

SALINITY: THINK TOTAL CHANGE OF LAND USE

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LOCATION

“The Springs” farm is situated on Southern Yorke Peninsula, 45 km “as the crow flies” from Adelaide, across Gulf St Vincent, 200 km by road from Adelaide, and 7kms from the coast (Figure 1). It has a Mediterranean climate and is acknowledged as one of the best barley growing areas in Australia. The undulating landscape of Yorke Peninsula has only 5% of the original native vegetation left after extensive clearing, and most of this is in National Parks. Total clearance of native vegetation was an attempt to destroy the habitat of rabbits.

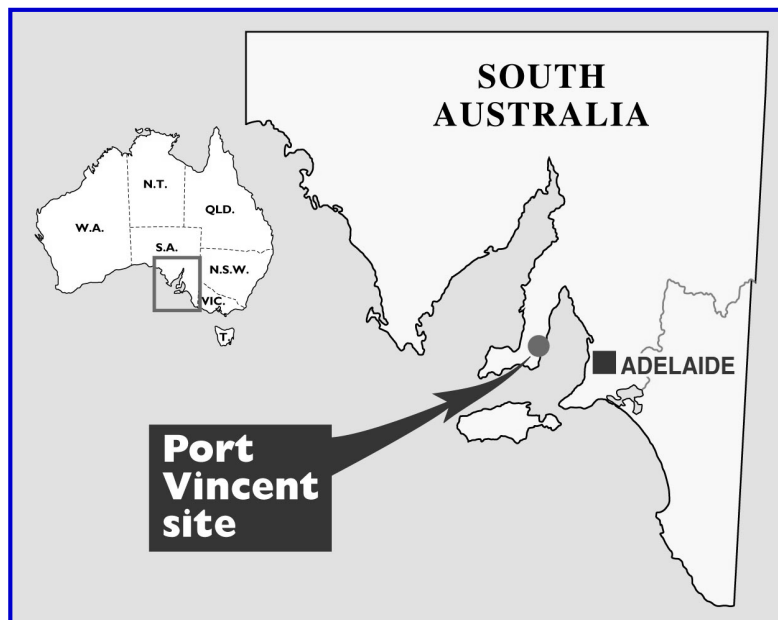


Figure 1. Location of “The Springs” farm at Port Vincent, on the Yorke Peninsula.

HISTORY

First settled in the 1870’s the Yorke Peninsula was cleared in areas where good underground water could be found for stock. A 35 square km area known as the “Stansbury Scrub” (including a large portion of our property) was not cleared until the 1940s and 50s as no good underground water could be found.

Yorke Peninsula land was sought after because of the close proximity of small ports for ‘shipping’ produce to Adelaide, and later the International trade via the Windjammers out of Port Victoria. Land on Yorke Peninsula today sells from \$500 per acre to \$2,500 per acre in the most sought after areas. Droughts are rare because of the geographical location and because the Peninsula is narrow and surrounded by water. The native vegetation on the property varied from 20” high mallees, broombush and acacias on the sandy loam, with larger mallees and sheoaks on the heavier soils. Soil types range from red with a high limestone percentage, sandy

loam over clay, and deep white non-wetting sand over clay on the hills. (Sandhills were cleared because of the rabbit problem).

In 1959 water was piped to Yorke Peninsula from the River Murray, and this brought about a large increase in stock numbers. Our farm was producing excellent prime lambs, wool, malting barley, peas wheat and oats. 1979 was a very wet, late winter/early spring, which left us with 200 acres of “low-land” under water. This water had come from the head of the catchment 14kms away.

We were unaware of the amount of salt in that water and with sheep “camping in these affected areas for the next 3 summers, we were left with a huge barren area. The top soil, which was now salty, drifted onto unaffected soil, which in turn ruined that too because it was left with a layer of salt on it. We were still quite ignorant at this time so we tried to talk to the farmers further up the catchment who told us it wasn’t their problem. 20 years later, these same farmers are now co-operating because of a National Grant through the Soil Board.

During 1982 we tried to get information re salinity but very little was known. We decided to make a stand as we were going out of business fast, as our best cropping land had gone. In the summer of 82-83, after discussion with the local Council, (the Chairman was a Soil Board Member) a culvert was put under the road where the water enters our property. A small grant was obtained from the State and Federal Government, and a drain was graded through the farm to the adjacent salt lake. We fenced off approximately 100 acres of the worst affected area to keep stock and to “tidy” it up, believing it would never be productive again.

