24. COMPILING A GIS DATABASE OF TREE FARMS ON LEYTE ISLAND

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Tree farms were located and surveyed as part of the Australian Centre for International Agricultural Research (ACIAR) tree farm project activities. The sample area was the island of Leyte in the Philippines. Tree farms found were referenced using a Global Positioning System (GPS), to incorporate the information into a Geographical Information System (GIS) database. Information from the sites was recorded and entered into an Excel spreadsheet, which was then placed into a GIS system. Information collected included owner name and address, species of trees, topography, access, reasons for the plantation, silviculture and the owner's willingness to use their trees for extension purposes. The information recorded into a GIS database was accompanied by shapefiles of Leyte. There was a problem with mismatching shapefiles in the GIS system due to different datums used. Photos of some of the sites were hyperlinked to the point files of the tree farms. The database is being used to select tree farms for demonstration sites. The demonstration sites are being used to demonstrate effective management of tree farms and plantations to provide advice about silvicultural methods and other aspects of plantation management.

INTRODUCTION

Part of the activities of the ACIAR project ASEM/2003/052 entitled '*Improving Financial Returns to Smallholder Tree Farmers in the Philippines'* involves locating tree farms within Leyte island, Philippines, for the purposes of using them for demonstration sites for extension activities. Creating a tree farm database of possible demonstration sites helps to assist choosing sites for the ACIAR Tree Farmer Project. It is necessary to conduct interviews with the owners to gather basic information about the farms, in relation to criteria for demonstration site selection. Appendix 1 lists the questions asked during interviews with the plantation owners. When information from the sites is recorded on a database, it can be accessed and evaluated by many people involved in the ACIAR project. Information can be referenced in the Geographical Information System (GIS), to allow for spatial and other forms of data analysis to be performed. However, precision and accuracy[1] of the data need to be considered when analysing the data. A Global Positioning System (GPS) can be used to record coordinate information and interviews with tree farm owners can be recorded into a GIS system. After an interview is conducted and the answers to questions are recorded on paper, the results are then also transferred into a GIS database. This paper discusses the methods used to create the tree farmer database.

THE SURVEY METHOD

The records of registered tree farms were obtained from every Community Environment and Natural Resources Office (CENRO) on Leyte Island. With these data, preferential sampling was used in the selection of farms. Tree farms were selected on the basis of the idea that the area planted should not be less than ¼ of a hectare and that the location of the plantation was known and accessible. However, with the purpose of obtaining a sample of tree farms, which are distributed throughout Leyte Island, purposive sampling was used in

[1] Accuracy is different to precision; for instance accuracy is correctness (i.e. a point being in the right position); whereas, an example of precision would be the immediacy of points to one another (Levine 1998).

municipalities[2] with no available information on registered tree farms. A municipal official was usually able to provide information about existing tree farms in the community, but usually the official was uncertain whether farms were registered or not.

The *Barangay*[3] chairman of each community visited was first informed about the survey to introduce the purpose of the project and gain information on the locations of the farmers in the list. Introductory letters were given to the barangay chairmen, farmers and reinforced by verbal discussion. A questionnaire prepared in English was used in personal interviews with farmers. During the interview questions were translated in local dialects, particularly Cebuano and Waray-waray. If the owner was present during the field visit, an interview was conducted; otherwise basic information of the farm was recorded by visual inspection and through the information provided by any persons present.

A Garmin brand GPS (model number 76) was used to record a waypoint of each tree farm located. A waypoint is created simply by pressing the enter button on the GPS (provided there is a sufficiently strong satellite signal). A World Geodetic Datum[4] (called WGS 84) was used, by changing the settings on the handheld GPS instrument; this datum used differed from that used in the shapefiles[5] of Leyte. The datum of the Leyte shapefiles was D_North_American_1927. The coordinate system on the GPS was set to Universal Transverse Mercator (UTM). The coordinate system on the shapefiles used was called GCS_Assumed_Geographic_1, which is expressed in decimal degrees. However, some of the shapefiles had a different datum and coordinate system to the others. Additionally, some of the shapefiles lacked some details, such as the roads shapefile. The UTM coordinate system was chosen (which is displayed as eastings and northings), because it is an international standard coordinate system. A waypoint was created at each site and downloaded onto a program called Map Source to be exported into a file to be used in the ArcMap 8.3 program.

More than 70 tree-farm sites have been recorded with the GPS. The attribute table[6] of the tree-farm shapefiles contains basic information (including coordinates), which was recorded by the GPS upon creating each waypoint. The file was imported into the ArcMap program to display the waypoints on top of other shapefile layers. For every site, basic information including the name and address of owner, species and area planted, and age of the plantation has been recorded. Additionally, where possible farm owners were interviewed to gather more information relating to silviculture, establishment activities and cost were obtained. All information was entered into the Excel spreadsheet and edited when necessary to accommodate for updated information and fix any errors. The Excel file was then imported into the ArcMap program. A digital camera was used to photograph some of the sites, with photos hyperlinked into the GIS system. The photos were used as a means to provide a visual reference of the site, provide more site detail and supply photographic evidence for the information recorded.

