23. TREE REGISTRATION AND APPROPRIATE SURVEYING METHODS IN THE PHILIPPINES: CAN MODERN GPS UNITS HELP?

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Registering plantations of trees in the Philippines requires a boundary survey of the land on which they are planted and this is expensive for poor farmers. Legal and political requirements for farmers owning tree farms or plantations, involves tree registration by employees of DENR. An investigation was undertaken to test the effectiveness of two different procedures for recording boundary surveys needed for tree registration. The accuracy of a Garmin 76 Global Positioning System (GPS) unit and a compass and chain was checked under the same conditions. Tree canopies interfered with the ability of the satellite signal to reach the GPS and therefore the GPS survey was less accurate than the compass and chain survey. Where a high degree of accuracy is required, a compass and chain survey is a more effective and a less costly means of surveying land underneath a tree canopy.

INTRODUCTION

Tree registration is legally necessary for anyone owning and wishing to harvest trees in Leyte, the Philippines. For this purpose, the Department of Natural Resources and Environment (DENR) maintains a database of all tree plantations registered at the local Community Environment and Natural Resources Office (CENRO), an office of DENR. Employees of DENR administrate the process of tree registration and need to travel to areas for requirements such as undertaking a boundary survey of the property to be registered. In due recognition of political requirements, undertaking a boundary survey is best completed by a DENR employee. Currently many people do not register their trees with DENR for a variety or reasons, including the expense of one of the registration requirements, a boundary survey undertaken with a theodolite or similar equipment. This type of equipment can survey boundaries with distance measurement errors of several millimeters (Theodolite.com 2005) and hence a closing error[1] of less than several centimeters. One way of assisting farmers to register trees may be to reduce survey costs.

One of the objectives of Australian Centre for International Agricultural Research (ACIAR), project ASEM/2003/052, *Improving Financial Returns to Smallholder Tree Farmers in the Philippines* in Leyte Province, is to facilitate the marketing of trees. Improving smallholder's ability to register their trees with DENR would assist this objective. This article investigates the possibility of reducing the cost of a boundary survey by comparing the accuracy of a modern global positioning system (GPS) unit with that of a compass and chain survey. The accuracy of these methods is compared with a theodolite survey.

[1] Closing error is the error (in distance between two points), which occurs when the start and end points of a closed survey are in different locations. Closing error gives an indication of the accuracy of the boundary survey.

RESEARCH METHOD

The two different survey methods involved measuring a boundary of area to mimic that of a standard tree farm in Leyte, the Philippines. A boundary survey involves a perimeter to be derived (to be documented for registration) around the area where the trees to be registered, are situated. The start and end points of the survey should match to make the survey a closed area survey.

A GPS is a hand held instrument, which records coordinates on the earth's surface by receiving signals from satellites orbiting the earth. An uninterrupted line to any satellites will send signals to the GPS unit. A Garmin 76 (GPS) was used to survey the boundary of an area of approximately 1 ha, which was considered to be typical of a small tree farm in Leyte. Only part of the boundary was under a clear view of the sky. The GPS survey was replicated three times over the same area. The measurement of the end position coordinate, which was not covered by tree canopy, was measured 12 times with the GPS during one of the replicates. The standard deviation of the 12 end position coordinates was calculated.

The chain and compass survey used a chainman® distance measuring device, which is relatively inexpensive. This device is fastened to the operator's belt and measures the distance the operator walks by unwinding a cotton thread which passes over a calibrated wheel. The chain and compass survey was undertaken over a 1 ha area under a similar environment of the GPS survey. Like the GPS survey, the compass and chain survey was replicated three times over the same area, as operator accuracy was an important consideration. A prismatic compass was used to measure bearings. The closing error of the survey was recorded. For the compass and chain as well as GPS surveys, a paper map was made to document the perimeter and calculate the closing error of the replicated surveys.

