

The Land Monitor Project

A multi-agency project of the Western Australian Salinity Action Plan supported by the Natural Heritage Trust.

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ABSTRACT

Land Monitor is a multi-agency project of the Western Australian Salinity Action Plan supported by the Natural Heritage Trust. It will provide land managers and administrators with baseline salinity and vegetation data for monitoring changes over time, and land height data from which contours accurate to two metre intervals can be produced. The Project will also provide estimates of areas at risk from secondary or future salinisation. Land Monitor will cover the 18 million hectares of agricultural area of south-west, Western Australia.

Sequences of calibrated Landsat Thematic Mapper satellite images integrated with landform information derived from height data, ground truthing and other existing mapped data sets are used as the basis for monitoring changes in salinity and woody vegetation. Heights are derived on a 10m grid from stereo aerial photography flown at 1:40,000 scale, using soft-copy automatic terrain extraction (image correlation) techniques.

Proposed Land Monitor products include salinity maps, predicted salinity maps, enhanced imagery, vegetation status maps and spectral / temporal statistics. These products will be available in a range of formats and scales, from paddock, farm to catchment and shire scales to suit customer needs.

INTRODUCTION

Land salinisation, salinisation of inland waters and maintaining biodiversity have been identified as the three highest priority environmental issues in Western Australia (Western Australian State of Environment Report, 1998). However, government agencies and landholders have grossly underestimated the extent of salt-affected land in the agricultural areas of Western Australia (Ferdowsian et al, 1996). The effect of salinity on the extent and condition of native vegetation in the south-west has not been accurately assessed. In late 1996, the WA Salinity Action Plan was released stating that over 70% of Australia's dryland salinity could be found in WA. About 1.8 million ha in WA are already salt-affected, and this area could double in the next 15 to 25 years and then double again before reaching equilibrium.

The Land Monitor project is a three-year (1998, 1999 and 2000) collaborative project which aims to provide information to land managers on the area of salt-affected land and perennial vegetation cover, and their change over time. The project partners include Agriculture W.A., Department of Land Administration, CSIRO, Water and Rivers Commission, Department of Environmental Protection, Department of Conservation and Land Management, and Main Roads W.A.

This paper outlines the project backgrounds, aims, outputs and deliverables, and provides some experiences gained from the completion of the first year.

Background

The Land Monitor project is a multi-agency project following on from collaborative research work between CSIRO Mathematical and Information Sciences (CMIS), Department of Land Administration (DOLA) and Agriculture Western Australia (AgWA), under the National Dryland Salinity Program, supported by LWRRDC. This research has shown that Landsat satellite imagery can be used as the base dataset to map salt-affected land, monitor changes in the area of salt-affected land, predict areas at risk of developing salinity, and map and monitor the extent and change in perennial vegetation cover (see Furby et al, (1995), Evans et al, (1994), Wallace and Furby (1994)).

Salt-affected areas can be mapped by integrating and processing multi-date winter / spring Landsat Thematic Mapper (TM) images, with quality ground data on saline areas and height data from Digital Elevation Models (DEMs). Salinity classes are mapped according to the ground data supplied by experts in the field. In any one year, some of these areas will be confused with areas of low productivity. To overcome this, three consecutive years of imagery are used, and the resulting probability of salt-affected land is combined with position in the landscape to further refine the salinity estimates. Salinity is inferred from areas that are consistently mapped as saline, low-producing land in the context of what is known about the landscape from both DEMs and ground truthing. By using a sequence of image dates, change in salt-affected areas over time can be determined and land at risk of developing salinity in the next two or three decades can also be predicted.

Multi-date imagery provides the most practical and inexpensive method of defining past trends in broad-scale salinity. Land Monitor will show for the first time the broad-scale extent of salinity in Western Australia and give an indication of how it is spreading. The map outputs will help raise awareness about the extent of the problem and encourage the commitment necessary to fight it.

For mapping and detecting trends in the extent and status of remnant native vegetation and, revegetated areas, multi-date summer Landsat TM data in conjunction with ground observations and existing datasets, has proven to be an accurate, efficient, and cost-effective process and has been recognised federally in mapping projects such as the National Agricultural Land Cover Change project (see Barson et al, (1996) and Danaher et al, (1996)).

Production of the high resolution DEMs involved the acquisition of new aerial photography (1:40000 scale) for extensive areas. Heights are derived on a 10m grid from stereo aerial photography flown at 1:40,000 scale, using soft-copy automatic terrain extraction (image correlation) techniques. The DEM production is managed by DOLA through contracts to the private sector.

