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DIRECT SEEDING: AN APPROPRIATE TECHNOLOGY FOR THE REGENERATION OF DEGRADED ABORIGINAL LANDS

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Introduction: Vegetation management and Aboriginal communities.

Vegetation management is not a new concept to many Aboriginal people. Traditional vegetation management practices such as patch burning required a thorough understanding of the ecology of vegetation communities, vegetation succession, and the associated fauna. Burning was not carried out indiscriminately but rather, informed decisions were made in response to the vegetation type, season and the time since the last burning (Walsh 1989). It has even been said that the traditional Australian landscape was an Aboriginal artefact, maintained in its pristine form by conscious Aboriginal management (Coombs 1989).

However, with European contact and the establishment of permanent Aboriginal settlements, the pattern of vegetation use by Aboriginal people living in remote settlements in the arid and semi-arid regions of Australia has undoubtedly changed.

Permanent settlements of Aboriginal people have brought about an increase in the people-pressure exerted on the land and vegetation surrounding those settlements. Whereas in the times before European contact people would move on when their impact on the local vegetation and fauna became detrimental to the environment and themselves, the advent of permanent settlements with regular supplies of food and water have provided very strong incentives for Aboriginal people to remain in a degraded environment, even though the environmental impact of a concentrated population on a relatively small area is clearly severe.

The practice of living a community lifestyle that degrades the local vegetation and subsequently creates health problems for the members of that community is of course not unique to Aboriginal communities. It is a problem that faces not only other users of the arid and semi-arid lands of Australia but most other communities in the world today. Nevertheless, the link between community health and the vegetation status of the surrounding environment is much more direct in remote Aboriginal communities than in other communities in the arid and semi-arid regions of Australia.

Aboriginal people living in remote communities in the arid and semi-arid regions of Australia often have a high dependance on local resources for food and firewood (Walsh 1989). Furthermore, Aboriginal people also spend a great deal of time outside their houses and are therefore very susceptable to dust borne diseases. In a significant report upon the health and lifestyle of Aboriginal people in Central Australia, it was observed that 80% of Aboriginal people spent 80% of their time outside the house in their back yards (Nganampa Health Council Inc. *et. al* 1987). The people of remote Aboriginal settlements thus experience a much greater degree of ill-health and discomfort than other people in arid and semi-arid Australia as result of vegetation denudation.

Clearly, vegetation management is an issue that must now be faced in a new way by Aboriginal communities. This does not mean that the traditional pre-contact methods of vegetation management should be rejected, for in many areas traditional methods such as patch burning may be ecologically sound (Burrows,

Ward and Robinson 1991) and very compatible with contempary community functions (Walsh 1989). However, because of changes in lifestyle and vegetation use, these methods alone are not enough and new methods that are are also ecologically sound and compatible with community functions must now be adopted, adapted or developed in order to cope with these changes.

Direct seeding and soil shaping

A technique that appears to have a lot of potential for use in remote Aboriginal communities is direct seeding in association with mechanical soil shaping. Direct seeding is a technique which is currently being enthusiastically promoted to pastoralists. It essentially refers to the establishment of vegetation through the distribution of seed. However, in degraded lands, particularly in the arid and semi-arid regions of Australia, vegetation establisment is much more likely to be successful if effort is also invested in soil preparation (Bastin 1991; Tatnell 1990).

For several decades now researchers in Australia have been investing effort into the development of soil preparation techniques that are not only capable of enabling seeds to germinate successfully but will also enable newly germinated vegetation to permanently re-establish itself (Cunningham 1987). In the arid and semi-arid regions of Australia, where water availability is the critical limiting factor, techniques which involve the moving and ripping of substantial amounts of soil to maximise rainfall catchment and improve the infiltration of water have proven to be the most effective. The soil shaping techniques that have been most widely used in Australia for this purpose are the construction of ponding banks, pits and furrows.

The concept of soil shaping can hardly be considered new. Earthworks to divert floodwaters and maximise use of rainfall have been used by ancient cultures for thousands of years. As early as 600 years B.C. a system was developed on the banks of the Nile to channel the regular floods into a series of rectangular basins bordered by dykes (Heathcote 1983).

The basic principle of soil shaping techniques is very simple. Water retaining structures such pits, furrows, waterponds, and the Nile valley basins work because they enable water to successfully penetrate the hard soils of arid regions and become available to seeds and existing vegetation. They also enable wind-blown and water-borne organic matter and seed to collect, improving the soil and promoting natural regeneration.

