Soil salinity

Salinity is a major issue throughout the Northern and Yorke landscape region. Some of the salinity is natural (primary) and some is secondary salinity resulting from activities such as clearing of native vegetation associated with European settlement.

Dry saline land or transient salinity occurs across the region in the absence of a water table. While dry saline land salinity is an issue, groundwater-driven salinity poses a greater threat in terms of environmental and socio-economic loss (Dooley *et al*. 2002).

Primary salinity

Primary salinity is natural salinity that existed prior to European settlement. It includes salt marshes, tidal swamps, natural salt scalds and lakes. The lagoons and lakes on the Yorke Peninsula and around Lochiel and Balaklava are examples of primary salinity.

Secondary salinity

Secondary salinity is salinity that occurs in the landscape due to the actions of European settlement. It occurs when perennial native vegetation has been removed and replaced with shallow-rooted annual crops and pastures. Annual plants use less water than perennial vegetation, increasing the recharge to groundwater and causing water tables to rise. Rising water tables dissolve salts stored in the soil profile and bring them to the surface. When the water table intersects the surface due to a 'break in the slope', depressions or

Figure 1: Primary salinity on Yorke Peninsula. Image: Andrew Harding

Figure 2: Secondary salinity in the Mid North with sea barley grass, a natural coloniser of salinity. Image: Andrew Harding

low-lying areas, salts are deposited on the surface (discharge) and dryland salinity occurs.

Dryland salinity may also occur when the water table is within one to two metres of the surface (depending on soil type) due to capillary rise resulting in evaporation and deposition of salt on the soil surface.

Visual symptoms of salinity include: patchy crop and pasture establishment; reduced yields; bare areas and white salt crusts on the soil surface.

Discharge of saline groundwater to streams may have an adverse impact on water quality and the health of in-stream and riparian ecosystems.

If the groundwater is held back due to roads or geological features such a rock bars then the shallow water tables can be pushed to the surface causing salinity problems.

At times it is difficult to distinguish between primary and secondary salinity as secondary salinity often occurs at the margins of primary out breaks. Several lagoons on the Yorke Peninsula were once fresh but have become salinized since clearing and agricultural development (Dooley *et al.* 2002).

If nothing is done to manage salinity then further salinization of land and water resources is likely to occur, particularly if wetter seasons occur. Action to manage salinity needs to be strategically targeted and will generally fall into three categories of salinity management:

1. living with salt;
2. engineering solutions; and
3. recharge reduction.

A **salinity management plan** is likely to include a combination of options from the three categories and the potential effectiveness will depend upon the type of groundwater system that is causing salinity.

Groundwater systems can be either local, intermediate or regional flow systems.

Local flow systems have relatively short flow paths between recharge and discharge areas (i.e. less than 3 km). Discharge from these aquifers tends to occur as small areas of saline seepage. These systems generally respond well to recharge management.

Intermediate to regional flow systems (with much longer flow paths) usually produce larger and more severe saline discharge areas. These systems are less responsive to recharge management due to their larger scale (Dooley *et al*. 2002).

1. Living with salt

Salt land can be managed productively in a crop / livestock system, and if possible, it is best to fence off the affected areas. Livestock tend to camp on bare salt affected areas and they graze these areas off and make the situation worse. When fencing these areas off keep the fence well away from the boundary of the salt margin as these salt areas can increase and spread. If the areas are small, mulching with some old hay will help to reduce the evapotranspiration.

Once these areas are fenced off and stock excluded, then these areas will start to colonise with natural salt tolerant species. Salt tolerant vegetation (trees, shrubs, grasses) can be established on these areas to increase production, improve aesthetics and control degradation (erosion). There are many sites throughout the Northern and Yorke region such as Farrell Flat, Anama, Jamestown, Marrabel and Minlaton demonstrating the success of salt tolerant vegetation including

puccinellia, native grasses, saltbush and salt tolerant trees.

Large saline areas could provide the potential for the establishment of new industries such as mineral and chemical extracts, inland saline aquaculture, salt harvesting, solar ponds and irrigation with saline water (Dooley *et al*. 2002).