We planted salt tolerant grasses (puccinellia and tall wheat grass) and trees mostly for aesthetic purposes. In 1987, a stand of 7,000 River Red Gums was planted to lower the water table and as a future woodlot if need be. About 1990 we realised we could “central graze” sheep on the grasses in the affected area so the country was looking much better. We decided to fence the 100 acres into 3 smaller paddocks. The underground water level at this time was 30 cm below the surface. In 1996 we shifted a fence and found the water level/table in this same area had dropped to about 1 metre.

In 1995 we travelled to a Salt Bush Field Trip in the South Australian Mallee (3 hours drive away) and were very impressed by how we could adapt this plant to our saline areas. We planted our first 25,000 Old Man Saltbush in July 1996. We decided to plant in blocks of 4 rows, 2 metres apart with the plants also 2 metres apart with a laneway 5 metres wide between the blocks of 4 rows e.g. we aim for around 1,000 plants per acre.

The reasoning behind the ‘laneway’ ideas was to allow their movement of stock and broadcasting of fertilizer etc. The 2 metre spacings were for easier access for sheep around the plant and the spacings allowed puccinellia, tall wheat grass and clovers to establish for a broader feed base for stock. In the following 3 years we increased our plantings of Old Man Saltbush to 150,000 planted fenced off into 8 paddocks, the largest being 60 acres the smallest 10 acres and the rest averaging around 25 acres (Figure 3). These paddocks are purely for stock. We have included the affected land plus adjacent ‘at risk’ land, and ‘double fenced’ to plant windbreaks/shelter belts, corridors for birds and to lower the water table, plus shade trees in all these areas. We have put in watering points and the larger paddocks have 2 watering points, as water is a very important part of the animals diet in saline pastures.



Figure 2. Devastation caused by salinity (1982), once excellent cropping land (top); and the same area in 2002 showing reclamation and a return to productivity (bottom).

We have now learnt to look at our problem on a whole farm basis and take into account recharge areas, discharge areas, soil types and planning for cropping and stocking the whole farm. We are fencing recharge areas as we are desperate to intercept the water into the lower discharge areas, which is our best cropping land. Forestry has been considered but markets are too far away and water uptake is slow.

The trials we have done with lucerne have convinced us that lucerne is our best option. To enhance our prospects for success in growing lucerne we have clay-spread our non wetting white sand and will sow 70 acres to lucerne this month while the soil is still warm and damp (lucerne will not germinate well if it is too cold & wet). Pasture mixtures of Frontier, Santiago, Casbah & Nitro etc are being sown to improve the fertility for cropping and also as high quality nutrition for stock. With most of our saltbush now 5-6 years old, we can graze or maintain an additional 300 ewes and their lambs which would not have been possible in the past.

The feeding programme we are using at the moment allows the general farm pastures to establish after the opening rains, then sheep are returned for periodical grazing. We believe this keeps animals healthier with less scouring.

