Soil management for dairy and beef cattle grazing

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This pamphlet is intended to help North Coast dairy farmers and beef producers to protect their soils from the problems of compaction, erosion, poor drainage, soil acidity and nutrient deficiencies.

SOIL STRUCTURE, AND PREVENTING SOIL COMPACTION

Soil structure refers to how the soil particles are arranged into individual aggregates (lumps), and to the spaces and pores (holes) that exist within and between these aggregates. **Well-structured soils** have many pores and spaces in the soil to allow good drainage and easy plant root growth. Organic matter is essential for good soil structure as it helps to bind the soil particles together to form aggregates.

Soil pugging is a major management problem associated with dairy and beef cattle farming. It is caused by cattle grazing paddocks when the soil is too wet. The cattle hooves can sink up to 15 cm into the mud, causing pugging or compaction in the soil below. This significantly reduces pasture growth because the dense compacted soil layer restricts the movement of water, air and roots through the soil. The soil structure has in fact been destroyed in the compacted layer.

Well-structured soils grow the best pastures.

Soil pugging reduces pasture growth.

Preventing soil compaction

- **Remove stock from the wetter paddocks.** It is best to keep cattle off the wetter paddocks in the wet season, and to move them to higher, drier paddocks during any unseasonable wet periods. Use feeding pads if the farm lacks sufficient high ground (refer to the section 'Install loafing and feeding pads (*dairy*)' below).

- **Keep vehicles and farm machinery off wet paddocks.** In addition to causing compaction, the resultant wheel ruts can concentrate stormwater runoff which will erode the soil, forming gullies.

- **Install several watering points and shade areas.** This will help break up the herd into smaller groups, thereby reducing soil compaction in these areas.

- **Maintain a dense mat of pasture cover.** This will help cushion the effect of the cattle hooves on the soil. Compaction is more severe where the soil is bare and the pasture cover is sparse.

- **Place fences strategically.** It is easier to keep stock off wet areas if the paddock fences are located so that they separate the drier locations and soils from the wetter flat locations and soils.

- **Install loafing and feeding pads (*dairy*).** Loafing or feeding pads are either built-up areas of a porous material, such as sawdust (60–90 cm deep), or a layer of impervious concrete, where cows can be held and fed during periods of wet weather. This helps to avoid soil compaction or pugging, as well as prevent pasture damage. Refer to Agfact A1.7.3 *Loafing pads for dairy cattle*, available from NSW Agriculture offices.

Open concrete feed pad area—to avoid pugging up wet paddocks

Covered feed pad area—to avoid pugging up wet paddocks

- **Install laneways (*dairy*).** By confining cattle traffic to laneways, soil compaction is minimised. This helps to keep the rest of the paddock's all-weather area in a good condition for growing productive pastures. Cement or stabilised-earth laneways are especially desirable near the dairy, where traffic pressure is highest, but they can also be used throughout the property.

Fixing soil compaction

- **Grow deep-rooted pastures.** Sowing deep-rooted perennial grasses such as kikuyu, setaria or paspalum will help to break up compacted soil layers. The fibrous root systems of these grasses penetrate compacted soil; also, the addition of organic matter from leaf litter and roots helps to restructure degraded and compacted soil.

- **Deep rip the paddocks.** Deep ripping the paddocks with a suitable tyned implement every few years, or when necessary, helps to break up compacted layers in the soil and allow the roots, water and air to again move unrestricted through the soil.

A gravel laneway

A concrete laneway

Pasture damage caused by having no laneway

Maintaining soil structure

- **Prevent soil compaction** by adopting the practices outlined above.

- **Maintain a dense pasture cover.** The root systems of healthy pastures add organic matter to the soil. Growing the types of pastures mentioned earlier is the cheapest and most effective way of maintaining good soil structure. Overgrazing caused by overstocking can reduce the pasture's ability to provide this input of valuable organic matter to the soil.

- **Slash/mulch a pasture, rather than burn it.** Slashing/mulching promotes green pick. Slashing is preferable to burning, as the cut pasture material will break down and add valuable organic matter to the soil. Much of the organic matter is lost when a pasture is burnt.

- **Minimise tillage.** Wherever possible, sow pastures, silage and other crops by **direct drilling**. Direct drill sowing helps to maintain soil structure by minimising the amount of disturbance to the soil. It also reduces the risk of soil erosion, because the soil is not left bare by cultivation.