[2] A *municipality* is a regional administrative area within a province. The province of Leyte is divided into 43 municipalities, and the province of Southern Leyte into 19 municipalities.

[3] Each municipality is divided into smaller communities or *barangays*, as 'the smallest political unit in the Philippines, encompassing a village' (Utting 2000, p.220).

[4] The earth is represented in a GIS system by a *spheroid*, and spheroids can differ in shape. A *datum* is 'a set of parameters and control points used to define accurately the three-dimensional shape of the earth (for example as a spheroid)' (Vinenneau 2001, p. 263).

[5] A *shapefile* is a vector data storage format for storing the locations, shapes and attributes of geographic features (Vienneau 2001, p. 273).

[6] An attribute table is a table containing information which describes and relates to the displayed map features.

SURVEY AND GIS DATABASE RESULTS

The adequacy of data gathered through interviews was in most cases limited by the lack of records and knowledge of farmers about plantation establishment and silviculture, particularly the financial aspect. However, a basic description of the stand and the intentions for planting trees was obtained for most sites. Particular data constraints arose where owners were not available during the field visit.

The primary data collected by the GPS in the form of waypoints had an eastings and northings coordinate system, as required for UTM GPS coordinate settings. The basemap[7] shapefiles were recorded in a decimal degrees coordinate system and had a different datum to that used by the GPS, so the primary waypoint data were imported into the ArcMap program with the map properties set to coordinates in degrees. A trial showed that on a shapefile of roads of Leyte, the GPS track (which is a path recorded by the GPS) was approximately 150 m away from the road, as Figure 1 illustrates. The track was made by turning on the GPS receiver and holding the GPS so as to have clear reception from satellites, whilst travelling along the highway in a vehicle. The track was then downloaded on the computer to be displayed over the top of a Leyte road shapefile. The error of about 150m (due to the two different datums not matching) was alleviated by creating a new shapefile designated with the coordinate system of the basemap shapefiles of Leyte. For the purposes of GPS referencing of demonstration sites, precision was not a prime concern. However, 150 m errors are not appropriate, thus new points were created to account for the mismatching shapefiles. In the new shapefiles, points were created approximately 150 m away from the original points to place them in a more precise position in reference to the shapefiles of Leyte. The points were still not precise, but a high degree of precision was not necessary, because the spatial aspect of the GIS database is used mainly as a navigational tool. Additionally, making the final maps more precise would be time consuming considering the basemaps would need to be modified and updated. The original UTM data were retained, since UTM is the preferred coordinate system, being an international and widely used standard.

The end product was a shapefile containing waypoints, which had the same coordinate system of the basemap shapefiles of Leyte. The attribute table included information from interviews, to give detail about demonstration sites recorded as a point file. Where available, photos taken with a digital camera were hyperlinked to the attribute table. A map of the tree farms that were GPS referenced is provided as Figure 2. Maps showing the positions of the tree farms were also created and printed using the ArcMap software. Over half of the tree farms in the GIS system contained information from an interview conducted with the plantation owner.

[7] A basemap is a map used as an initial GIS layer, above which other layers are displayed.

