

Salinity in Queensland—irrigation

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Introduction

Approximately 542,000 ha are irrigated in Queensland with a gross value of production of \$2.3 b/yr and an average water use of 4.8 ML/ha (2004-2005). Irrigation involves a major change in hydrology, generally increasing deep drainage and groundwater recharge. Four processes of irrigation related salinity are identified in Queensland:

1. increasing groundwater salinity in aquifers subject to water extraction
2. increasing salinity and/or sodicity in irrigated soils
3. salinity caused by rising groundwater
4. seawater intrusion in coastal aquifers

Most aquifers pumped for irrigation in Queensland have been over-extracted resulting in an increase in salinity over time, reinforcing salinity processes 1, 2 and 4. The various forms of salinity occur primarily in irrigation areas receiving 500 – 1500 mm of summer dominant average annual rainfall.

Irrigated agriculture in Queensland

Irrigated agriculture is important to Queensland, providing a Gross Value of Production of \$2.3 b/yr to the State's economy (Australian Bureau of Statistics (ABS) 2006a). While the area under irrigation is less than 0.5% of the States agricultural land, it accounts for one third of the States gross value of agricultural production (ABS 2006b).

In 2004-2005, an average of 4.8ML/ha was applied to irrigated paddocks across the State (ABS 2006a) but water application rates for irrigation in Queensland vary significantly. For example, water use in the Northern and South West Statistical Divisions, which includes the Burdekin and St George irrigation areas, applied 60% more water than the state average - 7.3ML/ha and 8.3ML/ha respectively. Sugarcane and cotton account for 61% of irrigated lands in Queensland and 37% of the Gross Value of Production from irrigated agriculture (ABS 2006c). Irrigation is mainly used for the production of cotton in inland areas, sugarcane in coastal areas and high value horticultural crops.

Irrigation areas in Queensland

Figure 1 depicts the major irrigation areas of Queensland and the area of irrigation from the 1999 Land Use Map.

Inland riverine areas have been developed under older Government irrigation schemes and new privately developed ones. The older areas were developed during the 1970's and include Theodore, Emerald, Bundaberg and St George. The large expansion of private areas has occurred since the 1980's and includes the MacIntyre and Weir River floodplains, west of Goondiwindi. Furrow irrigation is typically used on a diverse range of clay soils but with an expanding use of travelling irrigators (centre pivot and lateral move) with smaller areas of trickle and drip irrigation.

The horticultural irrigation areas mainly use micro-irrigation systems, including drip, trickle and micro-sprinkler. The diverse range of crops include perennial tree crops and short-term vegetable crops. These irrigation systems are widely employed in Granite Belt (Stanthorpe),

Lockyer Valley, Bundaberg and Callide Valley.

The tropical and coastal irrigation areas at Mareeba-Dimbulah, Burdekin, Bundaberg and Mackay are predominately sugar cane. In these irrigation areas, cane occupies the largest area with irrigation methods including furrow and overhead irrigators. These areas also support horticultural crops using micro-irrigation methods. Other irrigated crops in these areas play a role in the crop rotation policy of many farmers.

Forms and occurrence of irrigation salinity in Queensland

The four processes of irrigation salinity identified in Queensland, as previously discussed, occur across the range of irrigation environments. Increasing groundwater salinity in aquifers has been identified in groundwater dominated irrigation areas, including the Lockyer (Gardner 1984) and Callide Valleys (Dowling and Gardner 1988). The increase in groundwater salinity is primarily due to reductions in dilution of salts in the aquifer systems. The salt store of the aquifer can be either already present in it or introduced into the system via increased deep drainage, inflow from in the surrounding upland areas due to broad scale clearing of native vegetation or naturally through atmospheric accession. In the Lockyer Valley some areas can now only grow salt tolerant crops such as beetroot (B Powell *pers comm.*) due to the increase in salt concentration in the groundwater.

The use of increasingly saline irrigation water, can lead to an increase of salinity and sodicity in irrigated soils. The increase of soil salts from poorer quality irrigation water leads to a reduction in the available soil water for crops due to increased osmotic pressure in the root zone. Many irrigators reduce the affects of saline irrigation water by mixing or shandyng poorer quality water with that of a better quality. Evidence of increasing soil salinity and sodicity has been recorded in the Central Condamine and inland Burnett areas. Management options are limited to mixing water sources, using increased water application rates in an attempt to flush the salt from the root zone, use of soil conditioners such as gypsum, and reducing evaporation through the use of mulches. Without careful management, the increased water application rate can lead to rising groundwater.

Salinity caused by rising groundwater within or surrounding irrigation areas is the most common irrigation salinity process in Queensland. Groundwater levels are typically rising, or have risen to a shallow depth (<3m), in and around irrigated areas throughout Queensland (Table 1), except where groundwater is used as a source of irrigation supply, or is pumped specifically to control groundwater levels. Rising groundwater levels are caused by an increase in the drainage of water past the root zone as a result of an inability of crops to use all water entering the soil from rainfall and irrigation, and the leakage from channels and other storage structures. Groundwater pumping can manage the effects of rising watertables but can lead to increasing groundwater salinity levels as described above. Salinity due to rising groundwater became an issue in the Emerald Irrigation Areas within two decades of the development of the undulating basalt areas. This was managed by installing subsurface drainage and more recently the lining of water distribution channels.

