PRODUCTIVITY, WATER QUALITY AND SALINITY - ACTION LEARNING TO PROMOTE BEST PRACTICE IN AGRICULTURE FOR PRODUCTION AND FOR THE ENVIRONMENT

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INTRODUCTION – CAPACITY TO INFLUENCE CHANGE

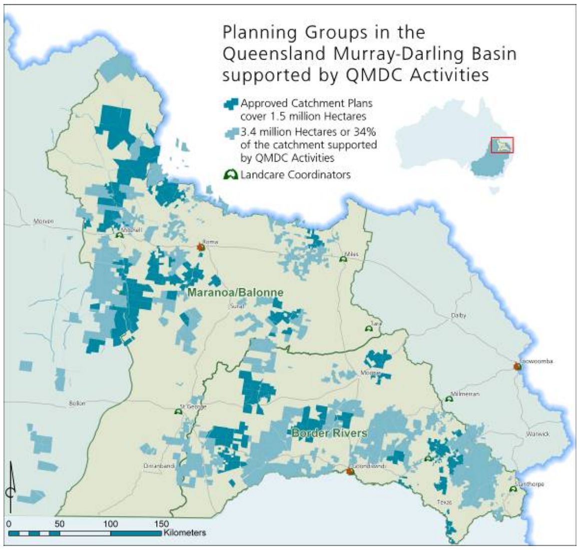

Figure I. Planning Groups supported by QMDC

The Queensland Murray Darling Committee (QMDC) is working with the community in the Maranoa Balonne and Border Rivers catchments to encourage and support sustainable use of natural resources. A number of initiatives have given QMDC direct contact with landholders managing over 30% of the catchment. Sharing a vision for healthy landscapes and viable communities, it is important that stakeholders gain insights into the links between production systems and the condition of our natural resources.

Key messages have been delivered to numerous planning groups using action learning tools. These provide a relaxed setting for information exchange leading to a common understanding of production systems and their interaction with the natural environment.

THE SCIENCE - SOIL AND WATER IN A PRODUCTION LANDSCAPE

Following are extracts from available information arranged to demonstrate the links between productivity, water quality and salinity risk using soil water research findings.

Stream Water Quality

The water quality in our rivers and creeks tells a story about how well we are managing our land. In the Queensland Murray Darling Basin stream sediment load has been identified by community, industry and environmental groups as a major concern. Land management practices that increase sediment load also generally increase the export rates of other contaminants from paddocks into streams. Sediment loads also represent soil loss, nutrient loss and possibly wasted pesticides which all threaten the profitability and sustainability of agricultural enterprises. Another concern with stream water quality is increasing baseflow salinity which may indicate rising groundwater and associated risk of landscape salinity.

Ground Cover

Soil loss can be minimised if vegetation cover is increased in grazing or cropping lands. Increasing the amount of vegetation cover on the ground not only decreases the loss of soil and other contaminants, but also results in better infiltration and increased soil water storage. Note the graphs below showing research findings that demonstrate that with increased ground cover there is both a decrease in soil loss and a decrease in runoff (increase in infiltration). Ground cover refers to plant material and debris on or near the soil surface which has the capacity to protect the soil from the splash impact of rain drops

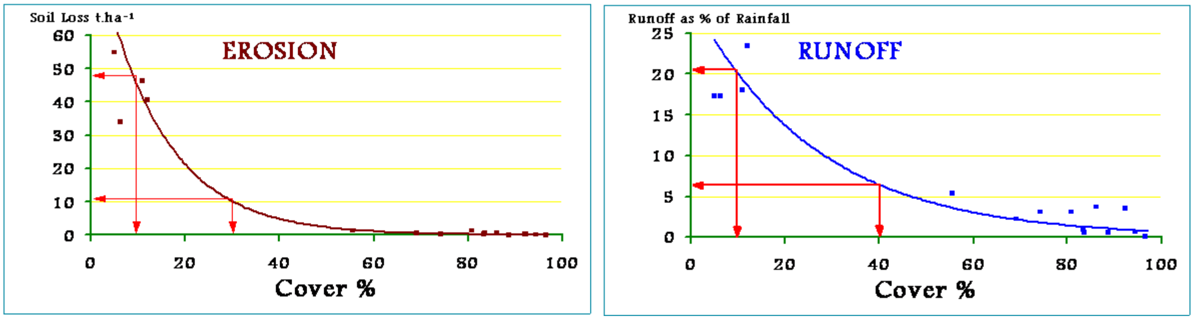

Figure II. Research findings from Freebairn et al, 1996 (left) and Silburn and deVoil, 2008 (right) demonstrating increased cover reduces erosion and increases infiltration (decreases runoff)

