Future Directions international

INDEPENDENT STRATEGIC ANALYSIS OF AUSTRALIA'S GLOBAL INTERESTS

FDI Feature Interview

Dr Richard George: The Threat to the West Australian Agricultural Sector from Dryland Salinity

Geoffrey Craggs
Research Analyst, Northern Australia and Regional Development Research Programme

Key Points

- Dryland salinity affects more than two million hectares of non-irrigated farmland in Australia. Half of that total is located in Western Australia.
- There has been a modest uptake of approaches designed to manage salinity, but the impact has been limited, mainly due to high costs and low success rates.
- The salinisation of Western Australian landscapes is continuing. It is caused by both current land use and the residual effects of historical land clearing. It is likely that future climate change could modify the spread of salinity.
- Salinity remains a major concern and further investment is required to develop options for its mitigation and opportunities for both individual and public benefit.

Introduction

FDI recently interviewed Dr Richard George, one of Australia's leading salinity scientists, on the effects of dryland salinity on agricultural systems in Western Australia.

Interview

FDI – What is the extent of dryland salinity in Western Australia and what is the trend?

Dr George – More than two million hectares of non-irrigated farmland is affected by dryland salinity in Australia, with half of that area in Western Australia. At one time, dryland salinity was expanding at about 14,000 ha a year (but this figure has not been updated for nearly 20 years).

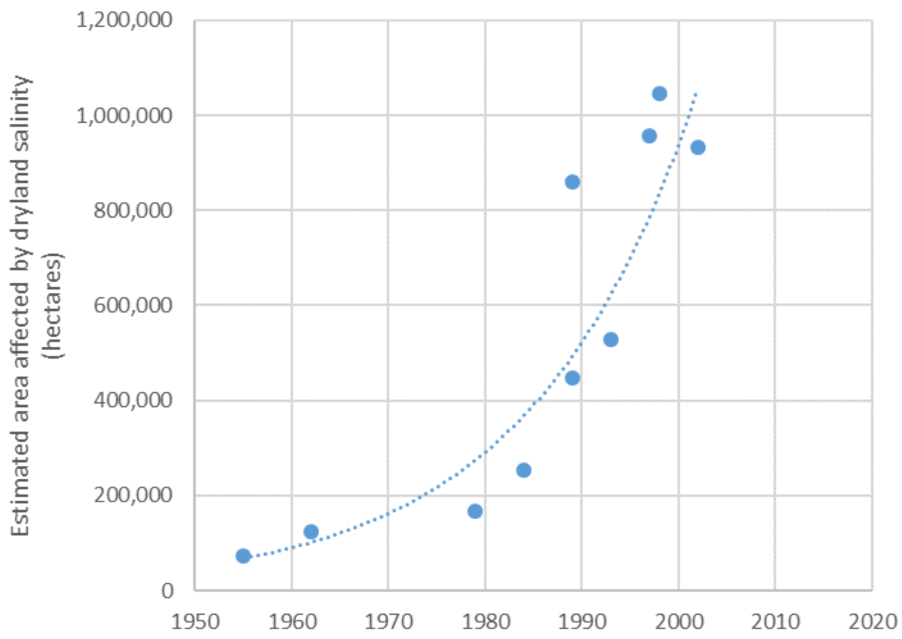

Figure 1 indicates that since 1955, the extent of reported dryland salinity has grown from 73,000 (1955) to about 1 M ha, a rate of about 18,000 ha/year, noting escalation and variability since 1990. The extent and trends from LANDSAT data (14,000 ha/year) are similar, despite variant methodology.

Dryland salinity of agricultural land is caused by a build-up of salt in the root zone of plants. Salts are derived from water tables that are usually less than 1.5 metres below the surface of the soil. Soil chemistry and related biological characteristics are affected to the extent that it affects their survival, growth and yield. Excess salts can also affect crop yields in areas without a permanent watertable; this occurs in clayey soils, especially in the Wheatbelt after dry periods. Its impact is less than salinity from high watertables.

Dryland salinity is unevenly spread between landholders, with the most affected areas located in the broad and flat valleys found in the Wheatbelt.

- The largest affected grower has almost 4,500 ha of saline land, with another 11 growers having over 2,000ha, totalling 31,500 ha (average 2,625 ha)
- Next, 66 landholders have between 1000-2000 ha of land affected; combined total managed is 88,500 ha (average 1,350 ha)
- Then the next 241 landholders hold 500-1000 ha average 684 ha of saline land, totalling 165,000 ha
- In the final category of 641 significantly affected landholders, they each have over 200 ha, totalling 200,000 ha (average 312 ha)

- The remainder of the current landholders (about 3,500), have <200 ha of saline land and make up a total affected area of 220,000ha

Unlike most other soil issues, it is important to understand that dryland salinity is the outcome of a **sequence** of landscape responses to clearing – and also the consequence of a century of farming practices. Land clearing altered the landscape's water balance (rain, evaporation, runoff and recharge), resulting in a loss of soil cover, deep roots and biology. That process led to enhanced acidification, compaction, repellence and structural decline, which, in turn, has reduced biomass production, carbon and water use. Excess water drained into the soils, resulting in localised waterlogging and enhanced runoff that enabled salts to accumulate or move downstream.

