Inquiry into coordination of the science to combat the nation's salinity problems

Introduction

Salinity management is just one part of an overall land management problem. Attempts to devise and implement *isolated* salinity management solutions, without considering the whole natural resource system (land, water, vegetation, biology) will inevitably fall short of the long term objective of *sustainable* land use.

Environmental Management Systems (EMS) and Whole Farm Planning (WFP) are both examples of a more holistic approach to sustainable land use – and both incorporate *salinity management*, where that is appropriate. However, like present salinity management plans, they also suffer from a lack of understanding of how landscapes function and the inherent variability that exists within each and every part of a landscape.

Although electromagnetic induction (EM) techniques were first introduced as a tool for salinity hazard mapping (Williams and Baker,1980) they have an even more important application in defining the spatial variability that exists in the upper part of the soil profile, or upper regolith, as the case may be. This gets straight to the heart of how land, water and vegetation interact in a landscape – and of course can lead to particular salinity management strategies.

Spatial Variability

Variations in geology, topography and soil types have increasingly been used for farm planning and particular land use systems. However the mapping techniques being used provide only very generalised information. They are largely derived from geological maps, air photographs and a very limited sampling and classification of soil types. e.g. it would be rare for a soil survey to make individual measurements (profile description, soil texture,hydraulic conductivity, physicochemical properties)

at a density of more than 1 site/ 10 ha. EM surveys, on the other hand, commonly sample at a density of 10 sites/ha, an improvement of 100:1.

When such detailed EM surveys are mapped, the spatial variability within the landscape becomes apparent. In the past this variability has simply been treated as 'background noise', but when examined carefully it becomes clear that the variability is an inherent property that should be recognised and treated as an integral property of the landscape. The reasoning behind this interpretation is that the EM reading, which is a measure of the apparent electrical conductivity (ECa), is also a *surrogate* measure of the movement of water up or down a profile. Low ECa values equate to low soluble salt concentration in the soil profile (numerous references) and hence are the equivalent of a situation in which incoming water (rainfall, irrigation) moves freely *down* the soil profile (recharge). A high ECa reading indicates an accumulation of salt in the upper profile as occurs during groundwater discharge.

Armed with this detailed description the landscape can be mapped in terms of the *relative* rate at which water potentially enters, or leaves, the upper soil profile. For salinity control measures the most 'leaky' parts of the landscape are those that should be targetted for long term treatment with perennial vegetation (trees, shrubs, ground cover). Unfortunately, for landholders, these leaky parts of the landscape do not always occur along fencelines. Hence the popular revegetation strategies of fenceline plantations may or may not intersect the leaky parts of a paddock. Although the present fenceline strategies have some commendable components (windbreaks, wildlife corridors, convenience) they do not (and never will) tackle the root problem of excessive groundwater recharge.

This may be a disturbing revelation to landholders who are faced with the challenge of reducing groundwater recharge for salinity control. Although there are a few farmers who, on the basis of soil type mapping, have altered their farm layout, there are no farmers who have altered their farming systems to account for the inherent variability that is present. When one speaks of changing farming systems, as many pedants are prone to do, then the changes will far outstrip the imaginations of even the most ardent and respected savants.

The *physical realities* of a landscape will be:

- uniform soil profiles (either 'leaky' or 'non-leaky');
- scattered 'leaky' areas within a uniformly 'non-leaky' system); or
- extremely variable and 'leaky' system.

The *practical realities* of these landscapes will be whether a farming system can be devised to accommodate these various degrees of spatial variability. This is where the *real* meaning of changing farming systems comes into play.

If such base maps of spatial variability were to be used in Whole Farm Planning or Environmental Management Systems, then I suspect that a whole new appreciation of the term 'sustainable farming' would be gained.

Mapping spatial variability

EM techniques are undoubtedly the fastest and cheapest method for mapping spatial variability. The causes of that EM variability are reasonably limited:

- changes in soil profile structure and texture;
- the soil water content at the time of survey; or
- the presence or absence of a source of soluble salt.

Of these, the total soluble salt present in the profile is the dominant (>75%) contributor to the reading obtained (numerous references) and, by inference, an indicator of the rate at which water moves upwards (discharge) or downwards (recharge) in a soil profile.

Landholders are obviously interested in the near-surface conditions (upper few metres). This can be satisfied by surface based surveys, either foot or motorbike mounted. It cannot yet be satisfied by aerial EM survey techniques – despite the hype that surrounds such surveys. The latter have a very useful product in describing the presence/absence of deep (>15 – 20m) stores of soluble salt but they have yet to provide any real information that a landholder could rationally devise land management options.

Although the thought of aerial surveys is attractive in terms of time and cost of obtaining the desired information they simply cannot compete with accurate surface based surveys. *Undoubtedly this Inquiry will receive submissions extolling the virtues of aerial EM but I will challenge the Parliamentary Committee to set up a face-to-face discussion between those proponents and myself.*

The way forward

Catchment Management Boards are gradually finalising their Catchment Management Plans by aggregating a series of individual 'management plans' aimed at specific targets – 'salinity' being one of the many. They are following the traditional approach of targetting specific 'problems' without appreciating that each of the 'problems' is part of a whole landscape management system. 'Salinity' is intimately connected to cropping/ pasture systems, soil pH, fertility, erosion, vegetation management, biodiversity, and climate. It *cannot* be treated effectively as a separate entity.

If this interdependence of environmental/ cultural factors is to be treated sensibly then one must look at the common denominator i.e. the physical structure on which all of these components are dependant. Although not the perfect common denominator, the spatial variability of electrical conductivity comes the closest of any survey system now available.

It would seem sensible then for Catchment Management Boards to support the 'base mapping' upon which individual landholders could make rational decisions with respect to their own land management practices. Given the many tens of millions of dollars that have been spent in the last two decades on 'modelling' landscape characteristics, to little or no real practical effect, one can only wonder when the emphasis will shift to gathering information that is of real and practical use to landholders in order that they may implement land management systems that have a chance of achieving the environmental results that the community desires.

Such surveys could be promoted under the umbrella of WFP or EMS, whichever is the governmental flavour of the month. Individual landholders want information that

is relevant to *their* land and, more importantly, at an individual paddock level. I believe they would welcome a subsidised mapping arrangement, as compared with regional maps that may or may not be relevant to their particular situation. They have been subjected to a decade or more of generalised solutions to salinity management with only a small proportion gaining any real financial or environmental advantage. If ever there were a way to kill off the impetus of 'landcare' then it is to continue with the adhoc and disaggregated approach that has been used (and appears to be still being used) to managing landscapes for the future.