SOIL – A VITAL AND NON-RENEWABLE RESOURCE

LAND & WATER CONSERVATION

SOIL SURVEY FOR WISE LAND MANAGEMENT

ISBN 0 7347 5055 2
MARCH 2000

SOILFACTS NO. 1

SoilFacts

Why is soil important to life?

Soil is one of the world's most valuable assets. It is essential to all lifeforms on this planet.

SOILS act as a filter to protect the quality of water, air and other resources;

SOILS provide a physical matrix, chemical environment and biological setting for water, nutrient, air and heat exchange for living organisms;

SOILS regulate biological activity and molecular exchanges among solid, liquid and gaseous phases. This affects nutrient cycling, plant growth and decomposition of organic materials;

SOILS provide mechanical support for living organisms and their structures, including most of our buildings, dams, pipelines and underground cables; and

SOILS influence the water distribution to runoff, infiltration, storage or deep drainage. Soils regulate water flow, which affects the movement of soluble materials such as nutrients or pollutants (Rosewell 1999).

● Soils make it possible for plants to grow.

Innumerable soil organisms play an important role in the vital process of nutrient recycling. In fact, soils contain by far the greatest source of terrestrial biodiversity. Soils mediate the biological, chemical and physical processes that supply nutrients, water and other elements to growing plants. The microorganisms in soils transform nutrients into forms that can be used by plants. Soils are the water and nutrient storehouses on which most plants draw to produce roots, stems, and leaves. We ultimately depend on soils for much of our food and fibre.

Soils, and the biological, chemical and physical processes they make possible, are a fundamental resource on which the productivity of agricultural and natural ecosystems depends.

● Soils regulate and partition water flow through the environment.

The condition of the soil surface will determine whether rainfall in terrestrial ecosystems either soaks into the ground or runs off into waterways.

If water infiltrates the soil, it may be stored and later taken up by plants; it may move into the groundwater; or it may move laterally through the soil, surfacing later in springs or seeps, or moving into waterways. Runoff may erode the soil and remove nutrients, causing loss of soil depth, reduced productivity and off-site pollution.

The balance between infiltration and runoff helps determine whether a storm results in soil water replenishment or a damaging flood. The movement of water through soils to streams, lakes and groundwater is an essential component of recharge and base flow in the hydrological cycle.

● Soils help buffer and protect against environmental change.

The biological, chemical and physical processes that occur in soils buffer environmental changes in air quality, water quality and global climate.

For instance, these processes assist the decomposition of organic materials and are important for the breakdown of many materials including pesticides, sewage and a variety of solid wastes.

The accumulation of pesticide residues, heavy metals, pathogens or other potentially toxic materials in the soil may affect the safety and quality of food produced on those soils.

Depending on how they are managed, soils can be important sources or sinks for carbon dioxide and other gases that contribute to the greenhouse effect (greenhouse gases). Various soils store, degrade or immobilise nitrates, phosphorus, pesticides and other substances that can become pollutants in air or water (Rosewell 1999).

Many different soils behave differently, depending on the uses to which they are put.

Australian soils

Australian soils, in general, have properties that make their management more difficult compared with soils in other parts of the world.

Unlike soils on Northern Hemisphere continents, Australian soils are mostly very old. They are the product of old rocks and have often been extensively reworked by rivers, wind, weathering, biological and leaching processes. Many Australian soils are also very fragile. These soils can be quickly depleted and rendered useless unless they are properly managed.

Our soils are often characterised by shallow, highly weathered profiles of low fertility (with plant nutrients occurring mostly in the surface horizons), low structural stability and high erodibility. Many soils also have other physical problems.

In NSW, the range of soil types and their properties is extremely diverse. Some soils can be water-repellent and hardsetting, often with fine-textured, tough subsoils. Other soils are sandy; some are cracking clays; others are highly prone to erosion; many have restricted waterholding and infiltration capacity; and some subsoils are very tough to work with and have poor aeration. Many soils in NSW are prone to becoming acid or saline.

