



What have we done to Australia's unique soils, and what are the consequences?

Australia's soils, microbes and plants evolved special processes to meet the challenge of limited water and nutrients. Early European visitors were greeted by the paradoxical splendor of 'green deserts' and of tropical rainforests growing on sand dunes. Since then, our farming practices have severely damaged Australia's soils. Urban agriculture has an important role to play in reversing the decline and preparing for future climate extremes.

What is special about Australian soils?

Some 80 million years ago, Australia was the last continent to separate from Gondwana. Since then it has drifted slowly north over a relatively stable part of the earth's crust. As a result, it is the only continent that has not experienced massive recent volcanic, geomorphic or glaciation impacts.

This means that much of Australia's land surface is covered by very old stable rocks from which many nutrients have been leached, or more recent sedimentary marine deposits with salt but low nutrients. Consequently, Australia's soils are also often old, leached, salty and low in nutrients.

Because of Australia's flat landscape and mid-latitude location, rainfalls are also low. Australia is the driest inhabited continent with a highly variable climate. Its aridity has accentuated the erosion of topsoils by wind and water and further loss of nutrients.

In response to these extremes, the soils and vegetation that evolved to cover the whole of Australia developed unique processes to access and cycle often low levels of nutrients efficiently, and to maximize the retention and

efficient use of every raindrop. These processes involved:

- The evolution of sophisticated microbial ecologies that aided the very rapid cycling of nutrients. This gave rise to the paradox of tropical rainforests growing on sand dunes.
- The formation of protective surface crusts and deep well-structured soils with high levels of organic matter. These maximized the infiltration of variable rainfalls in 'in soil reservoirs' to sustain the paradox of 'green deserts'.

As a result of these adaptations, Australia has been able to sustain plant cover on over 90% of its land area despite its dry and variable climate. While much of this area may be brown and dormant when arid, it can spring into highly productive life when water is present. European explorers documented these characteristics of the landscape, including the deep soft organic soils or 'moulds' that supported luxuriant perennial pastures and park-like shelterwoods throughout 'Australia felix' while water was present.

The impact of European settlement

The yields from the first sheep and cattle to exploit Australia's pastures and from the first crops grown in its soils were high, confirming how efficiently adapted the water and nutrient dynamics were in these natural biosystems.

But as we overstocked, cleared, burnt and drained these landscapes they were rapidly degraded. Within decades, vast areas were denuded by wind erosion that often removed up to 1m of topsoil, and flash floods incised streams and degraded and isolated floodplains.

By 1900, stock carrying capacities had crashed, as had the yield of crops. Efforts were made to improve productivity by introducing more productive species, cultivation, fertilizers, pesticides, and ever more inputs and technologies.

While these inputs have enhanced yields in the short term, they are often not viable unless heavily subsidized. More seriously, they have often resulted in further damage to the unique soil, microbial and plant processes that had underpinned the natural productivity when Europeans first arrived:

- Where soil carbon levels of over 10% were recorded in the 1840s, levels are now often less than 1%.
- Soils and catchments that retained 90% of their rainfalls now often conserve less than 10%. Water instead runs off in eroding surface flows and flash floods.
- Landscapes that were protected from desiccation by perennial pastures and shelterwoods are now often bare and pass quickly from normal rainfall into drought.

Agricultural yields can often only be sustained with massive inputs that may cost 40% of hoped-for returns and 10 units of oil-based energy for each unit of food energy output. Soil structures have collapsed to the extent that much more horsepower is needed to cultivate them, and plant roots can no longer proliferate readily through them.

Soils are no longer alive; instead they serve as physical media to hold up plants that are watered and fertilized hydroponically. As a result, plants and our food now contain a third of their pre-industrial nutrient content. More seriously, our food now often contains none of the essential trace elements that can only be absorbed from soil surfaces by microorganisms, as these are not available from the soil solution to hydroponic plants.

Over 60% of Australia's rural landscape of over 500 million ha has been affected by soil degradation. While recent practices have sought to slow it, cropping soils may still be losing 5-20 tonnes of soil and up to 5 tonnes of carbon each year. Over 66% of the landscape lies dormant and brown due to serious loss of resilience. As aridification and climate extremes intensify through southern Australia, the viability of our traditional farming regions is at serious risk. So too are our food supplies.

Urban agriculture can demonstrate the sustained production of healthy food via the very processes of nutrient cycling and water conservation that once characterized the Australian landscape. It has key roles to play in education, policy, mass demand, and in bridging the urban-rural divide so that we can work together for a safe healthy future.

Suggestions for further reading

Soils, an Australian Viewpoint (CSIRO, 1983)

Australian Soils and Landscapes, by N. McKenzie et al (CSIRO, 2004)

Soils in the Australian Landscape, by Ann Young and Robert Young (Oxford University Press, 2001)

A Million Wild Acres, by Eric Rolls (Thomas Nelson Australia, 2011)

Soils for Life: www.soilsforlife.org.au/