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Getting Movement on Salt

There is growing understanding amongst landholders and governments that dryland salinity, and the related impacts it has on water quality, infrastructure and farm productivity, is a major challenge that requires significant effort even to arrest its spread, let alone reduce its impact.The Commonwealth and State Governments' $1.4 billion national action plan for salinity and water quality is the first significant and co-ordinated effort to tackle the problem.

There is, however, a significant gap between the contents of the national plan, and translation of that plan into on-ground actions. Especially as most of the change seems likely to be required on privately owned farmland that was fully cleared and developed decades ago, and is land that may never show any impact of salinity.

In any discussion about policies to "solve" dryland salinity in Australia, a good starting point is a close examination of what is and is not known about the problem.

While often confused, irrigation and dryland salinity are not the same. Irrigation induced salinisation of soil is a phenomena that has been recognised for milennia. It occurs when irrigation water is applied to unsuitable areas of land. The result is excess leakage of water into the soil profile, adding to groundwater. If water is added to the groundwater faster than it drains away, the water-table rises closer to the surface, carrying with it accumulated salts. When these salts are carried into the root zone, they begin to have a dramatic impact on plant growth, and hence land productivity.

Dryland salinity has a different cause, but a similar impact. Changing vegetation on the surface (for example from trees to annual pasture) can result in less of the rain that falls on an area being used by plants. Some of this extra water infiltrates underground, and when the rate of leakage into the soil is greater than the drainage out, the water-table progressively rises, carrying salts which are deposited in the surface soils. This is a particular problem in Australia because the landscape is flat and the groundwater drains only very slowly. It is also a problem as the continent has a very stable geological history, which has allowed a progressive build-up of salts deep in the soil profile over millions of years.

The impact of dryland salinity is not confined just to plant growth. The salt also changes soil structure and results in corrosion of buildings and infrastructure, and is also transferred into waterways, making creek and river water more salty and reducing water quality.

The above very generalised description of the problem obviously glosses over some of the finer detail, and it is some of this detail which makes the issue all the more difficult to deal with from a policy perspective.

Dryland salinity will not necessarily occur automatically when trees are removed for agriculture. A range of factors, including soil type, geology, geography, climate and land management practices is critical in determining whether, and how quickly the problem may emerge in a particular area. It may also be the case that while vegetative changes have led to excess water leaking into the groundwater systems, the nature of groundwater aquifers is such that salinity problems will never arise on the area where the leakage is occurring (the recharge area).

Time-scales between cause and effect may be up to 150 years, although on sandy soil, (such as are common in Western Australia) the response timeframe is much quicker.[1] The time-scales of responses to solutions such as the planting of native trees may be much longer, and are commonly estimated in the hundreds of years, especially in lower, flatter areas.[2]

Spatially, the relevant scale to consider changes in groundwater levels appears to be at the catchment level, especially in the Murray-Darling basin. The critical aspects to consider are the leakage or infiltration rates of rainfall into the groundwater, and the discharge capacity or rate of drainage of groundwater out of that catchment.

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[1] Knight et. al (2002) Impact of irrigation and dryland development on groundwater discharge to rivers. CSIRO Land and Water. Technical Report 03/02.

[2] Pannell (2001) Dryland salinity: economic, scientific, social and policy dimensions. Aust Jnl Ag & Resource Econs. 45:4, pp 517-546

Within a catchment there will be variations at a sub-catchment level, with the tablelands and slopes areas generally having a higher groundwater discharge capacity than the lower catchment.[3]

While rising groundwater has no respect for human-defined boundaries such as State, Local Government or even farm areas within a catchment, it seems clear there is no meaningful transfer of groundwater between catchments. That said however, in eastern Australia there is no necessary correlation between recharge areas (where water is added to the groundwater system) and discharge areas (where the groundwater is in close proximity to the surface and productivity is being impacted).