Saline features such as wetlands, lagoons, swamps and samphire flats within the Northern and Yorke landscape region are important because they provide critical habitat for native species, many of which threatened and restricted to these ecosystems. Revegetation, protection and promotion of wetlands will enhance the region's environmental, aesthetic and social values (Dooley *et al*. 2002).

2. Engineering solutions

The main engineering options in the Northern and Yorke landscape region include:

- Drainage – surface drains, deep drains and contour banks;
- Clay spreading on water repellent sands (combined with plant establishment);
- Desalination of surface and groundwater supplies.

Drainage

Surface flows need to be maintained to avoid the build-up of water, by cleaning out culverts, having adequate culvert capacity and alignment, and improved drainage

Shallow surface drains can be designed and constructed to remove excess surface and shallow sub-surface water from the landscape, reducing flooding and waterlogging potential. Drains are shallow (less than a metre deep) and include contour banks, diversion drains, 'W' drains and spoon drains.

Groundwater drains and groundwater pumps are designed to lower shallow water tables. These options are very expensive and should only be considered when there are significant areas of salt affected land (or areas at high risk) and/or for the protection of high value assets.

A further problem with deep drainage is the disposal of highly saline water. Draining water from one area to another could increase salinity in other parts of the catchment and/or have adverse environmental impacts downstream.

For drainage works it is essential to seek advice from the Northern and Yorke Landscape Board and may require a Water Affecting Activity permit to comply with the *Landscape SA Act 2019*.

Clay Spreading

Clay spreading is quite common on sandy country throughout the region. The addition of clay increases the soil's water holding capacity and soil fertility and promotes better plant establishment leading to a reduction in recharge.

Desalinisation

Desalination of surface and groundwater supplies could be carried out for domestic water or township supplies.

3. Recharge reduction

Recharge reduction refers to the increased use of rainfall by plants across the catchment to reduce the amount of excess water entering the water table.

Recharge reduction is most effective in local groundwater flow systems and becomes less effective as the scale of the flow system increases (Dooley *et al*. 2002). These strategies will therefore be effective in the smaller areas in the hills and valleys, sandy areas and less effective in the larger areas on the floodplains.

Increased water use (recharge reduction) can be achieved by:

- Fencing off and improving areas of remnant native vegetation;
- Revegetation of the non-arable areas with trees, shrubs and grasses;

- Increasing the productivity of annual crops and pastures;
- Converting annual pastures to perennial pasture;
- Phase farming with a perennial such as dryland lucerne.

Figure 3: Recharge reduction; sowing lucerne on sand hills. Image: Andrew Harding

Although recharge reduction addresses the cause of salinity and is a long-term solution, it also has other benefits such as controlling water logging and erosion and includes opportunities for enhancing biodiversity and soil health.

Any soil or agronomic practice (liming, improving soil structure, appropriate fertilisers etc.) that leads to increased water use and increased productivity can potentially contribute to recharge reduction (Dooley *et al.* 2002).

Dry saline land

Dry saline land often called **transient salinity or 'magnesia patches'** is salinity that occurs in the absence of a water table. It results from inherent salinity within the soil profile, often due to the exposure of a saline or sodic subsoil following natural erosion.

The natural salts in the soil will move up and down according to seasonal conditions. During wet periods the salts are leached down the profile and then during hot and dry periods the salts are brought to the surface.

The concentration of salt on the surface affects the germination of salt-sensitive plants and without plant growth to provide a surface cover, further evaporation occurs and more salt is drawn to the surface (Kennewell and Young 1997). This type of salinity often occurs as a mosaic pattern in affected paddocks.

Dry saline land can be managed by establishing and maintaining a permanent surface cover; by minimising soil disturbance by tillage and livestock; and by covering small bare patches with old hay, straw or manure that will reduce evaporation and help to improve water infiltration.

Summary

Salinity is an issue in the Northern and Yorke region and takes various forms including primary and secondary salinity with and without a water table.

To manage salinity it is best to be able to recognise the type of salinity and to prepare a salinity management plan. Once management practices have been implemented it is important to monitor the progress of these actions over time.

References

Dooley T, P. Ciganovic, and C. Henschke (2002) *Regional salinity management within the Northern and Yorke agricultural districts*. Prepared for the NAYAD INRM Committee. Rural Solutions SA PIRSA

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