Ponding banks

Ponding banks are usually constructed using a bulldozer or grader. The experience gained from the construction of ponding banks in pastoral regions in recent years suggests that the size and shape of the banks should be determined in response to the topography of the country. In flat, scalded country circular waterponds are recommended. Low horseshoe-shaped (concave) banks are recommended on land with a slope of $< 0.15\%$ and crescent-shaped banks on land with slope $> 0.55\%$ (Rhoades 1987). In steeper country (gradient $> 2\%$) experience has shown that it is safer to build many short small banks with a flat or slightly convex shape, above or across erosion zones (Bastin 1991). It is also recommended that the height of the banks should be constructed so that, when settled, the bank is at least three times the depth of the ponded water. For example, if 10cm of water is to be ponded the bank should be built 40cm high which will, after weathering and compaction, reduce to a settled height of 30cm. The recommended maximum depth seems to vary. Recommended depths have been given as 7.5cm for the Hay district (Rhoades 1987), 15cm for the Broken Hill district (Newman 1966), 15cm for central Australia (Bastin 1991) and 6cm for the Carnarvon region (Williams and Shepherd 1991).

Furrows

Furrows are typically constructed using an opposed disc plough. Commercially available opposed disc ploughs comprise of a ripper and two opposed discs mounted approximately 1m apart and at an angle of approximately 45 degrees to the direction of travel. The plough cuts two furrows and the soil is ripped approximately 300mm deep. The ridge formed is approximately 1m wide and from 350 - 400mm high depending on the setting of the plough (Keetch 1981). A seed box is mounted on top of the plough enabling the furrows to be sown as they are formed. The 300mm furrows are usually constructed so that they follow the contour of the land and are broken regularly (ie. they are not continuous) to prevent erosion from the channelling of run-off water. However, on flat ground, furrows are typically made in spiral patterns.

The establisment of vegetation in furrows from naturally sown seed is not uncommon (Keetch 1981; Last 1990).

Pits

Pits are commonly created by a Paech pitter-tiller machine. The pits are approximately 1.8m long, 380mm wide and 300mm deep at their deepest point (Keetch 1981). Like the opposed disc plough, pitting machines are usually fitted with a seed box and pitting and seeding occur simultaneously.

The relevance of direct seeding and soil shaping techniques to remote Aboriginal settlements: the experiences of Central Australian Aboriginal Communities

The Pitjantjatjara Council Landcare Service first experimented with ponding banks at Ernabella in 1972. The banks at Ernabella were constructed with the help of the Land Conservation Section of the Conservation Commission of the Northern Territory (CCNT) who had previously built a great deal of seeded ponding banks, pits and furrows to revegetate and stabilise dust around Alice Springs. Although the land ponded by the banks was intended to be revegetated through the planting of seedling bagstock, it was found that once the previously compacted soil was ripped and ponded (allowing effective infiltration of water) the seed that was already present in the soil, but previously unable to germinate, was then able to do so. Witchetty bush (*Acacia kempeana*) and Acacia bush (*Acacia victoriae*) naturally volunteered in the treated areas and these species are now well established on the site.

Inspired by this unintentional success and also by the work around Alice Springs and on Central Australian pastoral properties, deliberate attempts to rehabilitate degraded land using mechanical soil treatment and seed were attempted by the Pitjantjatjara Council Landcare Service in 1987.

The Pitjantjatjara Landcare Service determined that a very important part of revegetation in remote communities was the careful selection of appropriate community areas to be treated and the appropriate species to use. Effective community liason was essential in order to gain an understanding of community functions and how they relate to vegetation and land use. This then enabled the identification of sections of land around the community that were least used by people. Soil shaping work and physical barriers to protect vegetation (fences, traffic bollards etc.) could be then be planned such that they would not be detrimental to the community's social functions. This was very important. Soil structures and physical barriers that are constructed in such a way that they

substantially interfere with community functions are unlikely to be welcolmed, accepted or even beneficial to the community.

An accurate assessment of the degree of soil degradation is also important. It was found that in some of the community spaces identified as appropriate for rehabilitation work, although the vegetation had been removed, soil degradation was minimal. In these areas it proved unnecessary to create pits, furrows, waterponding banks or even scatter seed. Once the persistent impact of people and vehicles on the vegetation was curtailed through the construction of fences and the re-definition of roads with controlling drains and traffic bollards, the vegetation would re-establish naturally. "An area of land was (just) fenced at Angatja, a homeland west of Amata, and the regeneration of acacia bush (*Acacia victoriae*) was substantial" (Last 1990).

In other areas, designated as culturally appropriate for revegetation, the soil degradation was substantial and mechanical soil shaping and seeding was deemed necessary. But which species would be the most appropriate to use?

Previously, most of the direct seeding work that had been performed by the Land Conservation branch of the CCNT had been directed at seeding plants that would effectively stabilise soil and provide feed for stock. The plants considered most suitable for this purpose were Buffel Grass (*Cenchrus ciliaris*), Birdwood (*C. setigerus*), Old Man Saltbush (*Atriplex nummularia*), Mitchell Grass (*Astrebla lappacea*), Native Saltbush of Israel (*Atriplex halimus*) and Northern Bluebush (*Chenopodium auricomum*). However, in remote Aboriginal communities, because of the need for trees and shrubs to supply shade, shelter, firewood, tools and artefacts it was decided that the seeds of larger shrubs and trees be used in addition to the seeds of grasses and small shrubs.