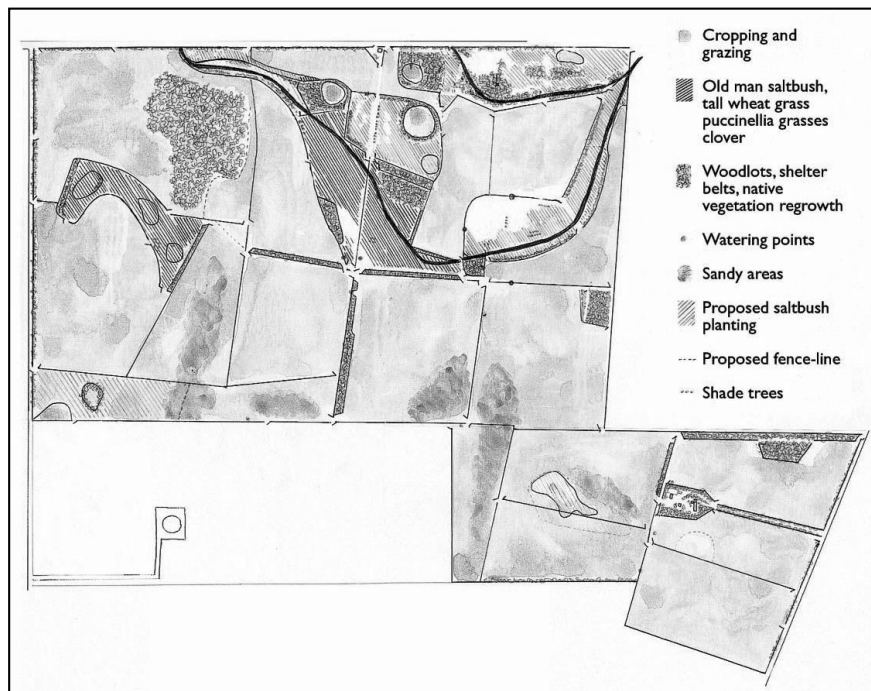


Figure 3. Farm map, indicating cropping and grazing land, saltland pastures and woodlands.

ROSEWORTHY RESEARCH TRIAL

The considerable investment of planting saltbush and puccinellia on the most saline sites of the farm was clearly beginning to offer profitable and sustainable grazing systems. Recent experience found lambs grew well with lactating ewes grazing saltbush pastures, a result that was largely attributed to the inter-row pasture that acts as a supplement to the salty but nitrogen-rich saltbush. However, a body of published research suggests that animal performance is poor when sheep graze saltbush without any supplementary feed (Warren & Casson 1991, 1992, 1994, 1996; Morcombe *et al.* 1996; Masters *et al.* 2001), although such a conclusion is not held universally (Wilson 1966; Hanjra & Rasool 1991). A research project was undertaken in autumn 2002 to investigate the optimal use of saltbush forage, and aimed to determine whether supplementation can improve sheep performance to generate profitable rates of liveweight gain, at a time of year when it is often expected that grazing sheep will only maintain or lose body weight.

Old man saltbush (*Atriplex nummularia*) and puccinellia (*Puccinellia ciliata*) were the dominant species in the plots used in the research project, although other grasses, samphire, and medic were also present in small amounts.

Potential value of saltbush to livestock

The nitrogen content of saltbush is theoretically adequate to support weight gain in adult animals (Warren *et al.* 1995). This is an important attribute of saltbush, as the Mediterranean summer-autumn period is usually characterised by low feed availability and, in particular, low pasture nitrogen (N) content (Chriyaa *et al.* 1997a; Roberts 2001). The high N content of saltbush does not deteriorate during the dry summer-autumn period (Jones & Wilson 1987; Atiq-ur-Rehman *et al.* 1999) while the plant is actively growing means that it is potentially a very valuable forage to fill the autumn feed gap.

Saltbush leaves contain 2-3% nitrogen (Arieli *et al.* 1989; Wilson 1994), similar to lucerne hay (Chriyaa *et al.* 1997b). Crude protein (CP) is mathematically derived from this N content ($CP = N \times 6.25$), suggesting that saltbush contains 12.5-19% protein; adult sheep require a diet of at least 12% protein for liveweight gain (Ashton & Morbey 1994). But Roberts (2001) states that CP does not give a true measure of saltbush protein content as up to 50% of the N in saltbush is

non-protein nitrogen (“NPN”, e.g. nitrate and betaine). NPN is utilised by rumen microbes less efficiently than protein-N (McDonald *et al.* 1995; Masters *et al.* 2001), lowering the nutritive value of the N present. Furthermore, the N in saltbush undergoes rapid protein fermentation (despite reduced rumen retention time due to the effects of salt on digestive physiology), leading to high ruminal ammonia and loss of N in urine (Hassan & Abdel-Aziz 1979).

Despite a positive N balance, Roberts (2001) found that sheep fed saltbush alone, lost weight rapidly, implying that the animals were energy deficient. This suggests that a source of carbohydrate is required to enable the microbes in the rumen to ‘capture’ a greater portion of the N as protein. This project was designed to compare two sources of carbohydrate; a high fibre source (barley straw) and a source of more-readily fermentable carbohydrate (barley grain).

Supplementing with roughage

Successful saltbush graziers believe roughage is imperative for optimum utilisation of saltbush, using inter-row pasture, cereal stubble or hay where necessary (Seymour 1997). Roughage is required as a source of fermentable fibre and soluble carbohydrate to utilise the high nitrogen content of saltbush and to dilute the salts (Roberts 2001). Feeding saltbush and roughage increases forage intake and liveweight gain (Warren *et al.* 1990; Warren & Casson 1992; Casson *et al.* 1996; Hopkins & Nicholson 1999), although these studies did not include a correction for any changes in body water content. Roberts (2001) doubled dry matter intake of sheep by mixing saltbush and chaff, attributing it to stimulation of microbial digestion in the rumen. In grain-growing areas of Australia, roughage is abundant as crop residues (Morcombe *et al.* 1991), either from grazing paddocks adjacent the saltbush or as baled straw.

