will appear

13. Select Append in Import option, choose Polygons as our Internal table to receive the data. Choose SeqNo field as the join field between the external and internal table.



14. Click Select Database to open our Microsoft Access file which contains the Polygons Table

15. On the lower part entries, Select Polygons as the external table to append, then match the join field using SeqNo field. Assign a prefix if the external table field has the same name field in the internal table so that it will not overwrite any records within it.

Annex 1
Training Design: 3-D Map Production

Day / Time	Topic	Content	Methodology
Day 1. AM	Introduction / General orientation on community mapping	• Introduction of participants and objective setting; • Sharing of experiences on community mapping and resource scanning; • Brief discussion on cartography.	Plenary / Group discussions

Annex 2
Training design: Basic Skills on Digital Mapping / GIS

Topic	Content		Methodology
Basic cartographic concepts, features, and relevant applications.	Orientation and Expectation Check. Significance of geographic info. Basic cartographic features. Relevant mapping applications.	• introduction of participants, resource persons and trng design • participants' expectations • importance / relevance of maps / mapping activities • define basic features: nodes (points), arcs (lines) and polygons (areas). • on map projections and geodetic datum transformations. • experiences on mapping applications	Plenary / Group discussions. Activity / Group discussions. Lecture (Input) Deepening / Synthesis
Building Spatial Data. The Global Positioning System, GPS.	Encoding geographic data with the GPS. Generating GPS positions. Data computerization.	• the global positioning system (history, uses, applications, limitations, etc.) • 3-dimensional GPS positions (hand-held rover satellite readings) • Initial computer data processing with Tremble's Pathfinder Office	Lecture Field survey. Computer hands-on practice.
	Geographic data digitizing techniques. Digitizing geographic data with scanned images.	• the tablet digitizer. • desktop digitizing with CartaLinx or ArcGIS • encoding digital geographic information using scanned images.	Lecture Computer hands-on practice.
Exporting digitized data to GIS software and Orientation on analytical capabilities.	The GIS (geographic information system). How to: Exporting digitized geographic data to GIS software. Filtering features (attributes) or locations. Relational database / interactive feature inquiry.	• spacial & statistical analysis / introduction on GIS • on GIS tools and software. • geographic data to MapInfo: An actual experience. • customizing maps based on specific feature attributes • produce thematic maps on special feature attributes • modeling, queries and over-lays	Lecture / plenary / group discussions. Computer hands-on practice. Lecture Computer hands-on practice. Lecture / group discussions Hands-on practice.
GIS Map Lay-out and Production.	On map production (lay-outing)	• basic map lay-out • produced thematic maps • Evaluation (strengths / weaknesses) of the process, visual aids, learning materials.	Lecture Hands-on practice. Printing maps. Plenary / group discussions.

Annex 3
List of Participants

Partisipantes

SDMC	Afabubo: Angelino M. Soares no Maria dias Ramos;
	Baricafa: Isabel Maria Hornay no Veronica Preto;
	Daudere: Julio Pereira no Leonardo Sampaio;
	Luro: Eugenio Morrera no Zelito dos Santos
Chefe de Suco	Afabubo Augusto F. Ramos B.;
	Daudere Fernando Horacio;
	Lacawa Tomas da Costa;
	Lautem Angelo Calvao Silva, SDDMC;
NGOs:	Eugenio F. Lemos, Permatil, Dili; Agustino A. Ribeiro, Prospek, Lospalos;
	Ildo J. Vinhas Fraterna, Lospalos; Modesto Ximenes, Matak, Lospalos;
	Pedruco Capelao, Concern, Lospalos.
Governu:	Domingos Soares Mook, MAFP Nacional; Delio Nunes MAFP Distric Lautem;
	Rolando C. X. dos Santos Ad. Sub. District Luro; Salvador Notalicio Lopes
	MAFP Distric Lautem;
SDDMC	Lautem: Abelita Florentina, Agapito da Conceicao Pinto, no Rita Pires
Rep. Juventude Luro	Ramiro M. Ribeiro
Daudere	Zito da Costa no Juliano de JesusJPL. M
Facilitators:	Marrie-ann Merza, Concern Worldwide
	Melvin B. Purzuelo and Gregaldy Azares, GF-WV;