- **Cultivate the soil only when its moisture content is right!** Cultivating the soil when it is too wet or too dry will damage the soil structure and produce a compacted soil layer. **Heavy clay soils** are best cultivated when the soil is dry. **Light sandy, silty or loam soils** are best cultivated when the soil is slightly moist. Ask your NSW Agriculture Soils Advisory Officer for an information sheet on assessing the soil's suitability for cultivation in respect of its moisture content.

Deep-rooted grasses—best for compacted soils

Deep rippers for compacted soils

IMPROVING DRAINAGE

In some low-lying areas, a well-designed drainage system may be necessary to carry surface water away and/or to lower the ground watertable below the pasture's root zone.

- **Check the regulations.** First check with the Department of Infrastructure, Planning and Natural Resources (DIPNR) (formerly DLWC) and your local government to find out whether approval is required from these authorities for a drainage system to be constructed in your area. This will be the case for areas mapped as being high-risk areas for potential acid sulfate soils. If some parts of your farm have been mapped as high-risk areas, you can obtain information on the management of acid sulfate soils from the NSW Agriculture Acid Sulfate Soil Advisory Officer and the Soil Advisory officer at Wollongbar. Some useful reference materials are listed in the 'Further Information' section of this pamphlet, and on the NSW Agriculture website: www.agric.nsw.gov.au

- **Professional design and layout of a drainage system is essential.** NSW Agriculture's Irrigation Officers can provide advice on the design and layout of an effective drainage system.

- **Laser grading (levelling)** can give a flat paddock enough slope to ensure that most surface water from heavy rainfall or flooding will run into the drains and not lie on the paddock surface. *Laser levelling should be undertaken by experts, and only then as part of a professionally designed whole-farm drainage plan.*

PREVENTING SOIL EROSION

Soil erosion can be prevented by adopting some of the following basic soil management practices:

- **Don't allow overgrazing.** Overstocking can reduce the pasture cover which protects the soil, and this can result in the soil being eroded during subsequent heavy-rainfall events. Livestock should be moved on to another paddock before their grazing reaches the stage where it starts to expose areas of bare soil—a **rotational grazing** approach is the best practice for pasture management, especially for dairy pastures.

- **Exclude stock from drainage lines.** The erosion risk for exposed soil is very high in drainage lines, due to stormwater runoff concentrating in these areas. It is therefore best to fence off drainage lines (or watercourses) in order to exclude stock so that any loss of vegetation cover in these areas is prevented.

Drainage lines—left undisturbed at sowing to avoid soil erosion

Regular soil testing pays.

- **Avoid cultivating through, or disturbing, natural drainage lines (watercourses)** when sowing pastures or forage crops, as this can result in soil erosion and the formation of gullies. Drainage lines are best kept in a natural, grassed condition.
- **Sow pastures and silage crops by direct drilling.** This helps to avoid soil erosion by not exposing the bare soil to stormwater runoff.
- **Deep rip or cultivate *across* slopes**, roughly following the contour. Cultivating up and down hills can result in serious soil erosion.
- **Erosion-control earthworks such as graded banks or diversion banks** may sometimes be necessary to prevent soil erosion from occurring in areas of sloped land that are to be cultivated for pasture improvement. *Professional advice on the design and layout of erosion-control earthworks should be sought from the Department of Infrastructure, Planning and Natural Resources.*

MAINTAINING SOIL FERTILITY

Soil fertility management ensures that the soil nutrients leaving the property in the form of milk or beef are replaced by the application of fertilisers.

- **Test the soil regularly.** Soil analysis by laboratories determines the soil's current levels of nutrients—its nutrient status. Regular soil testing can help to ensure that the correct amount of fertiliser is applied to the soil, satisfying the nutrient requirements of the crop while at the same time avoiding the environmental problems associated with overfertilising.

  Dairy farmers need to soil test regularly (every year) on a rotational basis across their farm in order to monitor soil nutrient levels and to detect trends in soil nutrient levels and pH.

  Beef cattle farmers should test their soils every two to three years. Consult your District Agronomist or local adviser on the nutrient requirements of each pasture species or mixture. Fertiliser companies can also provide recommendations on fertiliser application rates, based on soil test results.

- **Soil pH** is a measure of the acidity or alkalinity of the soil. Soil pH is important because it affects the availability of the soil nutrients to the plants. Most soil nutrients are available to plants in an environment where the pH range is 5–7 (all pH figures in this publication are as determined by the calcium chloride ($CaCl_2$) method).