Supplementing with grain

Grain provides a source of rapidly fermentable carbohydrates (mainly starch) to aid microbial utilisation of nitrogen from saltbush, as well as keeping the animals in a positive energy balance (Fontenot *et al.* 1955; Lewis 1957; Roberts 2001). An increased dietary energy content increases nitrogen utilisation (Arias *et al.* 1951, Fontenot *et al.* 1955; Deif *et al.* 1970; Hemsley *et al.* 1975; Hassan & Abdel-Aziz 1979), yet many saltland graziers believe that grain supplementation is not necessary when sufficient saltbush leaf (with a moderate to high energy content) is present (Seymour 1997).

Methods

Eight research plots were established on one paddock that had a relatively uniform growth pattern of saltbush and puccinellia. Each paddock was supplied with fresh water, and six sheep grazed each plot. Four treatment groups were used (hence each treatment was replicated once): (i) saltbush and puccinellia pasture only (SB+P); (ii) SB+P with 250 g/head/day of barley straw; (iii) SB+P with 250 g/head/day of barley straw; and (iv) SB+P with both grain and straw supplements (each at 250 g/head/day). The grain was fed out daily, and fresh straw was added when necessary. Grazing commenced on 26 March 2002 and lasted for 43 days, at which point there was insufficient dry matter on offer to continue the trial.

Preliminary results

The results are currently being compiled and analysed.

The intake of saltbush and inter-row plant material was, based on visual assessments, increased by providing the supplement of barley grain (Figure 4). Herbage cuts and sampling were undertaken to permit an estimation of feed on offer from saltbush and inter-row pasture, with the data still being analysed.

Virtually no straw was consumed in sheep fed SB+P with barley straw but, interestingly, some straw (approximately 45g/day) was consumed when it was fed with barley grain. The forage on offer in the plots was reduced to very low levels by the end of the experiment; inter-row DM on offer was <200 kg/ha, and most saltbush plants were nearly devoid of leaf material. However,

following removal of sheep and the opening rains, there has been a tremendous re-growth of saltbush and inter-row plant species, including legumes (medic) (Figure 5).

All sheep gained nearly 200 g/day during the first 2 weeks of the trial (Figure 6). Part of this weight gain may have been body water (body water content will be estimated, through use of deuterium oxide injections, but the data are not yet available). Between weeks 2 and 4, sheep that received grain only as the supplements continued to gain about 120 g/head/day, a figure that is unlikely to be due to any further increases in body water. This exceeded the weight gain of all other sheep, including those that received grain and straw supplements. The reason why it was better to supplement with grain alone rather than with grain and straw is not clear, but may be due to the whole diet being better 'balanced' with saltbush, dry puccinellia and grain than with additional roughage as straw included the diet (albeit a small amount of straw). This warrants further investigation.

During the last 2 weeks of the trial, all sheep lost weight due to insufficient feed being available, but those that received the grain supplements (either alone or with straw) lost the least weight (only about 50 g/head/day rather than about 200 g/day). Over the duration of the experiment (43 days in autumn), sheep receiving SB+P with grain (alone) performed the best, averaging about 60 g/day. Under a commercial situation, the grazing pressure would have been reduced earlier than 7 May (either by reducing the stocking rate or providing additional pasture/forage), and hence it is realistic to expect that a correctly managed grazing system with saltbush and strategic supplementation could deliver weight gains of at least 100 g/day throughout the autumn period.



Figure 4. An example of two of the experimental plots. Sheep in the plot on the left side of the fenceline received grain and straw supplements, whilst sheep in the plot on the right-hand side did not receive any supplements. The herbage remaining on the saltbush and in the inter-row is less in the left-hand plot. The photo was taken on 11 April 2002 (before the break of season).



Figure 5. The same two plots as shown in Figure 4, now showing considerable regrowth of forage by late July 2002.