COMPARISON OF ACCURACY

Dense canopy decreased the accuracy of the GPS and resulted in a different path being recorded for each of the three replicates of the GPS survey. The inaccuracy of the GPS led to poorer precision of the perimeter calculation[2]. Figure 1 reports the survey results of the GPS survey under the canopy. The accuracy of the compass and chain survey depended upon the operator. The accuracy was better than the GPS survey. The canopy did not encumber the accuracy of the compass and chain survey and the closing error was approximately one metre, relative to the accuracy of the end point coordinates as obtained by a theodolite. The standard deviation of the fixed-point coordinates was 7.9 m for the easting and 6.8 m for the northing, which is within manufacturer's specifications (GARMIN International 2001).

CONCLUDING COMMENTS

Tree cover affected the results of the GPS survey. A dense canopy led to greater interference of the satellite signal and thus less accuracy of the GPS. The GPS is useful for recording the positions of roads but is not suitable where an accurate survey is required. The compass and chain survey is more accurate, but with a closure error of approximately one meter over about 1 ha, it does not achieve the accuracy of a theodolite survey. Compass and chain surveys would be a low-cost option for farmers to undertake a boundary survey themselves, but this procedure has political and legal implications.

[2] Accuracy is different to precision, where accuracy is referring to a correct point; precision refers to the proximity of a number of points to one another (Levine 1998). Greater accuracy of the survey helps achieve precision among the replicates.

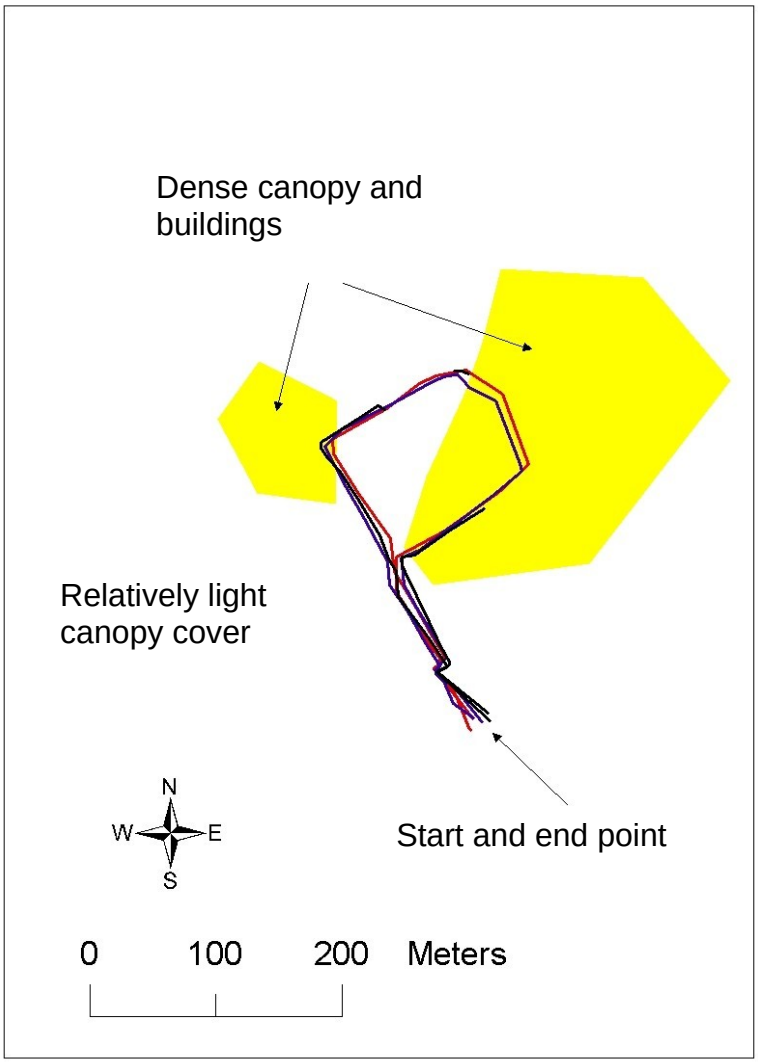

Figure 1: Diagram of the three replications of the perimeter recorded by the GPS

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