Project Aims

For the three years of the project, Land Monitor will produce information products for land management covering the south-west of Western Australia. The project aims to:

- Produce highly accurate Digital Elevation Models (DEMs) (from which contours down to 2 metre intervals can be produced);

- Map and monitor changes in the area of salt affected land from 1988;
- Predict areas at risk of future salinisation;
- Monitor changes in the forest and perennial / woody vegetation, and areas of revegetation from 1988;
- Distribute the information to the end-users and the community; and
- Establish a baseline for on-going monitoring.

LAND MONITOR PRODUCTS AND DISTRIBUTION

Sixteen Landsat TM scenes cover the agricultural area. The salinity monitoring deliverables are based on 5 to 6 scenes per year, for each of the three years. For an up-to-date indication of project progress, visit the Land Monitor web site at www.landmonitor.wa.gov.au.

Land Monitor Products

Digital Elevation Models (DEM)

Accurate, high resolution DEMs have previously only been available for a small proportion of the south-west of Western Australia. Through the Land Monitor project, high-quality DEMs will be produced, using automated techniques, on a 10 metre grid, for the south-west of Western Australia's agricultural area. From these DEMs, contours can be produced to an interval down to 2 metres.

Calibrated Landsat Thematic Mapper (TM) Images

Landsat TM images are firstly rectified to a base map grid and then radiometrically calibrated to like values using invariant targets to remove seasonal and atmospheric effects and sensor degradation. Calibrated Landsat TM data provides the base source of data for salt and vegetation mapping.

Salinity maps and salinity prediction maps

Maps of changes in the area of salt-affected land from approximately 1988 will be produced. By integrating calibrated winter / spring Landsat imagery with landform information derived from height data (DEMs), ground truthing and other existing mapped datasets, areas of salinity are monitored and areas at risk from future salinisation can be predicted.

Maps of perennial / woody vegetation cover and trends through time

Satellite imagery integrated with field data are analysed and processed to produce maps showing the current extent and status of woody / perennial vegetation cover, and how it has changed over time. Over a 10 year period, trends indicating stability, decline and increase are mapped, using indices / band combinations and thresholding techniques. Areas of increase in cover can be attributed to plantations, regeneration and recovery from fire while areas of decrease in cover can be due to bush fires, disease or clearing.
activity

Maps indicating vegetation history

Multi-date satellite imagery can be processed and enhanced using appropriate spectral bands, to produce maps indicating the extent of vegetation cover and its history over three image acquisition dates. No field validation has been undertaken for this product; however, visual interpretation has proven useful for indicating areas of relatively stable cover over the given time period, and areas that have undergone some change in vegetation status, such as variations in rates of increase and decrease in vegetation cover due to plantations, regeneration from fire, and clearing for agricultural purposes and from fire.

Summer Landsat TM data acquired from 1988, 1990, 1992, 1994, 1996, and 1998 are being prepared for vegetation mapping purposes.

Spectral and temporal statistics

Summary statistics from time series and trend analysis will be made available.

Customised Products

By integrating the above-mentioned base datasets from the Land Monitor project with a variety of other datasets available through WALIS agencies, a series of customised products can be produced to suit individual needs. Some examples include; contours down to 2 metre intervals generated from the DEMs, orthophotos, satellite imagery merged with orthophotos, satellite imagery or orthophotos with contours, and satellite image maps integrated with various vector datasets.

Distribution of Data and Products

Products from Land Monitor will be made widely available to landcare groups, land managers, participating agencies and the WALIS community. They can be provided in either analog / printed or digital form.

Printed products can be produced at a scale to suit individual needs, from paddock, farm, catchment, shire or regional scales. Landsat TM data can be printed as large as 1:50000 scale and at any customised smaller scale and integrated with various datasets from other agencies.

Digital products can be packaged in an 'easy-to-use' CD ROM product with free image viewing software which allows integration with other geocoded datasets, in various data formats such as BIL, ER Mapper, Arc View and TIF.

Where feasible, Land Monitor products will be down-loadable from the Land Monitor Internet site at **Error! Bookmark not defined.** . Please visit the Internet site for examples of products, progress maps, and a list of currently available standard datasets.

CONCLUSION

The Land Monitor project will provide the state with a series of base datasets and a range of information products for the agricultural area of south-west Western Australia. These datasets and products will be used at a range of scales and for many purposes. It is expected that these datasets will form a basis for on-going monitoring programs.

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