Soil management

Building up fertile soil with mulga branches

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Researchers are investigating ways to reverse the effects of land degradation using natural erosion and deposition processes.

Rehabilitating degraded land can be a complicated, labour-intensive and expensive pastime but the CSIRO solution recreates patches of fertile ground cheaply, relatively quickly and effectively.

Soil nutrients and water in arid Australia are concentrated in small fertile patches which make up 10-40 per cent of the landscape. If resources were distributed evenly, the threshold level or minimum requirement for plant growth would not occur.

Erosion and deposition create the fertile patches. Wind and water run-off transport nutrients around the landscape, accumulating in certain areas.

Once fertile patches are established, the nutrients stay within the patch because secondary biological processes recycle them. For example, nutrients are decomposed by fungi which are consumed by micro-fauna and bacteria. All of these organisms find refuge in the soil profile. Higher nutrient and water levels promote the persistence of shrubs and other perennials.

Overgrazing has caused the breakdown of the land's maintenance mechanisms (degradation) throughout much of the arid zone. It compacts the soil and leaves vegetation eaten bare. This allows the soil and its nutrients to be washed or blown away, destroying the erosion-deposition cycle. Growth stops when nutrients are dispersed below the threshold level.

After rain, fine soil particles form a slurry which flows into the soil pores, filling them and forming a solid mass which slows the infiltration rate.

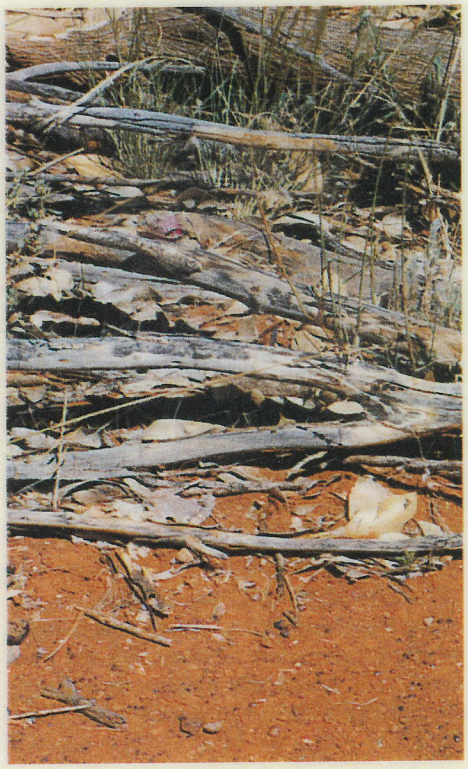
The worst degraded areas, having bare soil and no seedbank, cannot regenerate without active management. The nutrient-trapping cycle needs to be jumpstarted to allow fertile patches to be recreated.

Creating fertile patches

Researchers used mulga branches placed along ground contours to trap water- and wind-transported nutrients in mounds under the branches, mimicking the erosion-deposition process of creating fertile areas.

Mulga branches were used because it was the most plentiful local resource but any woody plant material will do.

Researchers were interested in mulga because traditionally it is cut for forage value during droughts in western New South Wales. The wood decomposes slowly, small branches first, often with termites harvesting the wood in very thin layers in a process called 'sheeting'. While the wood decomposes, it provides a safe place for resources to accumulate.



The bare, sheet-eroded soil surface (left) loses about one millimetre of soil each year. There are no perennials and annual herbs grow in season. In contrast, the plot treated with mulga branches (right) shows big accumulations of soil (one millimetre per year), dung and plant litter. All the grasses present are perennial, palatable species.

After three years the soil nutrient status under the mulga branches improved dramatically. Nitrogen and organic carbon content doubled and soil depth increased by 23 millimetres. During the same period, control areas without the mulga branches lost 3.3mm of surface soil, normally the most fertile layer.

The improved soil nutrient status and quantity led to biological activity which added to and stabilised the new fertile patch. Perennial grasses established on the formerly bare soil within the first year.

Litter from these grasses, and the mulga itself, was broken down by termites, returning nutrients to the soil where they were recycled.

Once initiated, fertile patches are self-sustaining, improving soil to the point where biological maintenance processes begin. Soil depends on the constant cycling of carbon through the system.

Fungal hyphae bind soil particles together by creating a 'sticky string bag', reducing erosion and increasing aeration and infiltration. Organic compounds at the molecular level stick soil particles together at a much finer scale, like glue. These compounds are still biologically active and bacteria consume them. So there needs to be a constant resupply of these compounds from plant roots and root hairs. These further contribute to the stability and development of the fertile patch.

This process could be particularly useful for land left bare after sheep production, opening the way for graziers to improve production and profits by reversing the degradation process.

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in brief

- Overgrazed, barren soil can be regenerated using natural erosion and deposition processes.
- Fertile patches can be created cheaply and relatively quickly by using branches to trap nutrients carried by wind or water.
- While the wood decomposes it provides a safe place for resources to accumulate.
- The fertile patches become self sustaining by improving the soil to the point where biological maintenance processes begin.