Damaged dirt

They're fragile and in need of attention. Dr Cameron Grant reveals the state of our soils.

AUSTRALIA has the oldest, most highly weathered soils on the planet. They are so old that most of the minerals have moved down gradually over time, leaving only a thin surface layer of sandy soil over a hard layer of clay subsoil.

Covering 20 per cent of the continent, soils such as these are leached easily of their organic matter and nutrients, which makes them hard and infertile.

They have fragile soil structure, erode easily and have little resistance to salinity and acidification.

The changes we have imposed on our environment and climate since European settlement have left an embarrassing blot on the South Australian landscape.

A short drive out of Adelaide illustrates the erosion we have caused, in part due to indiscriminate land clearing and burning, excessive cultivation, profligate irrigation and poor land management (especially with fertilisers and pesticides).

The same can be seen in most peri-urban areas of Australia and, indeed, the rest of the world.

Erosion is a serious issue in many parts of Australia, particularly in the cereal-cropping land of southern Australia as well as in Queensland's cropping and gazing areas, where accelerated erosion is caused by cereal cropping and excessive grazing.

The damage done, however, is not always as visible as that done by erosion.

For example, farmers learned in the early 1900s that Australian soils lack phosphorus so they applied phosphatic fertilisers to increase soil fertility and crop yields.

Little did they know, however, that they were also adding the heavy metal cadmium as a contaminant in the rock-phosphate from which the fertilisers were made.

This has created all kinds of problems for cadmium in the human food chain, prompting massive research by such scientists as CSIRO Land and Water's Professor Mike McLaughlin, who is based at Waite campus of the University of Adelaide to develop strategies to reduce cadmium uptake by potatoes and other crops.

Another example of insidious soil degradation due to poor land management has been the gradual acidification of sandy agricultural soils in the higher rainfall regions of SA, such as in the Adelaide Hills and on Kangaroo Island.

Our sandy soils can't resist the chemical changes that occur when nitrogen fertilisers are added.

By improving crop productivity on these soils without neutralising the acids generated by inefficient use of water and nutrients, we have inadvertently made our soils more acidic.

A more obvious sign of soil degradation in Australia is salinity, which we see on any trip between Adelaide, Sydney and Melbourne.

Salinisation occurs when groundwater rises to within 2m of the soil surface, which allows saline water to be sucked upward from the water table in a sponge-like fashion by evaporation.

The salt builds up in the region where plant roots grow and gradually kills most plants except saltbush and other salt-tolerant plants.

Water tables start to rise when the amount of water entering exceeds the amount of water leaving - a situation that has resulted from excessive land clearing (removal of plants that extract water all year round) plus comparatively small water extraction by annual crops such as wheat.

Soil erosion, acidification and salinisation all have negative effects on soil micro-organisms, which are crucial in soil reactions that break down organic matter and produce food for plants.

Soil-borne micro-organisms are responsible for the break down of organic matter in soils - and if it weren't for them we'd all be up to our necks in faeces.

However, despite our best efforts to reduce the organic wastes from municipal sewage treatment plants, the world still produces vast quantities of sludges (biosolids) that need to be stockpiled.

In recent times we have experimented with spreading biosolids on to agricultural land because the bio-solids contain large amounts of relatively stable organic matter and nutrients useful to agricultural crops. However, spreading biosolids on agricultural land tends to concentrate the compounds from the cleaning products, shampoos and soaps that run down our sewers - most of which contain the heavy metals, copper and zinc.

These metals are deliberately added to cleaning products to kill bacteria and make us smell nice.

The heavy metals in bio-solids tend to reflect the concentration of industrial activity in a region - bio-solids from industrialised cities contain more heavy metals than biosolids from regional and non-industrial cities.

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Where there's life, there's hope

THE state of soil degradation is not all bad. The ability of crops to succeed with fewer fertilisers in agriculture, for example, is being studied by scientists with a broad interest in ecology of soils and plants.

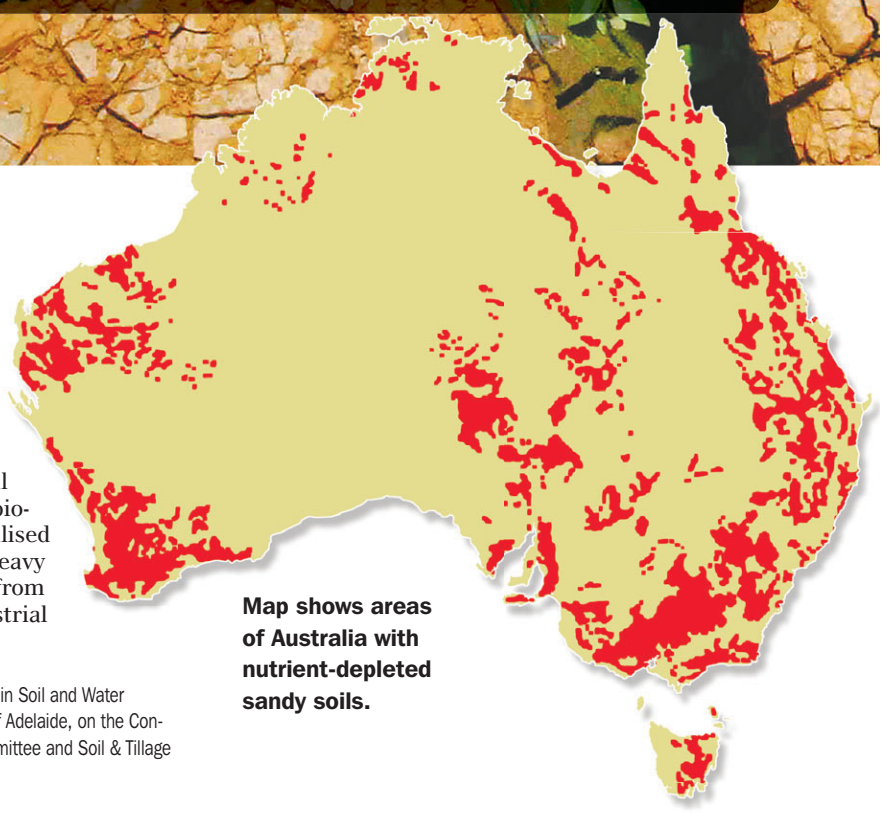
Research by Professor Sally Smith at Adelaide University (who recently won the prestigious John K Taylor OBE Gold Medal for her work in soil biology) is exploring the symbiotic relationship between plants and "friendly" fungi, where the soil-borne fungi enter plant roots to extract carbon, while at the same time supplying important nutrients to the plant, which plants can't extract alone.

Research to determine how to fix contaminants in soils and prevent them from entering the food chain is being conducted by scientists in CSIRO Land & Water and at the University of Adelaide (Dr Rai Kookana and Dr Ron Smernik).

Other scientists around Australia are exploring the usefulness of bio-accumulator crops (plants that take up unusually large quantities of contaminants, which can then be harvested and destroyed).

The need for scientists who understand the basics of chemistry, physics and biology of these important environmental problems is enormous.

The lure of the many other disciplines of science appears to place our many environmental and agricultural problems in the shadows. A career in soil science with applications in either agriculture or the environment is more important than ever before.



Map shows areas of Australia with nutrient-depleted sandy soils.