In 1987, using an opposed disc plough the Pitjantjatjara Council Landcare Service, the Land Conservation section of the CCNT, and the residents of Kalka, Pipalyatjara, Wingelina and Warakurna constructed seeded staggered furrows and spirals in each of these four communities. The results, after four years, are variable but nevertheless extremely encouraging. A small amount of rain (5-6mm) that fell in December 1987 was sufficient to germinate some of the grass and shrub seed that were planted. Follow up rain during the Autumn months of 1988 further assisted this growth. The success of the treatment was found to be significantly influenced by soil type. At Kalka, Pipalyatjara, and Warakurna, where the soils were lighter, only the grasses germinated along with a few Old Man Saltbush plants. However, at Wingellina, where the soil was heavier and the light rainfall was held by the soil more effectively, Witchetty Bush (*Acacia kempeana*), Umbrella bush (*Acacia ligulata*) germinated, in addition to the grass and saltbush species. More recently, self-sown Mulga trees (*Acacia aneura*) were also observed to be growing in the furrows and spirals.

In November 1990, the Pitjantjatjara Council Landcare received a grant from the NSCP to revegetate the bare land around the Warburton community. This time in addition to spirals and staggered furows made with an opposed disc plough, ponding banks were also constructed using a grader. Smaller seed species were sown using the opposed disc plough with the attached seed hopper whilst larger seeded species such as Acacias were hand-sown by members of the community. Warburton received substantial falls of rain in May 1991 and many of the trees, shrubs and grasses that were planted have now germinated.

One of the issues the Pitjantjatjara Council Landcare Service has been confronted with in this work is the need for large quantities of local seed. It is recognised that revegetation programes for communities and homelands need to include the

establishment of stands of single species in order to provide a source of seed for future revegetation programmes.

The Walungurru community has also been involved in rehabilitating degraded land around their community with the assistance of Tangentyere Council and the CCNT. In February 1989, 10 appropriately selected hectares of land around the Walungurru community were treated with opposed disc ploughs. Through consultation with the community it became apparent that at Walungurru only locally occuring species were to be used. The people of Walungurru collected kilos of appropriate local seed for the revegetation programme, mainly Acacia and Eucalypt species. This seed was supplemented by purchased seed to make up a mixture of 23 native species. As with the work at Warburton, smaller seeds were sown using the seed hoppers and the larger seeds were hand-sown by community members.

The results of the work at Walungurru have also been impressive. After 2 years of growth, fed only by the scant and unreliable Western desert rainfall, ground cover and erosion control has been achieved and the resultant plant density closely resembles that of the natural shrubland surrounding the community (Hay 1991).

Direct seeding and soil shaping technology in remote Aboriginal settlements: the future.

The experiences of Central Australian remote Aboriginal communities have elucidated many aspects of the use of direct seeding technology in remote communities that warrant further attention. Some of these issues are common to those raised by pastoralists. Issues such as: the possible benefits, cost effectiveness and social appropriateness of seed treatements such as pelletization and scarification; the potential role of fire management on revegetated areas (Purvis 1986; Friedel *et. al.* 1990); the role ants and other insects play in seed dispersal and establishment (Greenslade 1987); and the need for seed orchards. Other issues are perhaps more specific to remote Aboriginal communities themselves. For example, if the desired goal of the revegetation programme of a remote Aboriginal community is the restoration of a vegetation community that will supply shade, shelter, firewood and food, as well as an environment that will attract game - how should furrows and ponding banks be constructed such that they best facilitate the achievement of this goal? Also: what is the most desirable arrangement of the furrows?; what is the optimum seed mix to use?; what sort of successional changes will the vegetation undergo once it is established and how will the composition of the initial seed mix influence this?; and is there a role for drip irrigation or regular manual irrigation in the seeded furrows?

There are a number of organisations that are presently looking into these sorts of issues. Many of them are concerned mainly with the issues of direct seeding and soil shaping as they relate to the pastoral industry, but some are specifically looking at the use of this technology in remote Aboriginal communities. The Pitjantjatjara Council Landcare Service and Tangentyere Landcare are continuing to follow up and expand their involvment in the dissemination and development of this technology in remote Aboriginal communities in Central Australia. In W.A., the Remote Area Developments Group (RADG) is now conducting research into direct seeding and mechanical soil shaping for use in remote Aboriginal communities the Pilbara.

Clearly, there is still much to be learnt about the use of direct seeding and soil shaping techniques in Aboriginal communities but nevertheless, the present progress in Central Australia should not be ignored. Considering the extent of vegetation loss and soil degradation that is present in many remote Aboriginal settlements in Western Australia, surely this is a technology that the people of

remote Aboriginal communities, and those that work with them, should seriously consider.

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