Highly saline and often acid groundwater was found to be rising in two monitoring bores sited near irrigation fields and infrastructure in the Border Rivers west of Goondiwindi (Biggs *et al.* 2005). Groundwater levels were not rising in nearby bores not influenced by irrigation. Salinity induced by irrigation (horticulture) and leaky dams was observed at many sites in the Granite Belt in southern Queensland (Biggs *et al.* 2005). Shaw *et al.* (1992) noted that in the Pioneer Valley, Mackay, salinity and waterlogging problems would be inevitable even under best water use efficiency management practices. They also state that the shallow depth to groundwater would be an issue in less than five years from the commencement of large-scale irrigation practices for much of the valley.

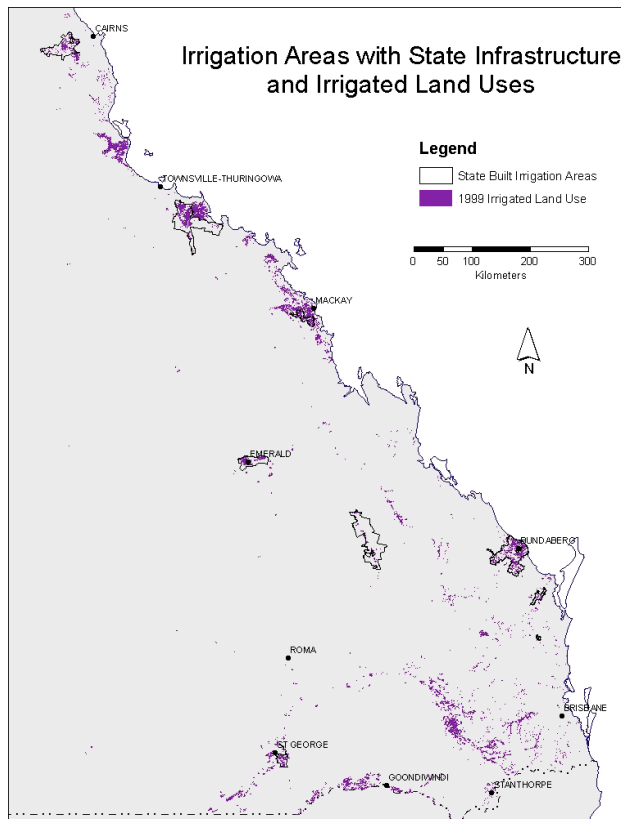


Figure 1 Queensland Irrigation Areas and Irrigated Land Uses

Table 1 Minimum watertable depth for selected irrigation areas of Queensland

Irrigation zone	Watertable depth (m from the surface)			
	1990	1995	2000	2005
Mareeba-Dimbulah	5.0	4.5	2.5	1.14
Burdekin	6.0	5.0	2.0	1.15
Emerald	8.5	4.0	0.5	0.89
Bundaberg	3.0	2.0	1.0	1.19
Lower Mary River	2.0	1.5	0.5	0.60

Seawater intrusion in coastal areas occurs in the Bundaberg and the Burdekin Irrigation Areas. Seawater intrusion into the coastal freshwater aquifer occurs due to a lowering of groundwater heads relative to sea water levels. The intrusion of saltwater into the freshwater aquifer has several effects, including reducing groundwater quality and potentially increasing salinity and sodicity levels in soils through the use of poor quality irrigation water.

Deep drainage under irrigation

Silburn and Montgomery (2004) reported that deep drainage under furrow-irrigated annual cropping in heavy clay soils (Vertosols and Sodosols) are generally large (100-200 mm/yr) in inland riverine plains of Southern Queensland receiving an average annual rainfall of 500 – 700 mm. Tensiometry and lysimetry data indicate that large gradients in matric potential can move water rapidly through these soils, despite low hydraulic conductivity. Similar rates of deep drainage would be expected under similar soil hydraulic conditions in other irrigation areas. On more permeable soils, rates of water movement would be expected to be large (>200 mm/yr), despite the use of “efficient” practices such as drip irrigation and soil moisture monitoring.

Area affected by irrigation salinity

The extent and severity of irrigation induced salinity in Queensland has not been specifically researched, but it is known that more than 10,000 ha is affected in the Bundaberg,

Maryborough, Emerald and Burdekin River irrigation areas. There is undoubtedly more land affected than these statistics indicate. To further this point, during the 2001 Agricultural Census, irrigators indicated that 5,000 ha of land showed signs of salinity with 2,000 ha of saline land unable to be used for production (ABS 2002). The 2002 ABS figures state that 392 farms showed signs of land salinity, while in 2004-2005 a total of 287 agricultural establishments reported irrigation salinity issues (ABS 2007). The difference in these figures indicates that a systemic study of irrigation salinity should be conducted across Queensland to set a baseline for future natural resource management.

While in excess of \$65 million has been invested in the last decade to improve irrigation practices and understand dryland salinity, there has been minimal investment in identifying the scale of any current or potential irrigation salinity in Queensland. In 2004-2005, Queensland farmers invested \$188 million in the prevention and/or management of land and soil issues (ABS 2007) with lack of information being a key barrier to improved natural resource management.

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