Salt of the Earth

A different perspective on the salinity problem

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High soil salt content was common in Australia before the introduction of European-style agriculture. Salt has long been prominent in Lake Eyre and other such internal drainage basins, but saline lakes were also common throughout northwest Victoria. Large areas of southwestern NSW supported saltbush, which is characteristically associated with saline soils.

The current concern is that changes in hydrology associated with agriculture will redistribute the salt so as to significantly damage agriculture and biodiversity. In consequence, research on salinity became a national priority in the mid-1970s.

Despite over 25 years of priority public research, the risk from salinity is said to be rapidly increasing. Vast areas have been identified as potentially being laid waste by salinity. Workers in the field tell us that salinity will halve agricultural production by reducing productivity and arable area. Some organisations claim that many billions of dollars are required to provide a solution.

Two difficulties arise with this situation. Firstly, while more than 25 years of public research has evidently been ineffective, the solution is said to require more of the same. Secondly, both agricultural productivity and the total area under cultivation have been consistently increasing; losses due to salinity are barely discernable against the gains. Salinity has caused localised damage, but the widespread devastation predicted has not occurred.

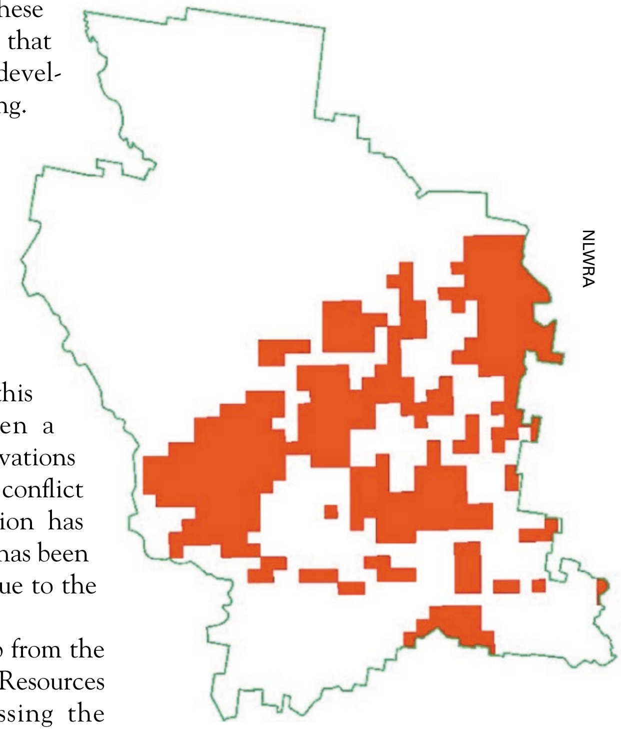
It is easy to conclude that these circumstances are interrelated, that doomsday scenarios are being developed to increase research funding.

One characteristic of this research has been the use of models to demonstrate salinity risk. Forward projections have been made using these models, all of them based on uncertain assumptions as to how salinity arises and propagates.

An ironic consequence of this focus on modelling has been a tendency to dismiss direct observations and measurements where they conflict with the model outputs. Fiction has replaced observation, and GIS has been prominent in this deception, due to the spatial nature of the issues.

Part of the salinity risk map from the 2000 National Land and Water Resources Audit (NLWRA), encompassing the Cootamundra Shire in central NSW, illustrates this situation.

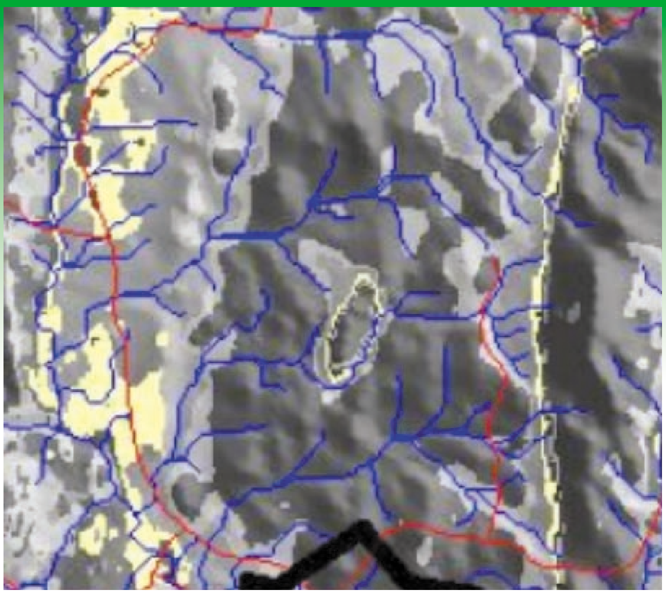
The rationale for this map, with salinity starkly represented as red in Figure 1, is difficult to determine, but dryland salinity risk is shown as occurring in the Murrumbidgee catchment in the south but not the Lachlan catchment to



NLWRA

Figure 1: Areas identified by NSW Water and Conservation as being at risk of salt infestation

Figure 3: Part of the Murrumbidgee catchment. It shows three separate expressions of salinity within a 10 km radius. A circular feature in the centre exists around the base of a hill, where lateral seepage comes to the surface at the boundary between erosional and depositional soils. On the left, salt is associated with a surface drainage system (streams in blue) due to near-surface lateral drainage.



the north. Note that within the Murrumbidgee catchment, the mapped salinity risk is unrelated to either topography or geology.

