Department of Agriculture

Farmnote

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Recharge management for salinity control

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Salinity series

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Leakage of rainfall below the root zones of plants, so that it contributes to the groundwater, is known as recharge. Recharge rates under native vegetation are normally very low and typically range from 0.01 to 10 mm/year in the low to medium rainfall areas (300 to 700 mm/year). Widespread clearing of native deep-rooted woodlands and forests and the introduction of shallow-rooted crops and pastures in large areas of what have become the agricultural region, has led to a significant increase in the amount of rainfall ‘leaking’ into groundwater systems. This recharge may be at least 10 times the original rates and is a major contributor to the increase in dryland salinity.

Water leaking beyond the plant root zone does not always reach the groundwater as it can move laterally through the soil and join surface streams. Increased recharge will cause groundwater levels to rise if the underlying aquifer (layer of weathered rock which holds water and allows water to move through it) cannot transmit the additional flow to discharge areas. (Discharge is the process of water loss from aquifers, and can occur as direct seepage or by evaporation from the watertable.) When the watertable rises to within 1 or 2 metres of the soil surface, symptoms of dryland salinity begin to appear.

As a result of increased recharge rates, groundwater rises of between 0.1 and 1 m/year are being recorded across the South-West. Groundwater levels will continue to rise until the rate of recharge and discharge are again equal. This may take from as little as 30 years in the higher rainfall areas to 100 years or more in eastern and northern areas.

Nature of recharge

Recharge is not uniform across the landscape. It is higher in deep soils with poor water-holding capacity (sands) and lower in soils of high water-holding capacity (clays). It can also occur as a result of surface ponding, the existence of large soil pores or leakage beneath man-made infrastructure such as dams.

To exactly mimic native ecosystems, recharge rates under farmland need to be reduced to levels similar to those of the forests. However to restrict and in some cases reduce the area of saline land, recharge rates need only be reduced to the level at which the aquifer can discharge water.

Recharge on farms

Recharge rates are difficult to measure, but on an annual basis recharge is typically about 5 per cent of rainfall. In wet years the amount will be higher (more than 20 per cent).

On a typical farm (2,000 ha) with an annual recharge of 20 mm, the volume is equivalent to about 100 large farm dams (each 4,000 cubic metres). Over time, recharge to water storage beneath a typical farm amounts to millions of cubic metres (see Table 2). Generally recharge reduction will not significantly reduce the amount of water stored or discharging on a farm in the short-term unless groundwater flow is significant. In most wheatbelt areas reductions in recharge will either delay the onset of salinity, slow watertable rise or reduce discharge rates.

Two approaches can be taken to reduce recharge:

- increase the water use of plants to create a deep and dry soil profile above the watertable;
- remove, store or use surface water that would otherwise become recharge.

Perennial plants (pastures, shrubs, trees) offer the best opportunity for reducing recharge.

Impact of recharge reduction

The impact of recharge reduction and the eventual extent of salinity depend on the hydrology of the catchment and its management. Options can be assessed using a range of soil and groundwater computer models.

Table 1 shows the average annual recharge in millimetres, calculated by the computer modelling software AgET for four common land management units in the central wheatbelt with a mean annual rainfall of 365 mm.

Table 1: Indicative mean annual recharge for a central wheatbelt site.

Land management unit	Annual pasture	Cereal crop	Lucerne phase farming	Eucalypts
	mm/year			
Sands	40	30	15	<5
Gravels	25	20	30	~ 0
Duplex soils	10	10	<5	~ 0
Heavy soils	5	5	<5	~ 0

Note: 1 mm = 10 cubic metres per hectare

Table 2 shows the total volumes of recharge for a hypothetical 2,000 ha farm in the central wheatbelt calculated by CATCHER and AgET computer modelling output.

Table 2: Total volumes of recharge for hypothetical 2,000 ha farm in the central wheatbelt calculated using the output from Table 1.

Scenario on 2,000 ha farm	Recharge (m^3)
Native vegetation prior to clearing	<20,000
All sand planted to trees (600 ha)	170,600
All duplex soils to perennial pasture/crop phase farming (800 ha)	280,600
All gravels planted to oil mallees (200 ha)	300,400
All gravels to perennial pasture/crop phase farming (200 ha)	310,200
All heavy soil to trees (400 ha)	320,600
Traditional annual crop/pasture rotation	350,000

The management change that would cause the greatest recharge reduction is the planting of trees on all sands, as the recharge rate on these soils is highest under normal district practice. Planting trees on all heavy soils has a lower impact on total recharge than some potentially more profitable options.

It should be noted that most approaches to reducing recharge include a combination of methods. The result of this will be greater than for any one option alone.

Preventing salinisation by recharge control may not be practical or economic in areas where:

- economically attractive perennial crops do not exist;
- groundwater gradients are very low, so there is very little and very slow water flow below ground;
- recharge is highly irregular; and
- discharge areas are very small in relation to recharge areas.

In areas where groundwater gradients are very low and recharge occurs in large, irregular amounts (say from cyclones one in five years), recharge control may not be able to prevent salinisation. In these areas, recharge control buys time to allow alternative systems to be developed.

Modelling suggests that adoption of recharge management systems can extend the time before salinity appears by as much as 40 to 100 years. For example, establishing a tree and *annual* crop alley farming system may result in a 20 to 30 per cent reduction in recharge. However, this will only result in a 5 to 20 per cent reduction in a hillslope area with a shallow watertable. Establishing a tree and *perennial* pasture alley farming system may reduce recharge by 50 per cent. This will result in a 30 to 50 per cent reduction in the area of hillslope with shallow watertable (more than double the effect of the annual pasture).

In areas with active groundwater systems, regular annual recharge and relatively steep topography, smaller reductions in recharge may be significant and reduce both the current extent and potential for salinity.

It is theoretically possible to reduce recharge by increasing the proportion of water that becomes streamflow by installing earthworks which manage waterlogging, inundation and flooding. While some work has been done on assessing recharge under level banks and seepage interceptors in the Great Southern, the relative impact on recharge has not been quantified across the South-West region.

Not all of the south-west needs recharge control. Some higher rainfall areas with shallow soils and a long history since clearing have had the salts leached from the landscape. The groundwaters are now relatively fresh and the area affected by salinity is stable. By contrast, areas of deep soil with recent clearing and lower rainfall will experience continued growth in salinity and usually require recharge management.

Measuring recharge reduction

There are only two simple ways to determine the impacts of recharge reductions:

- measure changes in the rate of watertable rise;
- measure a reduction in the extent of salinity.

To measure impacts on watertables, observation wells should be installed in or near the treated area. Ideally, monitoring should begin prior to treatment in order to establish existing trends. If this is not possible, a similar untreated area should be monitored for comparison.

Further information

- Reports from the National Land and Water Resources Audit are available at: http://www.nlwra.gov.au/atlas
- AgET, CATCHER and FLOWTUBE can be downloaded at: http://www.agric.wa.gov.au/progserv/natural/
- Farmnote 102/2000. ‘Monitoring groundwater levels’ by Lisa Crossing and John Simons.

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