The estimated scale of current and future areas affected by dryland salinity also make the problem particularly difficult to deal with. Various estimates put the current area affected at about 4.5% of cultivated land or 2.5 million hectares (of which 1.8 m ha is in Western Australia), and suggest that over the next fifty years the affected area could increase to 15 million hectares. Maps of the areas affected show the problem is most evident on the western side of the Tablelands and the western slopes of southern Queensland, NSW and Victoria, sweeping in an arc south of the Murray River. In Western Australia, the main area affected is the wheat-belt. These areas have generally been cleared of trees and perennial native vegetation for many years, and annual crops and perennial pastures introduced. Not surprisingly, the water in rivers sourcing runoff from these regions is showing a progressive increase in salt content.

A further point of detail to note prior to considering policies being implemented to tackle the problem is the extent to which current farm landuse practices leak water into groundwater systems. A compilation of analyses by the CSIRO indicated that in high rainfall areas (> 600mm pa) leakage of rainfall to groundwater under native perennial woodland was around 5-10 mm per year, compared with leakage of 50-120 mm per year under perennial grasses.[4] In medium rainfall areas (400-600mm pa) the difference between pastures and trees was less distinct, with some perennial based farming systems controlling leakage fairly well (to around 10mm pa) and lucerne-based pastures reducing leakage even more.

Despite this, the leakage rates remained double that occurring under woodland native vegetation. In low rainfall areas (<400mm pa), "the use of deep-rooted lucerne has been shown to reduce leakage rates to the same level as natural Mallee vegetation (less than 1 mm pa ". A further study cited in western NSW found that clearing trees for grazing seemed to cause little or no increase in leakage rates for well managed systems that are not overgrazed.

3 Walker et al (1999)Effectiveness of current farming systems in the control of dryland salinity. CSIRO Land and Water Division. www.clw.csiro.au

4 Walker et. al (1999) op. cit.

In summary, the problem of dryland salinity is one where:

- there are a multitude of interdependent factors which combine to determine the scale and extent of the problem within any area,
- cause (changes in vegetation leading to increasing groundwater levels) and effect (high groundwater levels affecting productivity) will generally occur within the same catchment, but not necessarily within the same State or Local Government area, and may be separated by a considerable time-scale,
- the impact of the problem is most evident in higher rainfall cropping and grazing areas where native trees and woodlands have long been replaced with pastures and cropping
- potential sources of leakage to groundwater are progressively less significant in lower rainfall areas.

Against this background, it is relevant to examine whether current policy approaches are likely to make an impact on this problem.

Current policy approaches

The National Action Plan for Salinity and Water Quality (NAP) is an agreement drawn up and signed between the Commonwealth and the State and Territory Governments (except Western Australia) in November 2000. The purpose of the NAP is to "prevent, stabilise and reverse trends in salinity, particularly dryland salinity, affecting the sustainability of production, conservation of biological diversity and the viability of our infrastructure; and to improve water quality and secure reliable allocations for human uses, industry and the environment."[5]

The NAP identifies 21 priority catchments for which the relevant State Governments will develop regional plans, and under bilateral agreements, joint Commonwealth-State funding allocations will be made available for actions in those catchments. Thus far, South Australia, Victoria, Tasmania, Queensland and New South Wales have all negotiated bilateral agreements with the Commonwealth, and funding has been made available under these for activities in South Australia and Victoria. The key elements of the NAP are:

1) targets and standards for natural resource management, particularly for salinity and water quality;
2) integrated catchment/regional management plans developed by the community and accredited jointly by the relevant Parties;
3) capacity building for communities and landholders;
4) an improved governance framework to secure the Commonwealth-State investments and community action in the long term, including property rights, pricing, and regulatory reforms for water and land;

[5] Commonwealth of Australia (2000) National Action Plan for Salinity and Water Quality.

5) clearly articulated roles for the Commonwealth, State/Territory, local government and the community to provide a framework to deliver and monitor implementation of the Action Plan

6) a public communication program.

There are a number of elements of the Inter-governmental agreement (IGA) which are different to previous arrangements that have applied to Commonwealth/State programs. The first of these is specified in Clause 16 of the IGA, which requires that delivery of the programs should be via a regional body which has a suitable level of authority, has administrative, financial and technical ability, and is accountable for implementing the plans. This proposes that rather than Commonwealth funding going to State agencies and being substituted for State Government funding as has been the case in the past, the Commonwealth is seeking much more transparency in relation to how the money will be spent.

