1997

Defusing the salt time bomb

David Berry
The plan marshals the joint resources of Agriculture Western Australia, Department of "It will be a long and costly war, but it must be fought. And it has to be won." Three billion dollars needs to be spent over the next 30 years, and 3 million hectares of appropriate trees and shrubs will have to be planted, to make a "significant" impact on the problem, the Government says.

Full recognition of the magnitude of the problem came last November when the State Government launched its Salinity Action Plan, which acknowledges salinity as "Western Australia's biggest and most dangerous environmental problem".

It is estimated the capital value of the land lost so far, including the cost of lost production opportunities, is in the order of $1445 million.

Nor can we claim that warnings were never given of the risk of the bomb going off. In 1917, J. W. Paterson, Professor of Agriculture at the University of Western Australia, presented soil samples and a report to the Royal Commission on Mallee Belt and Esperance Lands. Paterson claimed that probably one third of the area considered for development was too saline for profitable farming. The response he got was: "... the Commission having given the question close consideration, strongly urges that scientific prejudice against our mallee lands be not permitted to stand in the way of their being opened up for agricultural purposes".

Uncleared valley now totally affected by salt

David Berry spoke with some of the key research personnel in the program and he reviews the strategies and the research which will give us total water use.

That there was a salt time bomb ticking away beneath Western Australia's agricultural land should not have surprised us.

In 1864, Henry Lefroy, Superintendent of Convicts on a farm east of York, commented: "To the very important question of good water, it being evident that flocks must depend on well water, I record my opinion that subsoils must contain the salts bought into them annually for countless ages, as salts must be left in the soil by evaporation".

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And so the clearing continued. Today about 18 million hectares of Western Australia has been cleared for agriculture, 1.8 million hectares is salt affected. By the years 2010/20, the area of salt affected land is forecast to rise to 17 per cent, and could go as high as 32 per cent (6 million hectares) before a new salt balance is reached.
He says an important point is that crop yield is not necessarily a good gauge of water use. "The length of the variety's growing period is a far


### Annual cropping

Steve Trevenen is Agriculture Western Australia's Cereal Products Program Manager and is encouraging wheatbelt farmers to start factoring total water use into their cropping rotations and variety selections.

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**Table 1. A comparison of water use in native vegetation and cleared agricultural land.**

<table>
<thead>
<tr>
<th></th>
<th>Native vegetation</th>
<th>Cleared agricultural land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>370 mm</td>
<td>370 mm</td>
</tr>
<tr>
<td>Run-off</td>
<td>0 mm</td>
<td>18 mm</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>359 mm</td>
<td>319 mm</td>
</tr>
<tr>
<td>(soil surface evaporation and leaf surface evaporation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interception loss</td>
<td>11 mm</td>
<td>7 mm</td>
</tr>
<tr>
<td>(from wet leaves)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rainfall to groundwater</td>
<td>0 mm</td>
<td>26 mm</td>
</tr>
</tbody>
</table>

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Evapotranspiration

Evapotranspiration is researchers' jargon for the total of evaporation from the soil surface, plus the water used and transpired from the plants and trees.

Water use is highest from trees, and diminishes through perennial pastures, to annual crops and annual pastures, which use the least water.

Evapotranspiration of agricultural crops is commonly in the range of 250 to 500 millimetres a year, that is, less than 50 per cent of annual rainfall.

The principal thrust of the Salinity Action Plan is to increase evapotranspiration in order to contain the recharge of the watertable. The Plan's strategies include using annual and perennial plants (including trees), and engineering systems such as drainage and the collection and recycling of surface water.

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Hillside seep behind a dolerite dyke. (running across the picture)
An indication of the shortage of perennial vegetation, State-wide, is gained by looking at the Esperance and Ravensthorpe Shires, where 1.6 million hectares of the total 2.4 million hectares have been cleared. Less than 2 million hectares more water than lupin and barley varieties.

Variations exist between varieties, whether canola or barley, mostly related to the length of the growing period and green leaf area. Franklin barley, for example, a longer season variety, increased water depletion in trials at Dalyup by as much as 20 millimetres compared with Stirling barley.