A clue to the nature of these results can be found on a website belonging to the NSW Department of Land and Water Conservation. It appears that the DLWC point observations of high salinity or groundwater levels have been assigned a nominal area defined by a pixel size, and risk has been mapped by assuming that the size of the saline area will continue to expand over time.

This approach is the most superficial and trivial imaginable; all the catchment area will become subject to salinity if the assessment period is extended. It assumes that salinity continues to expand regardless of controlling factors, and that salinity is confined by catchment boundaries independently of geology.

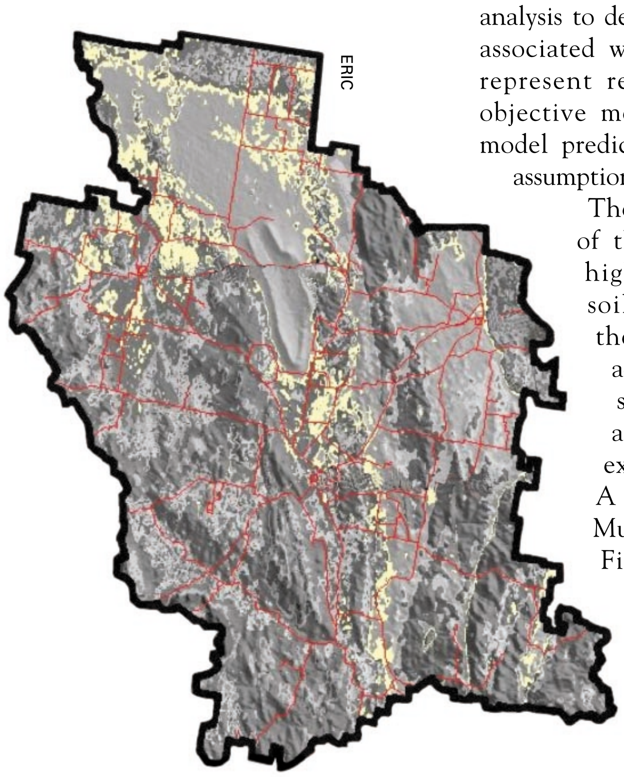


Figure 2: Areas identified by ERIC as being at risk of salt infestation, using a different methodology

A more realistic assessment of the salinity risk in the Cootamundra Shire is provided by results we obtained in a consultancy for the Cootamundra Development Corporation. This study was undertaken to identify areas suitable for intensive agriculture and so focused on sustainable development rather than salinity. Our SoilMap methodology was used to provide high-resolution mapping of soil properties, and this then produced regional salinity hazard and risk maps at a level of resolution and detail not achievable by other means.

The results are based on mapping spatial patterns of soils using airborne measurements of gamma radiation (radiometrics) and field sampling and soil analysis to determine the soil properties associated with those patterns. They represent reality, as determined by objective measurements, rather than model predictions based on uncertain assumptions.

The ERIC salinity risk map of the same area (Figure 2) highlights areas of highest soil salinity, as these have the greatest potential for adverse change. There is no similarity between the ERIC and NLWRA maps; closer examination identifies why. A zoom in on part of the Murrumbidgee catchment in Figure 3 identifies three forms of expression of salinity within a 10 km radius. Attempts to explain these occurrences of saline soils through rising groundwater run contrary to scientific method.

At the right of the image, the most striking salinity

Fiction has replaced observation, and GIS has been prominent in this deception ...

pattern is the linear features associated with geological faults and fractures that act as preferred pathways for the accumulation and transport of water and salt. These conduits or pathways need bear no relationship to surface drainage (catchments or topography). Some saline areas in the shire occur on ridgelines where salt drains across the boundaries of major catchments.

In the Lachlan catchment in the northern part of the shire these linear features drain onto plains, and while the features can be mapped across the plains, the loss of gradient results in salt spreading across parts of the plains. None of the expressions of dryland salinity is related to groundwater rising locally.

The applicability of the ERIC salinity mapping methodology is illustrated in Figure 4, which identifies the reason for damage to a section of main road. The road is located on a pathway for salt and water. While the regular need for repairs was plainly visible to shire engineers, the reason for the damage was not.

The council repaired this section of road for many years on a regular basis, without ever being able to accept that runoff or recharge from the surrounding hills could have produced the volumes of water travelling along the straight. Many theories were considered to try and explain the problem.

These included such things as blaming

the railway for damming the flows, blaming the farmers for clearing the land, blaming the settlers for placing the road in the valley ... in short, blaming anyone or anything. It was a pointless exercise. The problem is caused by an essentially natural process of salt movement.