Estimates indicate that the cost of this salinity to agricultural production is about $500 million per year. This cost, however, does not include the impact on: farm assets, such as dams and related infrastructure; catchment water resources; infrastructure, such as roads; the environment; and social values.

Three factors affect dryland salinity: climate, land clearing and land use. Collectively, these factors are difficult to monitor directly. Indirectly, however, they are monitored by a network of surveillance bores drilled across the Wheatbelt and South-West WA. The output from the monitoring network, when combined with computer models, is used to formulate impact and risk assessments.

Hazard maps have been created for most agricultural regions and are available on the DPIRD website. Such maps depict areas that may have shallow water tables in the future and could become saline. Estimates put the area falling within this category between 2.8 and 4.5 million hectares.

FDI - What approaches are being made to manage salinity?

Dr George – The main drivers are publicly funded research and development and direct action by landholders and industry groups. Strategies include: preventing additional clearing in declared water resource catchments; investment in land management practices; testing new crops and perennial pastures; and driving tree-based regenerative schemes. A complete management programme will also involve engineering drainage and specialised earth banks.

The adoption of new approaches has generally been low, reflecting the high cost, low reliability and limited effectiveness of existing salinity management methods. Adoption tends to be highest for practices that directly address saline land and least where there is competition with existing farming practices on non-saline land.

Active responses to salinity fall into four broad categories:

1. Low input - fence and manage saline-affected land with salt-tolerant plants and by planting higher tolerance crops, such as barley, instead of wheat.

2. Medium input - revegetate saline land with trees, shrubs and salt-tolerant plants for grazing purposes.

3. High direct input - deep drain, pump and actively manage saline land, including the surface water.

4. High indirect input - revegetate areas remote from saline land with perennials, such as trees, forage grasses and legumes.

Since the mid-2000s, salinity planning has been directed by a policy developed in WA, called the *Salinity Investment Framework*. This framework is based around risk assessment and economic principles; it recognises various levels in management goals: recovery; containment; adaptation; and the protection of land, water, biodiversity and environmental assets.

FDI - What are the implications of climate, land clearing and land use on salinity?

Dr George - As stated earlier, historical land clearing and land use practices have had the largest influence on the current extent and trends of dryland salinity. Future salinisation trends are more likely to be driven by changes in the Australian climate than by land use.

In 2019, the effects of past clearing and land use are still driving groundwater accumulation (seen as rising water tables) across the Wheatbelt and, as a result, salinity is increasing. A detailed hydrological assessment is contained in the report that underpins the Report Card on Sustainable Natural Resource Use.

Unlike the monitoring period prior to 2000, however, when almost all monitored bores had rising trends, the trend in a significant number of surveillance bores is now declining. The main reason appears to be reduced winter rainfall (10-30 per cent lower) since 2000. New assessments are being established for delivery in 2020-21. Using those assessments, future mapping and monitoring will be able to clarify the situation.

The effect of future climate changes on salinity is being reviewed by scientists across the globe. The CSIRO assessment of Global Climate Models (GCMs) forecasts that there will be less rainfall in south-west Western Australia under future warming scenarios. Those forecasts suggest that the current trend of lower rainfall levels, increased temperatures and potential evaporation, which have been observed since the mid-1970s, will continue. Unless summer and out of season rainfall makes up for the reduction in winter rainfall, the spread of salinity should be lower than previously forecast. The questions are: where, when, by how much, and what else could have been lost or affected?

Changing land use to reduce the amount of water entering saline Wheatbelt aquifers was proposed as the primary means of managing salinity from the late 1960s to the early 2000s; this was the objective of most investment programmes. Later programmes focussed on the promotion of perennial deep-rooted vegetation, forage pastures and widespread “high water use” crops. Monitoring and modelling the adopted systems (1986-2015), at measurement sites where less than 50-80% of the catchment was ‘recharge managed’, showed little effect on watertables. In fact, the results demonstrated that, for many areas, more than ten times the area affected would have to be planted to achieve mitigation of the salinity.

Ironically, it is likely that the reduced rainfall after 2000 has had a greater influence on the restoration of the water balance than salinity management programmes.

FDI – How should we respond to dryland salinity?

Dr George - For the **individuals** affected, the type and scale of response depends on their business, the extent and risk of salinity on their property, and the potential success of mitigation programmes. For example, growers without a strong livestock enterprise have less interest in planting shrubs and pastures to increase grazing value – they are more likely to be motivated to increase cropping area and invest in other areas of their business. For some growers it may be cheaper to invest in new land, focus on other Natural Resource Management issues (such as acidity or water repellence), or invest in new technologies and machinery that improve their cropping operations.