Organic matter is also low in many Australian soils, especially those in arid and semi-arid climates. One estimate suggests that about 75 per cent of Australian soils have less than one per cent carbon (whereas overseas, this is often up to about 5%) (Charman & Murphy 1991). Low organic matter means soils are more erodible and susceptible to structural decline, have less nutrient storage, are significantly more difficult to manage, and are easier to damage.

Degradation of our soils

From the start of European settlement, when the clearing of much of our forests began on an intensive basis, our old, fragile soils have been exposed to ill-conceived or poorly planned land use practices.

Many of the changes wrought by agricultural and urban development have been accompanied by increased rates of soil erosion; degradation in the form of salinisation, acidification and structural breakdown; and other problems including the movement of soil materials into our waterways. The destruction of protective plant cover and loss of nutrient-rich topsoil results in an inhospitable soil environment.

Strip croppng reduces erosion, allows for crop rotation and, in conjunction with no-till farming, improves soil structure, increases organic matter and raises crop productivity.

SALT THREAT

Extensive removal of deep-rooted native vegetation and its replacement with bare soil crops and pasture is raising watertables, mobilising salts stored in groundwater and the soil profile, causing soil salinisation, and facilitating seepage of saline groundwater to rivers, polluting our major sources of domestic and irrigation water supplies (Ghassemi et al. 1995).

In some parts of Australia, most notably the large irrigation areas of the Murray-Darling Basin (established from about 1900), salinised surface soils, caused by land use changes since European settlement, have been present for a long time (CA 1996). In other areas, such as the dryland agricultural areas of central and northern NSW, salinity is regarded as a more recent phenomenon (CA 1996) of increasing magnitude and economic relevance. The hydrological balance of whole regions has been modified and watertables have risen to near soil surface (Greiner 1994).

Irrigation-induced land degradation

Inefficient irrigation practices add water to underlying groundwater. If more water is being added than can move laterally in the aquifer, groundwater levels will rise. Unless the groundwater is highly saline, most irrigation-induced land degradation begins as waterlogging. After time, and depending on evaporation rates and degree of flushing, salt concentrations increase until they affect crop yield. Waterlogging alone reduces crop yield (CA 1996).

Dryland salinisation

Dryland areas are those that depend solely on rainfall for plant growth. They are susceptible to hydrologic disturbance when deep-rooted native plants are cleared and replaced by introduced shallow-rooted crops that use less water. More water then moves below the root zone, raising groundwater levels to a higher point in the soil profile. Salts are remobilised in the higher, previously unsaturated zone. Evaporation follows periods of waterlogging, with salt then appearing (usually) at the surface (CA 1996).

In NSW, more than 70% of the land is affected by more than one type of land degradation, with 29% severely affected. The most extensive forms of degradation identified in 1989 were water erosion (35% of the State), wind erosion (25%), soil structure decline (18%) and induced soil acidity (EPA 1997).

Induced soil acidity and salinity are also symptoms of our poor land management record and have been recognised as problems only recently. Our understanding of their nature and extent continues to improve.

More than 30% of Australia's agricultural belt (NSW in particular) will be threatened by salt problems within 50 years, resulting in billions of dollars of lost production. In NSW alone, some 7.5 million hectares are facing the salinity threat because of land clearing. More than 55 million hectares have been cleared in the last 200 years. Salinity is now Australia's costliest environmental problem, estimated at more than $800 million and rising by $130 million annually (PMSEIC 1998).

In 1995, NSW Agriculture estimated the cost of land degradation in terms of lost production to be about $700 million per annum (EPA 1997). But, this does not include off-site damage including water quality problems and loss of biodiversity as these have not been highly valued (until recently).

Many authorities contend that soil is not a renewable resource in the Australian landscape. Soil takes thousands of years to form from parent rock. Rock weathering rates in Australia are estimated at being one millimetre every 50 years or less (Birkeland 1994). Since soil in NSW is forming at a rate of about 0.04 to 0.4 tons per hectare per year, soil erosion rates greater than 0.4 tons/ha/yr are not sustainable (Rosewell 1994). In many areas, we are losing soil faster than it is being formed.

There are technical solutions to many land degradation problems. There are ways in which we can all make a difference. If you make land use decisions or are considering changing the way you manage your land, please consider the impact of your actions on the health of the soil.

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