Issues that arise from the above situation include accountability; results have been produced – using public funds – that have no basis in fact or logic. The results are said to be scientific, but the methods used to produce them run contrary to scientific method.

This raises an issue of liability. The results in the NLWRA have the potential to further waste public funds and to

Figure 4: Salt crossing a roadway in Cootamundra shire

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Care of the Catchment

Natural resource plans in the Goulburn Broken

Renee McPhee

The Goulburn Broken Dryland is an agricultural region in northern Victoria. The largest town in the region is Shepparton. Catchment and Agricultural Services, a unit of the Victorian Department of Natural Resources and Environment (DNRE) is charged with managing this fragile but valuable environment. GIS was established in 1996 as part of a three-year project to implement a salinity management plan for the area.

Over the past five years there have been significant changes in both the technological aspects of GIS and the overall demand for widespread, user-friendly applications. The development of improved tools has largely been driven by the capture of high-quality natural resource information and the subsequent need for users, often with limited technical ability, to easily access this information for planning at property and sub-catchment scales.

We have recently developed such a tool. Our Natural Resource Planning Tool helps catchment management officers and program leaders with natural resource planning.

The protection of native vegetation provides a prime example of the tool in action. Officers use it to determine where resources are used as they attempt to implement the native vegetation management strategy. This strategy was set by the Goulburn Broken Vegetation Plan Steering Committee in 1999.

The need for such a tool was based on objectives determined by the salinity team. They wanted to match land use with land capability so as to enhance the responsible use of public money. Team members also wanted to improve environmental protection works. Such a tool also had implications for productivity and business planning.

The first step was to determine what natural resource information was necessary. In addition to this, guidelines were set to ensure that the system was user-friendly. The designers based these guidelines on an assessment of the technical skills in the department.

As a result, a set of GIS layers – all at 1:25,000 scale – has been incorporated into the tool. These include land units, contours, geology and rainfall. Water features such as wetlands and lakes are also

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included. Another layer shows cadastral boundaries and roads. Vegetation, such as tree cover and broad vegetation types, is matched by layers that show land degradation – potential recharge or discharge and pest plant and animal locations. Another layer shows rare and threatened flora and fauna locations. There is also a layer of satellite images and aerial photos.

DNRE uses ESRI's ArcView as its primary GIS software. ArcView 3.2 is generically licensed and is available to all employees in DNRE.

Satellites sites with corporate and regional data were set up at each office throughout the catchment. These are maintained by GIS technical officers.

devalue private property. While the map maker may not be responsible for errors – and the user must exercise due caution (see 'Death in a Back Paddock', *GIS User* 50, Feb–Mar 2002) – there is an additional issue in that such publicly funded results can influence legislation, regulation and government control processes.

Land users could be forced into taking management actions that have no rational basis and are unlikely to produce the desired outcomes.

This comparison of mapping results highlights the value of a commercial environment for technology development, innovation and application. The SoilMap results provide a reliable basis for land use planning and management decisions and also improve understanding of the causes and potential risk of adverse salinity.

There are significant advantages in undertaking public research in a commercial environment, where results are automatically tested for applicability and reliability through a process of innovation. The results also illustrate why the Commonwealth government and industry are now seeking to make public research funds more accountable and open to competition by industry.

The processes and issues of dryland salinity are further addressed in a series of papers on the ERIC website (www.eric.com.au). These include the development and application of the SoilMap methodology over the past 10 years.

Papers by Trethewey and Gourlay and others that address salinity myths and scenarios for dryland salinity are on the website.

Dr Brian Tunstall is director of the Environmental Research and Information Consortium Pty Ltd (ERIC).

Users can determine paddock and property boundaries for easy mapping ...

As a result of this, it was found that the easiest way to create the tool was using ArcView's avenue scripts.

Catchment management officers at satellite sites have each been set up with individual projects. A few simple clicks of the customised buttons allows the user to locate works and determine areas and linear measurements easily and accurately. Users can determine paddock and property boundaries for easy mapping and vary the GIS layers of particular properties. They can also add information.

In this way users can obtain a conceptual view of the property in question and adjacent areas and determine eligibility for grant funds, for instance. The tool also helps make the natural resource plan relevant, interesting and usable for a particular landholder by providing detailed information about the natural resources on the property.

Officers have attended workshops and received one-on-one training in how to use the tool. An easy-to-use step-by-step manual has also been created.

Departmental officers visit landholders involved in environmental grant schemes individually to prepare management plans for their property. Before the initial site visit, a professional map-based package is produced for the landholder. During the site visit the landholder and inspecting officer will add other relevant information, which is then entered onto the GIS system using the catchment activities management system. The program of works is then negotiated with the landholder.

The natural resource tool is user-friendly, and this has encouraged more widespread use of the technology. It has created a professional and organised approach to natural resource planning. Management officers are able to provide information to landholders about land management issues on their property and to discuss their eligibility for grants.

The provision of this information to landholders in a way they can understand is an important part of encouraging participation in the management scheme. We hope it will increase the rate of works implementation on individual properties.

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