

# CASE STUDY

## of success with saltland pastures #7



## INVESTING IN SALT LAND

### Charlie Bruce, Kingston, Upper South East

#### The salinity issue

Charlie Bruce admits that many landholders in the district, including himself, weren't convinced that salinity was a problem for them. "After clearing the native vegetation, crops and pastures would generally go well for about 5-10 years. But then productivity would drop away, and the land would 'go sour,'" he recalls. Initially these declines in productivity were thought to be due to some type of fertility issue, but it didn't take long for Charlie to realise that salinity was to blame.

Sitting on top of a highly transmissive regional limestone aquifer and with clearing throughout the district, it didn't take long for watertables to rise. With 600 ha (over a third of his property) comprising relatively low-lying inter-dunal flats, Charlie had plenty of incentive to get on top of his salinity and waterlogging issues.

The moderately to highly affected flats became much worse after wet years in the 1980s and early 1990s. Flying over the district in May 1991 the widespread devastation brought by salinity could be seen from the air. Captured on airborne video, the red tinge of emerging samphire plants was visible across large areas. This devastating scene was the catalyst for the development of the Upper South East



Charlie demonstrates the depth to watertable (a bit over 1m below the surface) on one of his saline flats.

#### Fast facts

Farmer names	Charlie Bruce
Farm location	Boonoonar, Near Kingston, Upper South East
Enterprise mix	Wool, prime lambs, cattle
Saltland pastures	Puccinellia & tall wheat grass
Rainfall pattern	525 mm, winter dominant
Catchment clearing date(s)	1960s to mid 1970s
Salinity appearance	Natural salinity and waterlogging on inter-dunal flats has been made worse following clearing. Wet years exacerbate the problem.
Original vegetation	Eucalypts, Melaleucas (broom bush), cutting grass
Saltland soils	600 ha of inter-dunal flats, with loams to sandy clays over calcrete
Depth to watertable	Normally less than 1m below the surface
Groundwater EC	Varies from 1200-5000 mg/L travelling east to west
Motivations for taking action	Reclaim production from a large area of grazing land that had been lost to salinity

Dryland Salinity and Flood Management Program that has seen drains cut through parts of the district.

#### Looking for answers

Starting shortly after he took over the property in the early 1970s, Charlie began seeding sub-clovers, strawberry clover, Demeter fescue and other pasture varieties to boost productivity on the underperforming flats. These persisted and performed well in patches, but in the long term the exercise was a failure. Sea barley grass eventually took over.

In the mid 1970s tall wheat grass made a big difference to productivity, and a few years later Charlie started planting puccinellia. "In the 1980s tall wheat grass grew shoulder height," Charlie recalls. "But as salinity has increased in recent years tall wheat grass hasn't done so well." Having a mix of species present in his saltland has allowed different species to provide reasonable production as salinity levels rise and fall with the variable seasons.

Charlie's puccinellia paddocks have lasted well, with many of them over 20 years old. In some he has noticed that, over time, compaction may be increasing capillary action in the soil thus reducing production. To rejuvenate the established puccinellia he is trialling cultivating in one paddock. So far a lack of rain has produced poor results.

Regional limestone aquifers are very porous and suited to drainage, but currently the regional drainage scheme does not benefit *Boonoonar*. With a lack of drainage, and very low gradients groundwater hasn't got anywhere to go. Watertables are usually less than 1 m below the surface on the flats however recent drier than average years have resulted in some lowering of groundwater levels. Typically waterlogging is also an issue, with some of the flats usually remaining waterlogged from July through till October.



*Flooding on the inter-dunal flats (Aug 2003).*

Charlie has seen the drains around the district work, returning watertables towards pre-clearing levels, and he hopes that one day his property will be connected. Drains cut through neighbouring properties have released the shallow groundwater, turning salt-affected land, that was being colonised by samphire at the height of the salinity problem in the late 1980s and early 1990s, into land that now supports vigorous lucerne stands.

### **The system**

Charlie's decision to establish puccinellia and tall wheat grass on his flats has paid off. The jump in production is estimated to have doubled to at least 5 DSE/ha on the



*Puccinellia dominates on high salinity flats.*

salt-affected ground. Having gone to perennials across the farm Charlie has observed a longer growing season, more productivity and bigger wool cuts.