For those growers that prioritise land management, however, there is the risk that the system will fail to work as proposed (whether by technical advisers or advocates). For example, the system (e.g. drainage) may not achieve minimum impact or future conditions could degrade previously established benefits. Costs may also escalate if regulators change standards and the requirements for mitigation of nearby and distant downstream impacts increase.

Adoption of vegetation management may have a similar outcome, if not designed for optimal impact and profit via separate benefit streams (wood products, bioenergy, oils and, potentially, carbon offsets). Evidence to date suggests plantings that achieve salinity control are likely to impact profitable cropping (area, root-competition) and not defray the costs and market risks for long-term products. Further, in some catchments, tree crops (most woody perennials) may negate recharge to unique and high value low salinity aquifers and streams and bring significant unexpected costs. Benefits from vegetation need to stand alone, or be planned for wider values that include management of the business and wider landscape – not just for salinity.

In considering **public interest**, the benefits of investment are usually weighed by the value of assets at risk, using tools such as the Salinity Investment Framework. Protection of agricultural land is generally seen as having a predominantly private benefit, which should be managed by the industry responsible. Benefits of public investment are usually defined by protection of shared assets, such as water resources, infrastructure (towns, roads) and conservation areas. There are several examples of the management of such assets, e.g. water resources catchments, such as Denmark, towns, such as Wagin, and conservation areas, such as the Lake Toolibin wetland. Typically, these assets have been protected by revegetating the catchment (Denmark), creating an engineering system that effectively disconnects the catchment from the assets (Toolibin), or removing the hazard (groundwater pumping – Wagin). In most cases, however, where the risk derives from land not managed by the asset manager, capacity to avert degradation is low. Notwithstanding the costs and trade-offs between private and public good, this area remains a high priority and research and development is a necessary policy instrument to enable informed responses.

Salinity remains a major area of concern and investment is required in both the individual and public interest. Likely areas of investment by government and industry sectors may include:

- Monitoring and forecasting the extent, risks and costs of salinity, using new technologies and visualisation tools to convey information, as those tools become available.

- Making information on management options, adoption pathways and stakeholder networks available to land managers and potential investors.

- Providing governance systems that enable interaction between various levels of public and private stakeholders.

- Defining policies and investment opportunities, including providing support to research and development, as well as to direct investments that are shown to be effective and economic, e.g.

    - Selective breeding and development of deeper-rooted crops and forages that reduce recharge and offer climate resilience, while providing protection of soils.

    - Using selective breeding and genetics to enable production in saline land areas.

    - Developing the means to use saline groundwater (e.g. via drains and pumps) as a resource (e.g. for: desalinisation, mineral extraction for rare metals). This could be coupled with new energy production options, to provide low cost energy with potential for local horticulture/food production.

    - Companion revegetation for energy, co-products, carbon sequestration and environmental measures to manage salinity, erosion and protect biodiversity – via new relationships with major carbon emitters, as a means to drive innovation and adoption.

    - Developing planning instruments whereby land can be leased, sold or managed by third parties that want to use it to address salinity through mining, conservation and carbon abatement projects.

- Supporting individuals and communities using incentives to encourage innovation, reclamation and improvements in farming practices – driving the concept of change and adoption of new farming systems. This could include specified guidance and penalties where appropriate.

Concluding remarks

Dryland salinity has often been defined as a stand-alone environmental problem, to be solved (land reclaimed) and addressed in isolation from other natural resource and production issues. Evidence from 30 years of investment and adoption in land use changes suggests, however, that widespread reclamation is not yet feasible. It suggests that adaptive management of the one to two million hectares of affected land is what can be reasonably expected. While the use of engineering tools is viable in some instances, especially when managing high value assets, their use is typically constrained by costs, downstream issues and governance.

Adaptive management is not an admission of failure; it does not preclude the continued assessment of new options for management and improvements to existing systems. Indeed, it is better that the soil is stable and protected until profitable and sustainable management options evolve with time.

The WA Auditor General's Office published a report on dryland salinity management and the WA Government released its response earlier this year, by way of an independent report and consultative review (which is currently open for public comment). The review also reflected input by 35 cross-sector stakeholder groups and sought wider input to aid in the development of appropriate policy advice and actions.

*****

About the Interviewee: Dr Richard George is a Principal Research Scientist with the Department of Primary Industries and Regional Development. He has worked on dryland salinity - land and water resources management - for 35 years; most recently leading Western Australia's assessment of future irrigation opportunities across the State. Richard has published hundreds of reports and papers and has received natural resource and engineering awards for research and development projects. He says that understanding landscapes (especially in a way that leads to sustainable development), undertaking evidenced based science and then communicating the results to stakeholders, are the highlights of the work he and his group deliver.

*****

Published by Future Directions International Pty Ltd.
Suite 5, 202 Hampden Road, Nedlands, WA 6009, Australia.
Tel: +61 8 6389 0211
Web: www.futuredirections.org.au