Geographic Information System

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Abstract

The Geographic Information System (GIS) has considerably enhanced the interpretation and manipulation of mapping data by the Forestry Commission. Land managers now have much easier access to all types of map data using the relatively simple method of interrogation of the main database.

Introduction

The term Geographic Information System can be used to describe any set of land-based information. Increasingly, however, it is used to refer to electronically stored (digitised) maps which can be manipulated by using computers to generate information for land use planning, thus saving time and costs compared to traditional methods.

The ability to overlay a variety of mapping elements - forest type, geology, climate, land use, ownership and so on - and quickly replace one set of criteria with others is of enormous advantage when planning future forest use.

The Forestry Commission's System

The Forestry Commission is using the ARC/INFO Geographic Information System (GIS) to automate, manipulate, analyse and display geographic data in digital form. The functions performed by ARC/INFO fall into four main categories:

- **Input:** the purpose of the input operation is to take data, whether electronic or visual, and convert it into a form usable by ARC/INFO - for example, digitising forest-type maps.

- **Analysis:** including such functions as topological overlay, buffer creation, ad-hoc query, and modelling. Analysis operations examine the data with the intent to extract or create new data that fulfil a required condition or answer a specific question.

- **Data management:** involves the handling of large sets of digital geographic data. Management operations oversee the storage and retrieval of this data.

- **Display and conversion:** includes all operations that produce graphic output, such as maps and colour displays, as well as formatted reports of tabular information.

The system runs on the Commission's Prime minicomputer with a main memory of eight megabytes and over 1500 megabytes of disk storage.

Examples of GIS use in a Forestry Environment

As an example of the flexibility of a GIS, imagine this situation: senior management wants to locate the amount of Crown Land on basalt soils within 50 km of Devonport. When the required map is completed, management

decides on additional criteria - private property on limestone soils within 30 km of Devonport. By traditional methods, the original question would have been answered by layering the two or three relevant maps on top of each other together with a piece of tracing paper, and then colouring in the map areas that met all the criteria. The new demand would have delayed results for days while cartographers repeated the same time-consuming exercise.

GIS can already produce detailed maps capable of answering complex questions crucial to research and planning decisions. Its power lies in its ability to manipulate huge amounts of data.

Some further examples:

- Rainforest and landsystems are overlaid to produce maps of rainforest site quality based on geology, altitude and rainfall
- Using 1:25 000 forest type maps to produce 1:100 000 maps of remnant rainforest patches in eastern Tasmania
- Overlay dry sclerophyll maps with landsystems and with land tenure to identify sites for dry sclerophyll reserve proposals
- Overlay slope maps with geology to produce erosion class maps

Similarly, reports produced by the computer can summarise the land on each map according to forest type, land ownership and so on. The computer can also integrate additional map information already published at any scale, such as local government boundaries, land ownership, general vegetation and soil types and fertility, providing extra depth to forest planning maps in the form of overlays.

Information now on the GIS

In employing the power of GIS the Commission concentrated initially on digitising small-scale (e.g. 1:500 000) maps of the whole of Tasmania to provide base-level information such as land tenure, National Estate, vegetation, forest districts and sales concessions, valuable for State-wide information concerning forest resources and management. In addition, work is underway on the geology of the State, at this scale. Currently, map information is being digitised at a scale of 1:25 000, for detailed forest type, land ownership and slope-class mapping.

This work involves a vast accumulation of data related to forests, including land area, eucalypt and other tree species; tree heights and densities; and is based on the Commission's more traditional forest mapping techniques.

Work is now complete for 80 map sheets covering forests in north and north-eastern Tasmania and 30 map sheets for the south-east portion of the State. In addition, 30 sheets in the north-west are well underway as well as some 20 sheets in the Central Highlands. In total, data concerning more than half of the State's Crown forests have been entered into the GIS system, available for rapid manipulation when needed on the Commission's computer - an achievement unprecedented in Australia.

In addition to native forest type maps at a scale of 1:100 000, plantation maps are also being put into the GIS. The GIS will mean that the old Plantation Area System, which required a cumbersome system of data collection and coding, can be replaced by a streamlined system of thematic maps of such things as species, thinning, pruning and so on. Information can then be retrieved in a flexible way merely by overlaying the required maps and quickly answer questions such as 'how much pruned *Pinus radiata* is there which is greater than 30 years old in Nicholas plantation?' So far, maps from

Springfield, Nicholas and Oldina plantations have been added to the GIS.

Applications of the GIS are numerous. Two other examples are the current studies of wet eucalypt and dry sclerophyll forest conservation. These studies have used the GIS to overlay maps of forest types, land systems, nature conservation regions and land tenure to indicate the regional conservation status of each forest type according to geology and altitude classes.

Future Uses

In the future, many applications may be run using on-screen menus, custom designed with ARC/INFO fully functional programming language, ARC MACRO. When menu choices appear on the screen, wanted options can be selected by pointing the screen cursor at the option - ARC/INFO will perform the chosen function.

Another potential use is ARC/INFO's complementary software module, TIN - Triangulated Irregular Network. TIN is a set of programmes used to store, manage and analyse three dimensional surfaces for ARC/INFO. It provides data conversion, modelling and display capabilities for terrain and other types of surfaces. Modelling capabilities include calculation of slope, aspect, seen area from any point, volume, surface length, profiling and determination of stream networks and ridge lines.

By linking with statistical packages such as GLIM the GIS will be used to predict the occurrence of such things as rare species, forest communities and even archaeological sites from environmental attributes obtained from digitised maps of climate, vegetation and geology.

Automation of land records by other State agencies, using data bases capable of integration with the GIS, is planned by the State Land Information Committee.

This will allow ready access to all kinds of land information of value to a wide range of interests, eliminating the need for separate records.

In the meantime, increasing demands for greater planning accuracy are making the GIS an essential tool for the sound management of Tasmania's forests.

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