  Strongly acid soils (pH less than 5) require the addition of lime or dolomite to allow better plant uptake of soil nutrients and to avoid aluminium and manganese toxicity problems. Usually, fine agricultural lime (calcium carbonate) is the preferred liming material—the finer the lime, the better. Incorporating the lime into the soil gives the best results. Dolomite is often used when soil tests indicate that the soil also requires magnesium.

- **Recycle the soil's nutrients.** Try to ensure that the livestock manure is returned to the paddocks where the original feed was grazed—rotational grazing can help to achieve this. More regular grazing rotations, using smaller paddocks, can assist in reducing the extent to which nutrients from the manure are concentrated in small cattle camp areas.

Strip grazing (dairy)—best practice

- **Strip graze the paddocks.** Strip grazing the paddocks can produce a more even pattern of grazing and manuring across your property. It results in a more effective recycling of nutrients and a more efficient use of pasture. Strip grazing is usually managed by using flexible temporary electric fencing.
- **Return *dairy effluent* to the paddocks**, as it is a valuable nutrient and water source for pastures. However, it can cause a serious pollution problem if it finds its way into waterways. For this reason, seek professional advice on the design specifications and environmental requirements for the storage and application of dairy effluent. Advice on dairy effluent reuse can be obtained from your local Dairy Livestock Officer or Irrigation Officer with NSW Agriculture.
- **Encourage soil organisms.** Dung beetles and earthworms are two organisms which are very good for the soil. Earthworm numbers can be increased by increasing the amount of organic matter in the soil, keeping the soil pH above 5.0 and minimising soil disturbance (i.e. cultivations). Dung beetles can be introduced into paddocks where their numbers are low.

A set-up to return dairy effluent

- **Include legumes in pasture mixes.** Pasture legumes have the ability to fix atmospheric nitrogen, and therefore provide a source of nitrogen for the non-legume pasture species. This can help to reduce the nitrogen applications necessary to maintain pasture growth.

WHAT THE FARMERS SAY

Fleur Tonge, dairy farmer, Dobies Bight, Casino

'All our pastures are direct drilled after spraying off or mulching the previous crops or pastures. We do this to improve our soil structure by eliminating cultivation ... We've noticed a real improvement in the soil structure since we started direct drilling our pastures.

'Pasture growth is greatly reduced by pugging… The cattle are kept off the pastures if there is a likelihood of them pugging the ground. In these situations [wet weather], we use the feed pad and silage as an alternative.'

Phil Ensbey, dairy farmer, Lawrence

'We soil test every year for our silage cropping paddocks, and every two years for our general pasture areas, to keep track of our soil nutrient levels.'

Noel Rippon, beef producer, Mallanganee

'I always stop sowing crops and pastures at least 2 chain [40 metres] before the creeks, and leave the creeks undisturbed to avoid severe washes.

'I have soybean crops grown to help in the establishing of ryegrass pastures. After the second crop of soybeans, you notice a real improvement in the soil's condition.'

FURTHER INFORMATION

Further information is available from your local NSW Agriculture Enquiries Officer, Dairy/Beef Livestock Officer, Soils Advisory Officer or District Agronomist, or from Advisory Officers with DIPNR.

Publications

Soil Sense—soil information for North Coast farmers, NSW Agriculture, 2000.

'Soil Sense' leaflets (various titles) available from NSW Agriculture and the Department of Infrastructure, Planning and Natural Resources.

Pasture and forage crop sowing and management guide (produced twice a year by NSW Agriculture Agronomists for North Coast districts).

Farming successfully on the acid sulfate soils of the NSW coastal plain, DIDCO, 2001.

An introduction to acid sulfate soils, 2000.

ASS case study: Arthur Weis, NSW Agriculture, 2001.

Coastal backswamps: Restoring their values, Wetland Care Australia, 2002.

Floodgates and farmlands, Department of Land & Water Conservation, 1996.

Beef 'n Beans: Growing direct-drill soybean as part of a pasture improvement program, NSW Agriculture.

Agfacts and Agnotes on specific aspects of pasture production are available from NSW Agriculture offices.

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DISCLAIMERS

The information contained in this publication is based on knowledge and understanding at the time of writing (2003). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date, and to check currency of the information with the appropriate officer of NSW Agriculture or the user's independent adviser.

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