When asked for a State-wide view, David replies: “There is no evidence that annual crops or pastures, no matter how well they are managed, can by themselves reduce the rate at which watertables are rising. We need an integrated system of high water use perennials to compensate for the annuals.”

Which crops?

David Hall, Research Officer – Plant Soil and Water Relationships at Agriculture Western Australia’s Esperance office, is researching the water uptake of various crop species and the relationships of crops to trees. The work is funded by the Federal Grains Research Development Corporation.

He says the biggest challenge is finding rotations “robust” enough to keep the watertable below the root zone, not just for the crop years, but for the whole rotation.

“The main culprit is the annual pastures – they take time to develop which gives the watertable time to rise.”

David says the criteria they’re looking for with pastures is high leaf area, a deep root system and a long growing period, and perennials offer all three.

He says farmers are very interested in production and land care, but “…the marriage of the two is not yet complete with all farmers”. A big problem is that short-term finances are worrying farmers at the moment, which reflects low wool and cattle prices and lingering uncertainty that good grain prices will hold.

Crop cultivars

Of all the conventional crops, none has a higher water use than canola. At Esperance, for example, canola cultivars used 13 to 33 millimetres more water than lupin and barley varieties.

Salinisation of the broad valley flats in the wheatbelt has killed Salmon Gum (Eucalyptus salmonophloia) woodlands which are not regenerating.

better gauge – the longer it grows the more water it uses.”

Steve urges farmers not to make hasty judgements when selecting rotations. “For example, a lupin:wheat:canola rotation might look a poorer prospect than a more traditional wheat:pasture rotation. But because of canola’s high water use, perhaps only 10 per cent of the farm will need planting trees, instead of, say, 15 per cent for the wheat:pasture option. In the long-term, an extra 5 per cent of the property would be released for cropping!”

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per cent of the farmland is sown to perennial pasture or commercial timber.

**Perennial pastures**
Lucerne is experiencing something of a revival because of its capacity for mopping up watertables. At Gairdner, transpiration from lucerne exceeded rainfall by 50 millimetres per year. It was head and shoulders above wheat in water use, attributed largely to its drying of the soil profile during the summer months.

Kikuyu also performs well. On deep sands at Gibson, kikuyu reduced water storage by between 50 and 100 millimetres, when compared with neighbouring annual pastures.

**Fodder shrubs – tagasaste**
Another crop enlisted by the Salinity Action Plan is the high protein legume, tagasaste.

In the West Midlands, the home of deep sand agriculture, tagasaste is successfully mimicking the water use of native vegetation. According to Tim Wiley from Agriculture Western Australia's Jurien Bay office, "it has been proven to lower watertables significantly and reduce salinity".

The Salinity Action Plan has set a short-term target of half a million hectares of tagasaste, of which up to 100,000 hectares is planted already as plantations, mostly in the West Midlands. There is potential for as much again using "alley farming", primarily as a commercial treatment for wind erosion, with seven metre-wide rows planted 50 to 60 metres apart, Tim says.

"On poor sand-based annual pastures, where subterranean clovers battled to grow, tagasaste is providing a five-fold increase in carrying capacity – from 1 to 2 DSE (dry sheep equivalents) up to 10 DSE.

Back in the days when it was known as "tree lucerne", tagasaste's use was thought to be limited to drought fodder – for mechanically pruning once a year to keep stock alive. "We've since discovered it can be very successfully set-stocked with cattle," Tim says.

**Trees**
South-west reforestation trials have shown that a range of eucalypts and pines can lower the watertable by 7 metres and reduce groundwater salinity by 11 per cent. In the same study area the watertable rose by 2 metres in areas established to pasture. Little wonder trees get a lot of attention in the Action Plan!

**Eucalypts**
Eucalypts are well adapted to the Western Australian environment. After all, they maintained the State's water balance for tens of thousands of years before clearing.

At most sites where tree water-use has been measured, eucalypts showed themselves capable of using at least as much as the annual rainfall.

**Oil mallee**
CALM is spearheading oil mallee's development as a commercial crop, the success of which hinges on the 'eucoil' which flows from it.
John Bartle, from CALM's Farm Forestry Unit, has been studying tree water use patterns since the early 1980s when he was involved in studies of the impacts of bauxite mining and salinity in water supply catchments.

