

A NATIONAL LAND USE MAPPING IN 1:250 000 OF THE PHILIPPINES WITHIN ONE YEARS TIME

Hans Rasch, Ulf Kihlblom, Dan Rosenholm
Swedish Space Corporation
P.O. Box 4207, S-171 04 Solna, Sweden
Commission VII

Abstract

Satellite remote sensing have since the first Landsat was launched in 1972 been a promising tool for land use mapping. However, the technique has mostly been used in research and for production of colourful images used for marketing purposes. The implicit promises of satellite remote sensing have previously not been put into large scale production.

The Swedish Space Corporation have, for the World Bank, during less than a year carried out a national land use mapping of the Philippines. An area of approximately 300 000 square kilometres was interpreted and classified in 24 land use classes concerning forests, extensive and intensive agricultural land use, marine areas etc. The work was performed in SPOT multispectral images in 1:100 000. The results are presented, according to the national mapping system, in 1:250 000 as 43 thematic maps.

Introduction

This article provides an account of how a national land use inventory of the Philippines was carried out and a summary of the results achieved. It was, and still is the first of its kind in the world in that it covered an entire country or region of such size, about 300 000 square kilometres in all, and in the short production time.

The aim of the study was to supply the World Bank with input information to their Forestry, Fisheries & Agricultural Resources Management (FFARM) study for the Philippines. It was financed by BITS, the Swedish Agency for International Technical and Economic Co-operation and DENR was SSC's co-operating agency. The project was started in April 1987 and completed 12 months later, i.e. in April 1988. The material produced during the project has been submitted by the Swedish Space Corporation (SSC) to the client, the World Bank, who will in turn present it to the Department of Environment and National Resources (DENR) of the Philippines.

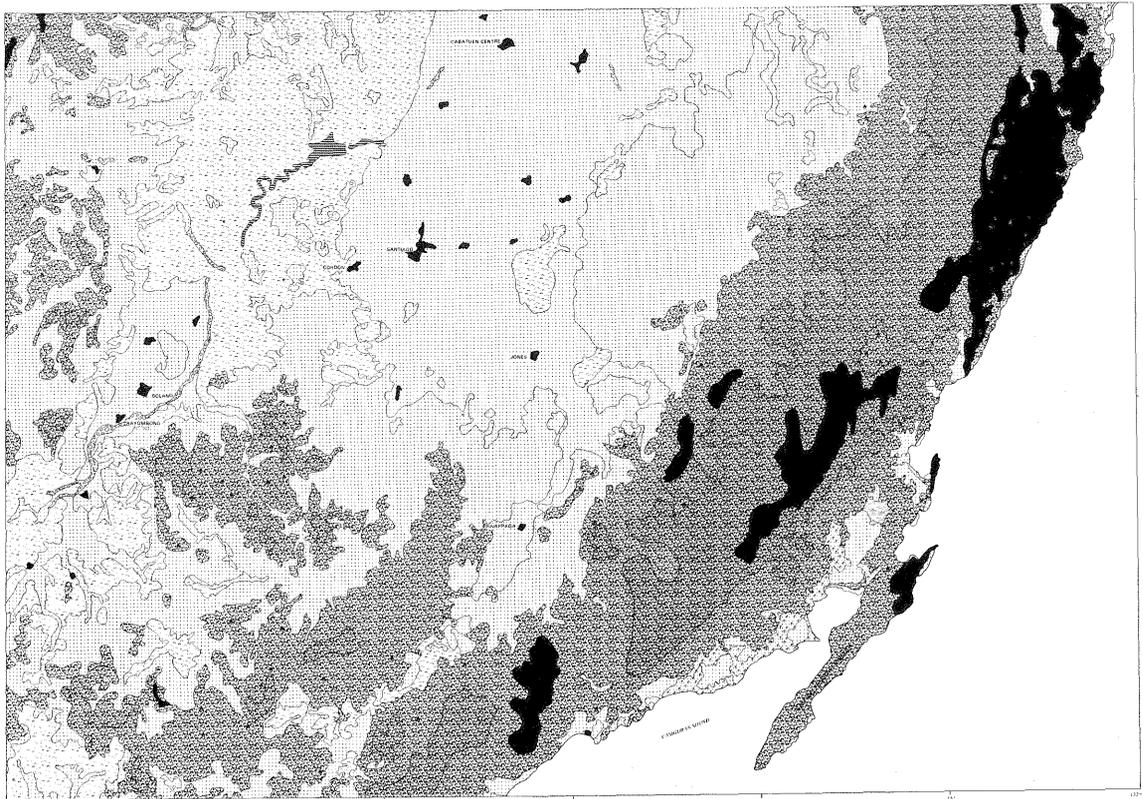
Examples of one of the main products delivered by SSC, a land cover map, are shown in the figure in very reduced form. The map appears on a scale of about 1:1 000 000, while the original scale supplied to the client was 1:250 000.

Execution

Multispectral SPOT mode XS colour infrared imagery was used. When the project started only 8 cloudfree scenes of the Philippines had been obtained. Totally 190 scenes were needed of which all were recieved, with an acceptable cloud coverage, before the project was finished. The scenes, 60 km x 60 km, that cover the project area were precision corrected and interactively contrast enhanced. They were then transformed into

diapositives on a scale of 1:100 000 for ground truthing and interpretation and, by computer mosaicking, further into Satellite Image Maps which were reproduced on a scale of 1:250 000.