During winter, growth on the flats is typically poor due to waterlogging and low soil temperatures, with some areas remaining waterlogged for 3-4 months in a normal year. During this time, stock are grazed largely on the sandy rises. Beginning in November stock are moved onto the flats for a month or so to avoid the grass seed problems associated with brome grass and silvergrass on the higher ground. Because the flats are salt-affected these problem plants do not persist, while puccinellia and tall wheat grass pastures (where sea barley grass has been controlled) do not present problems with grass seeds. Like any farmer, Charlie has to be very flexible and stock movements and feed supplementation largely depend on feed availability across the farm.

### **The fertiliser question**

For many years Charlie has been sceptical about applying fertiliser to his saltland. His soils are chemically low in phosphorus (which is leached out of the porous soils) so he has always put P out, but he is uncertain of the value of nitrogen for his saltland. "We are uncertain about the worth of adding fertiliser to what might be low value pasture. What should you add, at what rate, and what are the benefits?" he asks.

While saltland producers generally find that on the right ground, in the right year, and when applied at the right time, the benefits of nitrogen will be there – Charlie's caution is highly justified. After all, the decision whether or not to apply fertiliser is just another investment decision among many to be made on the farm. Like any investment, there will be risks and pay-offs. Importantly such an investment should be prioritised against the likely risks and

pay-offs for all the other investments the business can make.

To help answer his own questions on the matter, Charlie worked with a group of local saltland producers running small plot fertiliser trials over 3 years, on 8 different properties in the Kingston district. These small plot trials assessed responses in puccinellia and tall wheat grass pastures to phosphorus, nitrogen and a combination of both fertilisers, applied at the break of season. Another trial looked into just how much year-round production could be gained from a tall wheat grass system, with N and P inputs. This trial compared one 20ha paddock receiving a standard application of single super plus 25 kgN/ha, to another 20 ha 'control' paddock that received only the super. These trials were made possible through Land, Water & Wool's 'Sustainable Grazing on Saline Lands' (SGSL) program, which also enabled producer groups undertaking the trials to access information and resources from a wider network of saltland producers, researchers and extension workers.

The small plot fertiliser trials showed a great deal of variability in dry matter production across the properties, forcing the group to think hard about what was really going on.

Production was limited, despite fertiliser being applied:

- on very highly saline ground.
- where soils were very shallow (with physical or chemical barriers to root development).
- where P was inadequate, in the case of N inputs.
- where waterlogging occurred soon after N application.
- where soil temperatures were low.
- in dry years.

Pastures were not always responsive to N inputs. Where legumes (clovers, medics) persisted these usually provided adequate N for the pasture. P inputs also appeared to have no impact where P levels in the soil were already adequate.



*Kingston Salinity Group members taking pasture cuts in a productive tall wheat grass pasture.*



*In the tall wheat grass grazing trial, the paddock receiving both N+P (left) shows stronger, greener growth.*

On average, the small plot trials showed the largest annual responses occurred with N and P combined. This backs up the underlying thinking that sites need adequate P in order to gain the best response from N inputs. And also that timely N+P applications (before a site gets too wet or cold) can significantly boost pasture production.

The grazing trial for tall wheat grass has demonstrated the potential productivity of this system. In 2003 (with decent rain) the paddock receiving both N and P inputs achieved a stocking rate of 17.4 DSE/ha/yr, or a productivity increase of approximately 2 DSE/ha/yr (additional gross margin of around \$80/ha) over the control.

Since the SGSL trial work, Charlie has started to put nitrogen out on his saltland. In 2003, the first year of the trial, decent rains brought good results. Since then Charlie says results have been "very questionable, with bad years, a lack of rain and the cold probably to blame." When good rains return, Charlie is confident that with improved fertiliser and grazing management the stocking rates on his saltland pastures could potentially be doubled from 5 DSE/ha up to 10 DSE/ha.

For others considering applying fertiliser to saltland, it is generally recommended that soil testing be undertaken to assess whether P levels are adequate. The critical value for puccinellia is seen as 10-12 mg/kg, while for most pastures it is around 20 mg/kg (Colwell P).

Where legumes are present (only up to moderate salinity levels), the addition of adequate P will often be enough to drive pasture production. Where legumes do not persist (but soil conditions are otherwise favourable), N inputs may be critical for building and maintaining pasture vigour.

Early nitrogen applications (typically 25-50 kgN/ha in late autumn/ early winter) are usually more effective, producing greater annual dry matter production. Applying well before it gets too wet or too cold will avoid N inputs being lost and give plants a good start. Puccinellia plants in particular



*Cattle grazing mixed tall wheat grass (small clumps) and puccinellia pasture. [The larger clumps are cutting grass.]*

require good early growth (and careful grazing) to ensure enough height to withstand seasonal inundation.