Soil Water

The retention of soil, and the increased infiltration achieved by maximising cover, represents increased production potential. To realise this potential it is useful to understand and measure soil water with a view to using what is available for plant growth. The maximum water available for plant growth is known as the Plant Available Water Capacity (PAWC); it varies with soil type and crop. PAWC is the difference between the upper water storage limit of the soil (DUL) and the lower extraction limit of a crop (CLL) over the depth of rooting. In many seasons, the maximum water storage capacity is not reached due to insufficient rainfall, fallow weeds, run-off and evaporation.

In these cases, the actual water present is described in terms of the PAWC, that is, how full is the bucket. However, in other cases it is possible that even after the bucket is full, more rain falls which infiltrates but is not used by crops or pastures. This is likely to result in deep drainage, being drainage below the crop or pasture root zone. In native vegetation areas most of this deep drainage was used by deeper rooted trees.

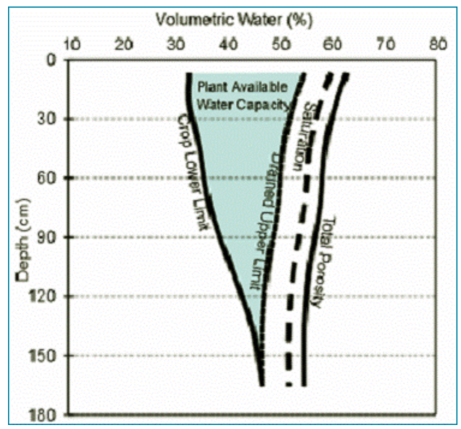

Figure III. PAWC and Water in the soil profile (Wockner et al 2005)

Salinity Risk

In agricultural areas where broad scale clearing has occurred, deep drainage is likely to result in recharge of shallow groundwater aquifers. This in turn represents a risk to production as the resulting rising groundwater may contain salt concentrations above crop or pasture tolerance levels. Deep drainage varies in different landscapes but is likely to approximate:

- 1mm under native vegetation
- 10mm under dryland cropping
- 100mm or more under irrigation

The deep drainage risk is greatest when irrigation water is applied inefficiently and, or, when winter crop rotations result in fallow paddocks during maximum recharge periods. Risk can be minimised by ensuring all or most of the water stored in the soil is used by plants. This can be achieved through initiatives such as: increased water use efficiency, opportunity cropping, grazing practices that maintain high pasture biomass and optimum native vegetation management.

ACTION LEARNING TOOLS – MAKING THE SCIENCE TANGIBLE

A number of simple tools have been developed to allow extension of key messages in a hands on manner. Brief instructions for these tools are outlined below. More detailed descriptions can be obtained from

APEN, 2005 or from Western Farming Systems, 2005. Links to these sources are included in the References.

Figure IV. Cover and Soil Movement demonstration to East Moonie Landholders

Cover and soil movement

Place three paint trays on a table with a lunchbox full of soil in each tray. Cover the soil on one lunchbox with shadecloth (100% cover) another with part shadecloth (50% cover) and leave the third one uncovered (zero cover). Use a watering can similar a rain event on each lunchbox (paddock) Runnoff from the covered soil is cleaner and usually noticeably less than the runoff from the bare paddock showing the value of cover for protecting soil from erosion and creeks from sedimentation.

Splash impact

On a bare smoothed soil paddock drop single drops of water from 1m above using a pipette and observe the splash effect on the paddock. Get someone to hold a piece of shadecloth just above the soil on another bare smoothed patch and drop single drops from 1m. Comparing the soil disturbance with the single drop shows the value of cover in minimising splash erosion.