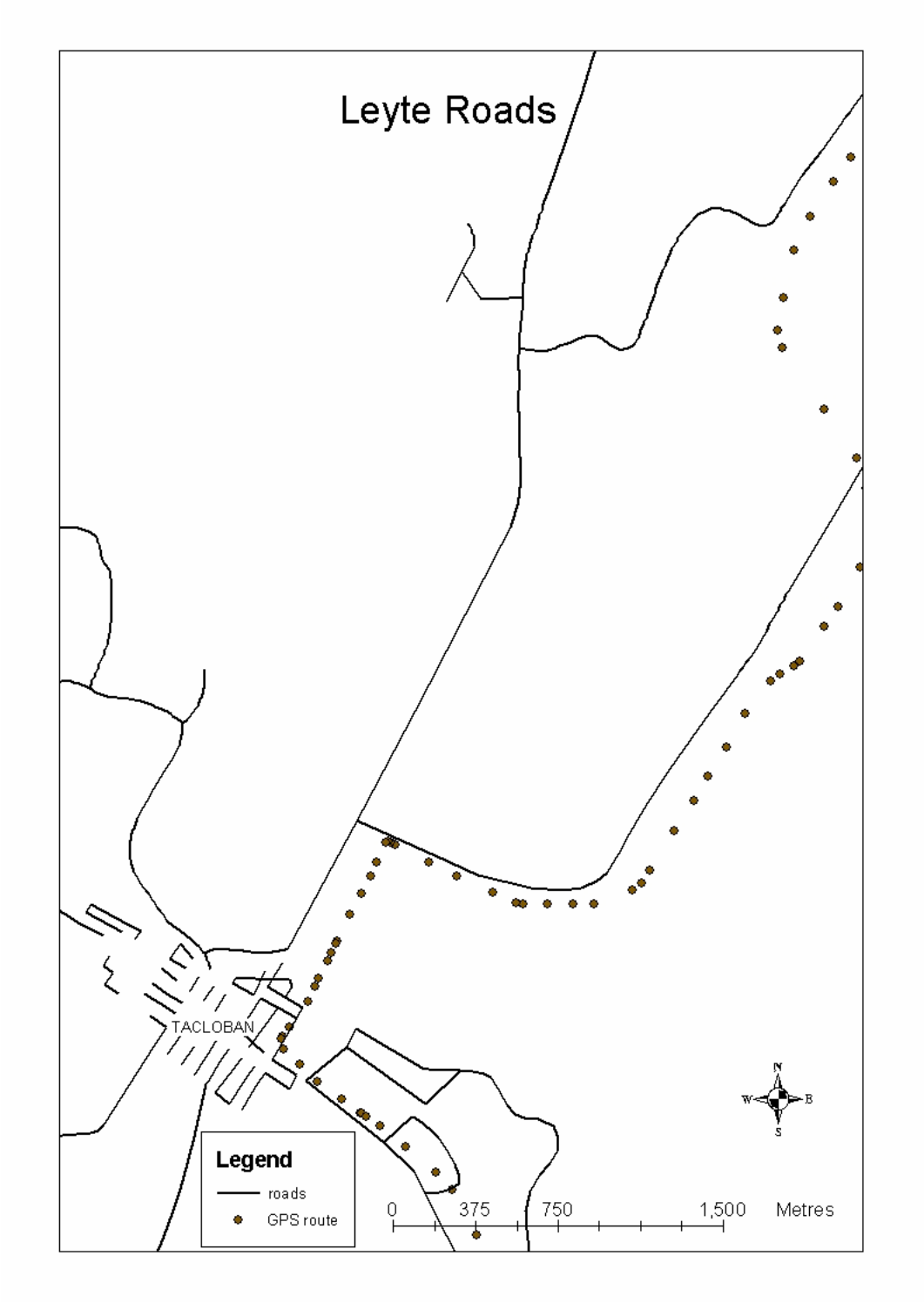

Figure 1. GPS track created while travelling on a highway in Leyte

Note. The route is about 150 m from the roads contained in one of the shapefiles of Leyte used as a basemap.