A second feature of the IGA is a requirement, under Clause 22, to develop catchment targets for salinity and water quality that are based on good science and economics, are measurable, and are able to be practically applied and achieved in a cost effective way. The desire to ensure effective outcomes are actually achieved is obviously the motivation behind this clause.

A third feature of the IGA is an agreement to clarify property rights and to implement an improved policy framework, including regulatory reforms for water and land use, under Clause 25. This clause is motivated by recognition that the normal regulatory approach of Governments to natural resource issues will not be effective in achieving the stated purposes of the plan, especially given the spatial and temporal issues at play in increasing or decreasing the extent of dryland salinity.

Regional or catchment plans

The most important elements of the NAP are the regional or catchment plans, which are required to specify the actions that will be implemented on the ground to give effect to the agreements. For NSW catchments, the plans that will be utilised are the Catchment Blueprints, which are integrated catchment management plans that have been undergoing development for some years. These plans have recently been released in draft form for public comment, and while not yet finalised, provide an indication of how the stated purpose of the NAP will be pursued.

As a relevant example, the draft Murrumbidgee Catchment Blueprint lists salinity as one of five first order objectives for that catchment, and sets specific targets for salt loads and salinity levels in the Murrumbidgee River over a ten year timeframe.6 It lists six management actions that will be undertaken to achieve the stated targets, including establishment of perennial pastures, retention and regeneration of native vegetation, establishment of new areas of native vegetation, establishment of plantations in recharge areas, and establishment of plantations for ground-water inception. The plan also proposes a number of engineering solutions such as sub-surface drainage to protect infrastructure impacted by rising water tables, and the establishment of salt-tolerant vegetation on areas of severe saline discharge.

The plan notes "The target relies on large-scale landscape change over the next ten years, particularly in the mid Murrumbidgee sub-catchments. Improved agricultural practices are required." The plan also notes "An implementation and investment strategy will be prepared by the relevant NSW Government agencies; Local Government; and the community under the guidance of the MCMB."

This last note in particular suggests the planning group has recognised that while the proposals in the plan may be based on current technical advice, there is no obvious means available to have these actions implemented, especially as many of them require actions by individual landholders that will negatively impact on their individual farm profitability. Short of some draconian regulation requiring landholders to plant a specific proportion of their land to trees and perennial grasses (an approach that would be both inefficient and ineffective) it is highly unlikely the actions will be taken by landholders in the absence of significant incentives.

Implementation on the ground

This was most starkly demonstrated in a recent study carried out in South Australia.[7] It examined six different landuse change options to reduce groundwater recharge in a specific catchment, the most 'extreme' of which involved replanting trees on 100% of the upper catchment, and on 50% of the lower catchment. This option had the largest impact, reducing the current rate of groundwater recharge by 74%, but imposed a net cost of $307 million on the landholders over a twenty-year period. Even incorporating a likely reduction in private and public infrastructure repair costs into the analysis, the study found that the most favourable option would cost each household in the catchment $26,600, or $2,500 per year for twenty years. This analysis ignored non-market benefits that might arise such as biodiversity and drinking water quality, but pointed out these would need to be valued very highly to justify the costs.

The report concluded that "catchment or basin-wide revegetation projects aimed at controlling dryland salinity are not likely to deliver benefits which exceed costs over a twenty year time period.", and " The findings of this study will have implications for other regions of Australia."

6 Murrumbidgee Catchment Management Board (2001). Draft Murrumbidgee Catchment Blueprint. www.dlwc.nsw.gov.au

7 Hajkowicz and Young (2000). An economic analysis and cost sharing assessment for dryland salinity management. Report to Primary Industries and Resources, South Australia. CSIRO Land and Water.

A similar conclusion was reached in a wide-ranging review of landuse options to combat dryland salinity that was produced recently by the CSIRO.[8] The report examined ten different land-use options that might be available to reduce leakage to groundwater. They were evaluated for their relevance, effectiveness, robustness and profitability. The conclusion was "Whereas certain land-use options in the right location and in expert hands can satisfy these four criteria, we do not yet have viable land-use systems capable of controlling leakage over the (Murray Darling) basin as a whole."