"By the late 1980s the hunt was on to find species which would make a quid, and which were relevant to landcare and salinity. It had to be a tree with vast markets - the State Salinity Action Plan alone is looking to plant three million hectares of trees!"

Murdoch University had researched oil since the oil crises of the late 1970s when eucoil was contemplated as a fuel additive. CALM picked up that work in 1992.

John says the future for eucoil is not as "...a treatment for coughs and colds and stuffy noses..." - the traditional liniment, lozenge and aroma markets, but as an industrial solvent in cleaners and de-greasers for which the eucoil's cineol component is well suited.

Major changes are afoot in these markets. The once popular chlorinated hydrocarbon-based solvents have fallen from favour because they are ozone depleting. The world solvent market will pay a premium for products with good "green" credentials, John says.

The oil mallee is "...suitable for everywhere" but with an eye to providing a critical volume that is essential for the viability of harvesting and extraction programs, CALM has targeted six areas - north of Morawa, Kalannie, Narembeen, Wickepin, Woodanilling, and Esperance.

So far, six million seedlings have been planted across five thousand hectares and support amongst farmers is very strong. An Oil Mallee Association with 360 members has been formed.

**Salt hazard and vegetation change mapping**

To understand priorities within catchments and between catchments, and to provide very practical assistance to farmers on the ground, the Salinity Action Plan has reached for the heavens.

Using the technology of Landsat TM satellites, systems are being developed to predict where salinity problems are likely to occur in the future and to document where they are today.

By plotting satellite data going back to 1987 against today's images, the rate at which salinity is spreading is calculated. Along with other data, such as contour maps and known hydrology of catchments, accurate models of what the future holds can also be created.

The Kent catchment on the South Coast was used for developing the Salt Hazard Mapping system, a joint effort by CSIRO Division of Mathematics and Information Science, and Agriculture Western Australia.

Sustainable Rural Development Manager for the South Coast, Don McFarlane, says the technique has already been applied with good effect to about 150,000 hectares in and around the Kent catchment and on-going development work is planned.

A proposal has been lodged with the Federal Government for the system to be developed as a tool for the whole of the south-west, from Geraldton to Esperance. If accepted, contour, salt and vegetation maps will be available to the whole of the south-west three years after the money comes through. Using existing resources, it will take over 10 years.

**Setting priorities - Focus and Recovery Catchments**

With more than 300 catchment groups operating in Western Australia, priorities have been set to make sure that support...
services are not spread too thinly. Ultimately all catchments will be addressed under the Salinity Action Plan but initial assistance is being provided through Focus Catchments and Recovery Catchments.

Agriculture Western Australia will support up to 30 initial Focus Catchments, identified by an assessment of the benefits and costs of achieving salinity control, and through a negotiated cost-sharing system. The selected catchments have sub-catchment groups which have completed the planning processes and are committed to implementation.

Recovery Catchments are those where public assets, such as water resources, natural diversity, towns and roads, are at risk from salinity. Where protecting such assets is recognised as a priority, the Government, in consultation with local communities, will develop recovery plans to protect all of the assets in perpetuity.

**Regional water use targets**

Broad water use targets have been set for various rainfall zones giving farmers a fair idea of what is expected for their area.

For example, in the central and eastern wheatbelt, a 20 millimetre increase in on-farm water use is considered reasonable. The Action Plan suggests this could be achieved, in part, by targeting 15 per cent of total farm area for perennial vegetation - either pasture or trees, possibly commercial tree plantings of oil mallees.

**Water balance calculator**

Nick-named 'WA'ttle' - what'll happen if ..., this computer software package is being developed by Agriculture Western Australia's Richard George, in conjunction with the University of Melbourne. It will provide water balance calculations for individual farms and is expected to be available on disk by September 1997.

Richard says the calculator has been programmed with a
Salt-affected area in a 20×9 km part of the Moora District mapped using Landsat TM images from 1992 and 1993, and landforms. Upper images show saline areas as having little vegetation cover (blue) or lower image showing saline areas (orange). Salt-affected area was 18.9% in 1987 and 21.6% in 1993.

For further information contact Don McFarlane, Albany, (08) 9892 9406 or Richard George, Bunbury, (08) 9780 6296.