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Waterponding the rangelands

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Introduction

Bare, scalded semi-arid areas in western New South Wales Australia are being transformed into biodiverse native pastures, thanks to the waterponding technique which is returning clear profit to the landholder and benefits to the environment. Waterponding is a land rehabilitation technique used on duplex scalded soils in the semi-arid rangelands. Waterponding is the holding of water on the scald in surveyed horseshoe-shaped banks, each covering 0.4 ha. The ponded water leaches the soluble salts from the scalded surface. This improves the remaining soil structure, inducing surface cracking, better water penetration and entrapment of wind-blown seed. In the 1960s, it was estimated that tens of thousands of square kilometres of sites on duplex soil in the rangelands of New South Wales had been denuded and were moderate or severely bare or 'scalded' as a result of wind erosion of their sandy top soils. (A 'duplex soil has sandy loam topsoil and clayey subsoil) (Cunningham, 1987). This was a consequence of past severe droughts and overgrazing of the native vegetation, allowing wind and water to erode the sandy loam topsoil. This left bare and relatively impermeable subsoil which prevents water penetration and is very difficult for plants to colonize.

Materials and Methods

The Marra Creek Waterponding Program was established at Nyngan NSW Australia in 1984 located between the Bogan River and the Macquarie River to refine and establish the waterponding technique as a recognized rehabilitation method for scalded rangelands. It involved the Soil Conservation Service of NSW and 18 landholders in the Nyngan Marra Creek District. It showed that success of waterponding in rehabilitation of scalded country depends equally on: bank construction to specific dimensions; correct survey techniques; suitable construction equipment; and appropriate management of banks to allow establishment of native perennial pastures. In 1984, Thompson (Soil Conservation Service, NSW) mapped 100 000 ha of scalded country in this area that had potential for waterponding Thompson (2008).

The most productive and effective waterpond shapes for relatively level sites were a horseshoe shape (on scalds with slopes up to 0.4%) and complete circles (on flat scalds). These enclose an area of approximately 0.4 ha within each waterpond (Rhodes, 1987). The horseshoe-shaped and fully enclosed circular waterponds rely on the rain falling directly into the pond allowing very little external catchment to enter the ponds. The ends of horseshoe-shaped banks should be surveyed to ensure that they are level. This enables any overflow water to escape around both ends rather than concentrating it in one direction. A maximum depth of 10 cm of ponded water was found to be ideal as any deeper would damage native grasses and shift the vegetation to more wetland species. This depth is achieved by the correct survey method, then construction of the waterpond bank with a road grader to a minimum height of 45 cm and 1.8-m base width. An important lesson learned is that the size of the pond needs to be limited to ensure that the area of pond and the catchment which feeds it are able to be held by the waterponding banks without fear of breaking. That is, failures can occur when either the surface of the catchment or pond is too great, or if these dimensions are marginal and wave action (which is capable of eroding banks in high winds) occurs. All ponding banks are subject to some damage of this nature, particularly just after construction. The preferred way to limit the size of the pond is to ensure the length of the total embankment of each waterpond does not exceed 250 m and the distance between ponds across the slope is 5 to 10 m. This leaves an area ponded within a bank of approximately 0.4 ha and allows space for the borrow area for the lateral bank as well as an undisturbed area for vehicles to drive on**.** Waterponding banks are carefully surveyed then constructed from adjacent borrow areas. They require a minimum height of 45 cm and a 1.8-m base width. This supports a maximum depth of 10 cm of ponded water which is ideal to induce deep cracking and germination and development of grasses and saltbushes. Wave action problem is worst in exposed situations where ponds are larger than 0.4 ha and where the banks have been built with insufficient freeboard and base width.

Before 1983, waterponding banks were surveyed using a surveyor's level and staff. This operation required three people, two to survey the waterponds and one to mark the line with a tractor mounted ripper. This method was far too slow and inefficient for the large areas of layout required. The Soil Conservation Service acquired a laser level transmitter and a simple handheld 5-m telescopic receiver. This survey system reduced the people required to two but still could not achieve the decided outcomes required to satisfy the demand. The handheld survey system was replaced in 1985 with the purchase of an elaborate vehicle-mounted laser receiving system that revolutionized the whole waterponding reclamation technique. In addition to the laser system, a vacuum tine marker was fitted to the rear of the survey vehicle which can be raised and lowered from inside the vehicle. This has enabled the entire survey and marking of waterponds to be carried out by one person from the comfort of an air-conditioned vehicle. This means that up to 50 ha can be surveyed and marked ready for construction in a day.

Over time, a wide range of machines have been used to construct waterponding banks including standard road graders (ridged frame and articulated) or similar. Pre-1985 road graders were generally too small to construct banks of sufficient size, which resulted in a very high percentage of waterpond banks breaching due to lack of freeboard and inadequate bank base width to stop tunnelling due to the very dispersible nature of clay pan soils. So over a 4-year period, the Marra Creek Waterponding Demonstration Program researched different horsepower road graders constructing different size banks, winning the dirt from different locations and the economics of construction methods. The results showed that the higher-powered articulated road graders greater than 200 HP have proven to be the most economical and efficient for waterpond construction. This type of machine has the power to side-cast material to form the bank with one pass on the inside of the bank and two passes on the outside, achieving a bank with well over 2 m base width and over 50 cm high. Construction in hard scalds will be easier if the grader has front scarifiers – and back rippers are useful for ripping across the waterponds for establishment of saltbushes and perennial grasses.

Results and Discussion

The land managers that undertake incentive projects to rehabilitate scalds carry out yearly photo and step point monitoring, commencing before the waterponding rehabilitation works take place. This highlights the dramatic landscape change that has taken place after the waterponding rehabilitation technique has been applied to scalded duplex soils. Photos and pasture measurements were undertaken on ‘Billabong’ Marra Creek NSW, commenced October 2005, waterponded November 2005 and monitored to 2014.This Billabong paddock waterponding site has increased from 1% ground cover in 2005 to 84 % ground cover in 2014 (Thompson, 2012).

When the waterponds modify the soil structure, improve water infiltration, increase soil moisture and decrease soluble salts and the vegetation is present on the ponded sites organic carbon can begin to accumulate in the soil. Research has found that the scalds store approximately 18.7 t/h of soil organic carbon to a depth of 30cm. Once the landscape has been restored by waterponding and revegetation we have found there is a rapid increase in soil organic carbon up to 25 t/ha within five years (Read *et al*., 2013).

The result of waterponding is indicating that land in the rangelands that has been rehabilated using waterponds does sequester carbon. This could lead on to waterponding being eligible for a carbon abatement activity and hopefully lead to Carbon Farming Initiative activity for carbon credits.

Conclusion

The increase in native pasture yield has made the waterponding technique an economic method of increasing production and reinstating functioning native vegetation communities on previously scalded lands.
Many methods have been tried to make scalded country productive, but nothing has worked as well as waterponding.

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