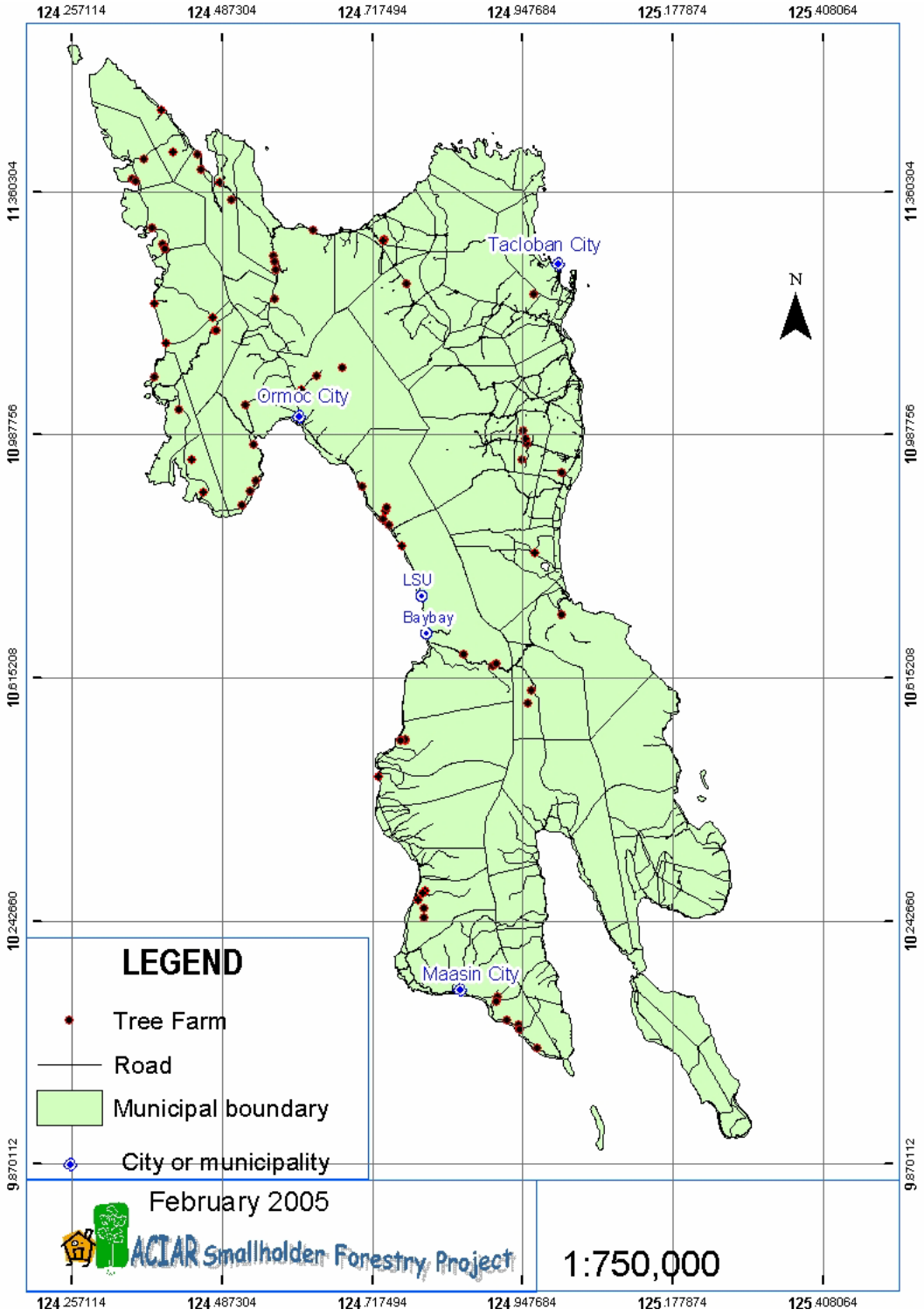

Figure 2. Locations of tree farms referenced using the GPS

DISCUSSION AND CONCLUSION

The GPS referencing of the tree farms was a useful means of recording information about these sites. The information is now being used as a basis for selecting demonstration sites for extension activities. The use of the GPS was a simple and quick way of recording waypoints. One difficulty experienced was that the datum and coordinate system used in the basemap shapefiles differ from the coordinates and datum used by the GPS. Some of the

resultant error has been eliminated by creating a new shapefile, and the level of accuracy is probably adequate for the GIS application.

The GIS database of tree farms allows access to information and a capability for spatial analyses, which would not be possible without using a GIS system. The database can be updated and edited. Another advantage of the GIS system is the hyperlinking of photos of some of the important sites, to allow people to have some appreciation of the site without visiting it in the field. Essentially, when using GIS data, there has to be a consideration taken when using secondary data, so that shapefiles from different sources will overlay with precision.

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APPENDIX. QUESTIONNAIRE FOR TREE FARMERS

CENSUS SURVEY FOR POTENTIAL TREE PLANTATIONS FOR STUDY/DEMONSTRATION PURPOSES

Place of interview: _____ Date: _____
Enumerator/s: _____
Respondent no.: _____

A. Background information

1. Name of the owner:
2. Home address:
3. Description of the plantation:

Species	Area	Spacing	Stocking	Age	Topography	Location
:						
:						

4. Farm accessibility:
   a. Distance of household to farm: _____
   b. Distance of nearest formed road to farm: _____
   c. Distance of farm to DENR nursery or office: _____
   c. Accessibility of 4WD road for log removal: _____

B. Timber production system

1. What are your intentions or reasons/purposes for planting trees?

_____

2. Are your trees registered? Why or why not?

_____

3. Source (s) of planting materials:
4. Labour requirement:

a. Establishment and maintenance:

Activities	Methodology	Cost	Other comment (s)
1. Land preparation			
2. Lay-outing			
3. Staking			
4. Hauling			
5. Digging/planting			
6. Ring weeding			
7. Brushing			
Others			

b. Silviculture

Silvicultural treatments						
Pruning		Thinning		Fertilizer		
When	Uses of pruned materials	When	Uses of pruned materials	What	How much	When
:						
:						

c. Value of the stand for silvicultural demo plots

C. Willingness to work with the project

1. Are you willing to welcome any technologies that the project may introduce to you?_____
   Why or why not?

_____

2. Are you okay if the project applies/tests its technology directly to your tree farm/plantation? ____
   If no,
   a. Why?

_____

   b. Are you contented with the status or performance of your trees now?
   If yes, any agreements you want with the project?

_____

D. Information about neighbouring farms

Name of the owner	Location
:	
:	