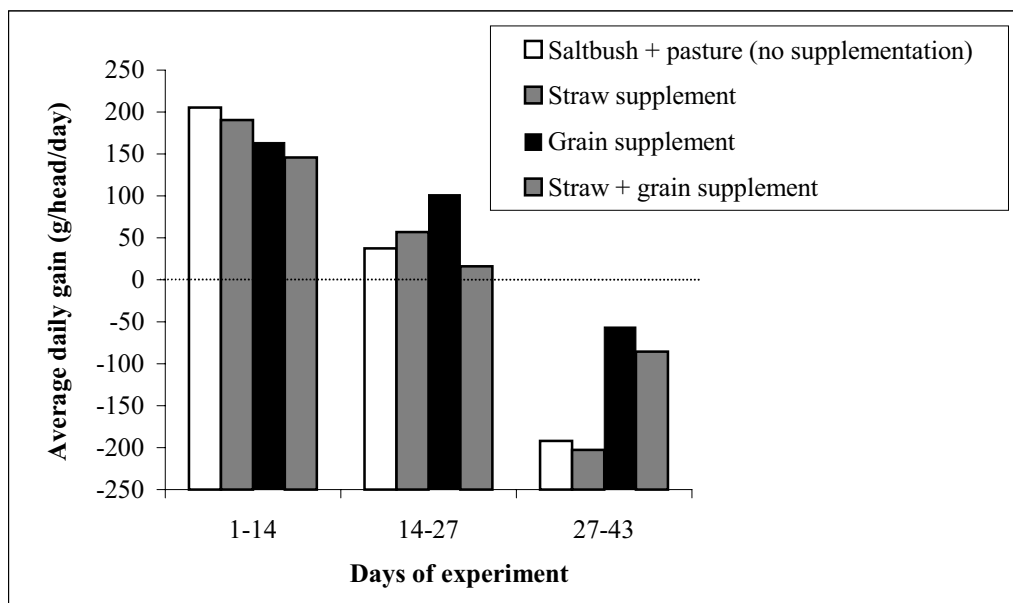


Figure 6. Liveweight gain of sheep grazing saltbush-puccinellia forage, with or without supplementation.

Continuation of the demonstration /research site

The plots used in the study described briefly above have been retained for use as a demonstration and/or research site. There is an annual visit by students from the Roseworthy Campus of The University of Adelaide studying Pasture Agronomy (which includes grazing management and saltland pastures). Student feedback from the tours have been extremely positive, as they have appreciated the example of whole-farm management for salinity, and have learnt about the profitable and sustainable grazing systems that can be established on saline land. It is envisaged that the established site, and possibly other paddocks on the farm, will be used for other studies in the future as a showpiece showing the productive use and rehabilitation of saline land.

WHERE TO NOW?

As a result of the Roseworthy Trial we now plan to feedlot XB store lambs in these saline pastures with a small supplement of grain in the autumn period when barley and legume stubbles have been eaten out, and prime lambs are at their best price. Within another 2 years the lucerne will be established which will greatly increase the sheep carrying capacity of the property.

In conjunction with our son in law Miles Cockington (a pastoralist from the North East Pastoral Area) we are developing a sheep project to produce high quality superior wool and meat whilst increasing the carrying capacity of an area through a combination of outstanding pastures and utilising reclaimed saline lands that have been restored with salt tolerant plant species. The ultimate goal being high return sheep that can demonstrate to and inspire other landholders and sheep producers the outstanding benefits of both restoring saline land and diversifying into large wedged framed, long stapled, fine micron, high value red meat cuts merino sheep. We have purchased a nucleus stud flock of very large framed ewes, selected for a laparoscopic AI programme, using the best genetics available. In 3 years our aim is to produce 8 kg or more of 16 micron wool with a staple length approximately 200 mm. Our programme not only focuses on improving wool quality of sheep on saline land but in addition the style of sheep being used also has benefits for lamb and meat trade.

CONCLUSIONS

- To win the fight against salinity a whole farm plan approach is essential. We have learnt that saline land will never be cropped again but can be restored to high value grazing land.
- We are now addressing all recharge areas because without addressing these areas we will not win the battle.
- Cooperation of all the farmers in the catchment is essential.
- Planting of trees for shelter, bird corridors and shade adding to the biodiversity is an important part of the overall plan. (We have planted approximately 120,000 trees on our property)
- Have a plan, a bank loan, and a positive outlook
- This degraded land can be turned into a profitable enterprise for future generations. What has taken us 20 years can now be done in 5 or 6 years.

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