A group of twelve Swedish Space Corporation specialists spent the first two months of the project period in the Philippines conducting the ground truthing in cooperation with DENR experts, mainly foresters. Five ground and twenty air reconnaissances were made, those by air in a Cessna 172.



*LAND COVER MAP
1:250 000 (original scale)*

*CLASSIFICATION LEGEND
(i.e. raster symbols, not shown
here)*

*SOLANO
MAP SHEET NO 2508*

Figure 1. A map sheet of the Land Cover Map in 1:250 000 reduced to 1:1 000 000. 24 different classes were discriminated in the multispectral SPOT images

After the ground truthing, visual interpretation of the 190 SPOT scenes was carried out in Sweden at the SSC offices in Kiruna and Stockholm (Solna). This work was facilitated by the fact that three of the DENR foresters who had participated in the ground truthing each worked for a month at the two offices.

The interpretation work on 1:100 000 scale was reduced photographically to a scale of 1:250 000, mosaicked to map sheets and scanned to digital maps for area calculation. The final maps were plotted as transparent Interpretation Overlays and Land Cover Maps on copy paper, both corresponding in coverage to the Satellite Image Maps.

Digital multispectral classification was carried out of three selected SPOT scenes. The object of this classification was to compare this technology with visual interpretation. The work included selection and study of training areas during the ground truthing, statistics calculation, and analysis and evaluation of the classification accuracy.

Products delivered

Seven main products were delivered by SSC to the World Bank. Figure 1 shows one of the 43 Land Cover Maps made on a scale of 1:250 000 that covered the project area. They correspond exactly to the coverage of the existing topographic map series of the Philippines drawn to this scale.

Another product was transparent Interpretation Overlays on the same 1:250 000 scale, giving exactly the same information as the Land Cover Maps but with symbols instead of rasters. These overlays can be superimposed on the Satellite Image Maps and on the existing topographic maps for comparison.

Although the interpretation was performed on a scale of 1:100 000, the SPOT scenes were, as a complementary product, mosaicked together and presented according to the national 1:250 000 map system as satellite image maps.

A fourth project product was a list for each of the 73 provinces of the country, in which the areas of all land cover classes were given, calculated automatically from the digital maps. These classes, 22 in all, appear in the legend at the bottom of the Land Cover Maps and the Interpretation Overlays, but due to the high scale reduction, the legend is not shown on page 9. In short, the 22 classes were made up of 5 forest classes including mangrove, 7 intensive land use (agricultural) classes including fish ponds, 3 extensive land use classes including brushland, grassland and shifting cultivation, and 7 non-vegetated land classes. Two classes of marine areas were also interpreted, namely coral reefs and silted waters.

A fifth product was digital classification of three selected SPOT scenes.

A report was also produced describing briefly the execution and results of the project. It focuses on an account of the land cover classification legend and the interpretation performed by the use of this legend. It also describes the digital classification.

Finally, SSC prepared a colour map of the Philippines on a scale of 1:2 000 000. The map shows the results of the project in a condensed form, with more generalized classes than those on the Land Cover Maps and Interpretation Overlays, and summarizes the areas of these classes per region of the Philippines.

Conclusions

Twelve months seemed a short period for the execution of the project - and indeed it was. Nevertheless, it was possible to

complete the project on time, thanks mainly to the professionalism and enthusiasm of the project team. One decisive advantage was SSC's coverage of all phases of the project within its own organization, from the reception of satellite data at Esrange to the production of maps, area statistics and report. Flexibility became a key element of the work. As an example, the last SPOT scenes were received at Esrange only a few weeks prior to the delivery of the project.

The successful completion was not only a result of the efforts made within SSC. There were many contributors who tailored their support so that SSC could concentrate full attention on production. The World Bank and Swedish Projects Incorporated in Washington assisted SSC in formulating the project from the very start to make possible a successful execution in the short time available. SPOT IMAGE programmed and re-programmed the SPOT satellite regularly with the highest priority on the Philippines so that images were received only a couple of weeks after request. DENR provided invaluable cooperation, and the World Bank and BITS streamlined administration matters. The Swedish National Land Survey Map Developing Group contributed intensively with their scanning equipment and personnel housed under the same roof as SATIMAGE in Kiruna, and the Swedish embassy in Manila provided liaison with DENR throughout the project.

The project proved that SPOT multispectral XS diapositive images on a scale of 1:100 000 are suitable and detailed enough for visual interpretation. It also proved that such interpretation is a fast means of mapping large areas. The work can be done by interpreters familiar with aerial photos without necessarily having specialist knowledge of digital classification and computer technology due to the similar radiometric properties of SPOT multispectral images and infrared aerial photographs.

Demonstrations of the project have indicated clearly that Satellite Image Maps, Land Cover Maps and area statistics similar to those produced for the Philippines project are attractive products on the market. This applies especially to the initial coverage of large areas such as countries and/or regions, particularly in connection with forestry and agricultural studies. The products can, due to the effective production organisation at the Swedish Space Corporation, be acquired rapidly at a low cost, in the current case they cost only 8 US Dollars per square kilometre. In many cases they can also be combined with or preceded by the production of topographic maps from SPOT stereo pairs, another speciality of the Swedish Space Corporation.

References

Rasch H. et al. 1987. Mapping of the Natural Conditions of the Philippines. Final Report. Stockholm