These results show that, based on the current state of knowledge, a 'do nothing' option may well be the most sensible and rational approach to the issue. The result would be a new equilibrium in groundwater levels that would be reached within the next fifty to 100 years, and an option would be available to use engineering solutions to protect high-value infrastructure, especially in the major urban areas.

Two factors impose some caution on this option. The first is the observation that is frequently made by researchers that even with urgent intervention, groundwater levels will still continue to rise for perhaps a century or more, meaning that early intervention may significantly reduce the longer-term scale of the problem, especially in relation to the availability of potable water from domestic and agricultural use in the future. The second is that the conclusion is based on currently available knowledge, which is rapidly being added to by research programs, and which may well uncover viable solutions (such as genetic engineering) which provide new solutions in the future.

The results of the various studies certainly suggest that there is no logic whatsoever at the present time in spending money on massive tree replanting schemes, irrespective of how "crowd-pleasing" such options may appear. They also suggest that using salinity to justify restrictions on the clearing of native vegetation in the low-rainfall zones of NSW is open to strong challenge.

Effective and economical solutions

What the results highlight most clearly is that dryland salinity is an issue on which it is possible to spend enormous amounts of money, with little effect. And it is also an issue where the bulk of the problem seems to arise from long-established landuse patterns in the high-rainfall zones, where there is no easy or economical option available to have the managers of these areas initiate changes to reduce leakage to groundwater.

However, recognising that it is the managers of farmland in the higher rainfall zones whose individual decisions may have an impact on the future extent of dryland salinity provides a key to how progress may be made in an effective and economical way.

These land managers currently have little or no information about the extent to which their current management activities may be resulting in leakage of rainfall to groundwater, nor do they have available any easy mechanism to estimate the potential groundwater impact of modifications to their current management practices. If each land manager had available an estimate of the average rate of leakage to groundwater occurring as a result of their current landuse patterns, then their opportunity to compare with neighbours, to benchmark across the industry, and most importantly to take action to improve that figure would be enormously enhanced.

Several researchers have examined the potential of using available research data to construct desk-top models that could be used to predict leakage to groundwater at a sub-catchment or individual farm level. Petheram[9] concluded that available information meant that predicting relationships between landuse and recharge was only "partially successful", a conclusion supported by Stirzaker.[10] Even within a paddock, soil and topograpy vary considerably, making robust estimates of leakage expensive to measure, and difficult to predict.

Yet logic suggests that a farm-level groundwater leakage figure would equip individual land managers with an essential tool they could use individually to reduce the total amount of groundwater leakage arising from their land. It would also enable public funding, in the form of incentives, to be allocated in a competitive manner to those landholders whose proposed actions would be most effective in maximising a reduction in leakage. In that way, there would be some reassurance that public monies expended on salinity were obtaining a maximum return, when expended on private land.

Longer term, a farm-level groundwater leakage indicator could also be utilised in a farm environmental accreditation scheme, such as the Environmental Management Schemes (EMS) that have been proposed, and which European markets are threatening will eventually become a prerequisite for market access to the EU.

There is no doubt that significant further research expenditure will be required to develop a robust farm-scale leakage indicator, and even more expense will be required to have the indicator utilised widely by farmers. That said, it may well be a less expensive and more effective approach than others that have been suggested, and it is certain to be more acceptable for farmers than blanket, and often ineffective regulations.

COMMENTS CONTAINED IN THIS DOCUMENT ARE BASED ON INFORMATION AVAILABLE AT TIME OF PUBLICATION.

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[8] Stirzaker et. al. (2000) A Revolution in Land Use: Emerging land use systems for managing dryland salinity. CSIRO Land and Water. www.clw.csiro.au

[9] Petheram et. al. (2000) Towards a framework for predicting impacts of land-use on recharge: A review of recharge studies in Australia. CSIRO Land and Water. Report 28/00. www.clw.csiro.au

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