Infiltration effects of dirty water

Cut the tops off two transparent plastic water bottles. Block the openings with pieces of sponge and insert tops upside down into the bottoms of the bottles. Place 2-3cm of soil into the inverted tops ensuring there are no large air gaps. Pour well shaken dirty water into one inverted top and clean water into the other. The clean water infiltrates more quickly down through the soil demonstrating why dirty runoff water from soil with poor cover blocks soil surface pores resulting in increased runoff and poor infiltration.

From infiltration to soil water

Set up a water bottle as per the previous infiltration demonstration without putting soil into the inverted top. Poke a straw up through a fitted hole in the bottom of the bottle so that water will leak out through the straw when the water level in the bottle is nearly up to the inverted top (see figure V below). Pour different amounts of water into the bottle explaining the bottle neck/foam is the infiltration limitation. Water left in the bottle neck after rain can be tipped out as water near the soil surface is lost to evaporation. Water poured in at sustained fast rates will overflow the inverted top simulating runoff. After a series of events the bottle will fill enough to leak out the bottom straw introducing the concept of deep drainage. The water left in the bottle after the deep drainage has finished is the soil water store.

Plant Available Water Content (PAWC)

Using two different sponges the variation between PAWC for different soils can be introduced. Use a standard piece of foam for one sponge and a car wash sponge which holds water better, for the other. Ensuring each sponge is dry at the start, put a litre of water in each of two containers then place a sponge in each container. Get participants to squeeze and release the sponges in the water to absorb as much water as possible. Sponges are now at saturation point. Each sponge should be lifted up over the container allowing water to drain freely back into the container. The standard foam sponge will lose more water simulating a sandy soil. The car wash sponge can be aligned with clay or clay-loam soil. After the sponges stop leaking, squeeze each one into a separate measuring container. The amount squeezed out represents PAWC. The brawniest person in the room could be asked to give one of the sponges another squeeze to get a bit more out. This introduces the variation between different plants in their capacity to take up water from the soil. Even after the last squeeze the sponge is still cool to touch showing some water is retained in the soil even with aggressive root systems.

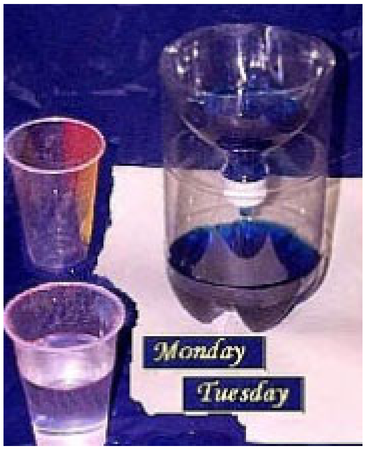

Figure V. PAWC and deep drainage risk demo tools from Western Farming Systems (2005)

Unused soil water and landscape salinity risk

To demystify salinity and to introduce landscape salinity issues, a number of quick attention grabbers have been successfully used.

Introduction to salinity and Electrical Conductivity (EC): Salinity jargon can be explained with a basic EC meter, some metal, salt, soil and cups. Explaining that Electrical Conductivity or EC is an indirect measure of salinity is a good first step. Watch the EC reading jump when a pinch of salt is placed in a cup of rain water.

Effect of evaporation: Evaporation affects the salt store in wet patches of the landscape. To demonstrate this, measure the EC of some tap water, boil half of this away and measure the EC again. It should be twice that of the source water. In the kettle, as with a landscape, very little salt is taken up with evaporation. With each wetting up from seepage, or rising groundwater and subsequent evaporation, there is the potential for salt to accumulate.

Water accepts soil salts into solution as it infiltrates: Measure water EC before and after it is "infiltrated" through 10cm of soil (as per the clean water from previous section on infiltration effects of dirty water).

SUMMARY

These action learning activities have been delivered in a wide range of settings. Working with landholders, they have been delivered in sheds, on riverbanks and on kitchen tables. The same activities have been well accepted in high school and primary school settings. In many cases stream water quality and macroinvertebrate monitoring concepts are explained as a follow on from these soil water activities.

The action learning activities have provided a common understanding and language for subsequent discussions between landholders and other natural resource management advocates. They can also be used to break up more academic presentations to people who find these difficult or tedious. They are seen as a useful addition to the tools available for promoting and supporting sustainable land management in the Queensland Murray Darling Basin and beyond.

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