Out-of season (summer-autumn) feed production is valuable, and applying fertiliser to boost summer-autumn feed in saltland pastures can offset the high cost of supplementary feeding. In reaching a decision, the cost of alternative feeds (conserving hay, buying feed) should be weighed up against the likely extra production from fertiliser inputs.

## Economics

For landholders considering establishing similar saltland pastures, some example economic figures are provided below. Example costs and benefits expected from pasture establishment (see Table 1) were fed into a profitability calculator (developed by PIRSA economist Graham Trengove).

The boost in production on Charlie's saline flats following development is estimated to represent an increase in stocking rates from around 2.5 to 5 DSE/ha/yr. This represents Charlie's established practice, applying minimal N inputs. Greater production (up to 10 DSE/ha/yr) could be expected with greater N fertiliser inputs.

Following pasture establishment, greater profits are expected if greater numbers of stock are grazed on the extra feed produced, rather than increasing production from existing animals.

For puccinellia, a pasture life of at least 20 years has been demonstrated. For tall wheat grass the question is often 'how to get rid of poorly managed stands,' rather than 'how long will it last?'

To prevent tall wheat grass becoming a weed issue, it is recommended that stands be well buffered from sensitive biodiversity areas and managed to prevent seed set. Trials in Victoria (Dion Borg, Vic DPI) indicate that production and feed quality are optimised if tall wheat grass pastures are kept below 20 cm in height.

*Table 1. Example costs and benefits for puccinellia and tall wheat grass establishment.*

<b>Pasture establishment</b>		
Cultivation		\$20/ha
Seed	Pucci (4 kg/ha x \$4/kg) + tall wheat grass (8 kg/ha x \$9/kg)	\$88/ha
Fertiliser	Super (18 kg/ha x \$300/t) + 18:20 DAP (7 kg/ha x \$515/t)	\$9/ha
Weed & pest control	Spray-top in spring prior to sowing plus knockdown at break of season & RLEM control	\$15/ha
<b>Other capital costs</b>		
	Fencing & water – additional expense not required as established area is part of whole paddock, not a niche area	Nil
<b>Annual maintenance costs</b>		
Fertiliser	18:20 DAP (7 kg/ha x \$515/t)	\$4/ha
<b>Other factors</b>		
Previous grazing potential of the land		2.5 DSE/ha/yr
Period of grazing foregone during pasture establishment		1 yr
Grazing potential after development		5-7 DSE/ha/yr
Capital invested to purchase additional livestock (once off)		\$45/DSE
Estimated life of the pasture		20 yr
Profitability of the livestock (annual gross margin)		\$25-35/DSE

The measures of economic performance shown in Table 2 are:

- 'net present value (10%)' [ie. the total future profit from pasture development in today's dollars assuming a 10% discounting rate], and
- the minimum pasture life to break even.

Table 2. Profitability estimates for puccinellia and tall wheat grass pasture establishment based on a 20 year pasture life, under different stocking rates and livestock gross margins.

Values are: \*NPV (10%) – the total future profit (per hectare) in today's dollars over the life of the pasture; and \*\*minimum pasture life to break even.

Total stock run following pasture development (DSE/ha)	Profitability of livestock (annual gross margin)		
	\$25/DSE	\$30/DSE	\$35/DSE
5	*\$158 / **7 yr	\$236 / 5 yr	\$313 / 5 yr
6	\$302 / 4 yr	\$415 / 4 yr	\$528 / 3 yr
7	\$446 / 3 yr	\$594 / 3 yr	\$742 / 3 yr

For example, assuming a gross margin of \$25/DSE and a stocking rate of 5 DSE/ha (extra 2.5 DSE/ha) is maintained over the 20 year life of the pasture, the total future profit arising from pasture development in today's dollars (assuming a discounting rate of 10%) would be around \$158/ha. To start returning a profit the pasture needs to last at least 7 years.

In this scenario, minimal inputs and a long pasture life contribute to the profitability of this system, despite only modest gains in production. Profits clearly improve as higher stocking rates can be supported, however this is likely to require some additional expense on fertiliser.

Further benefits not taken into account in this analysis include:

- The additional value of out-of-season (summer-autumn) feed available on saltland pastures.
- Health benefits to stock, grazing in grass seed free saltland pastures.

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