DEPARTMENT OF
PRIMARY INDUSTRIES

Sustainable Farming Systems for Steep Hills

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Salinity & Water
AUSTRALIA

Glenelg Hopkins
CMA

CRC FOR PLANT-BASED MANAGEMENT
OF DRYLAND SALINITY

SUSTAINABLE FARMING SYSTEMS FOR STEEP HILLS

"Developing sustainable and profitable pasture management systems that will increase groundcover, reduce recharge and runoff and improve the seasonal growth pattern and persistence of perennial grass pastures for steep hill country in central Victoria."

Steep hill country is an important landscape in southeastern Australia. Despite lower productivity, this land is important in recharge control, a key factor influencing dryland salinity and water quality. However, much of the steep hill country has been poorly managed and overgrazed, leading to low groundcover and dominance by introduced annual grasses and weeds.

These problems are of major concern for the industry, which led to the 'Sustainable Farming Systems for Steep Hills' project. The project has been funded by Department of Primary Industries (through the Wool Strategy), Glenelg Hopkins CMA (through NAP) and CRC for Plant-based Management of Dryland Salinity.

Project aims

- Increase plant population density and ground cover by deep-rooted perennials, particularly native grasses, in steep hill country;
- Reduce water and nutrient runoff and deep-drainage;
- Build the capacity of landholders to manage their hill pastures in a both profitable and sustainable way; and
- Save costs by developing low-input farming systems.

Site details

Three field sites are located on commercial farms, 10 – 15 km from Ararat. The soils are sedimentary, typical of the region. Soil Olsen P is 4 – 17 mg/kg soil and pH (water) 4.9 – 5.4. The long-term average annual rainfall is 615 mm. Pastures are dominated by introduced annual grasses such as silver grass.

Project design

The project has three linked components:

1. A large-scale grazing experiment to investigate pasture management options;
2. A small-plot experiment to evaluate pasture species/cultivars; and
3. A demonstration site to compare various management systems and their impact on water run-off and quality.

Large-scale grazing experiment

The experiment is to develop low-input management practices that increase plant population density and groundcover in steep hills without pasture renovation. The prerequisite is that there is an adequate proportion of desirable species (native and perennial species), though low in terms of plant density and botanical composition, in the existing pasture prior to treatments.

Bare ground in steep hills due to overgrazing.

A flora species survey in November 2002 found 46 species (26 native and 20 exotic) in the 3-ha experimental area. Most of the native species are grasses such as *Austrodanthonia geniculata*, *Austrostipa oligostachya*, *Elymus scaber* and *Microlaena stipoides.* However, silver grass is the dominant species in the sward (Table 1).

Table 1. Major flora species and their average abundance in plots located in top, mid and bottom slope.

Common name	Scientific name	Abundance (%)		
		Top	Mid	Bottom
Silver grass	*Vulpia bromoides*	70	35	30
Yorkshire fog	*Holcus lanatus*	30	30	30
Kneed wallaby-grass	*Austrodanthonia geniculata*	15	2	2
Common wheat-grass	*Elymus scaber*	15	20	20
Weeping Grass	*Microlaena stipoides*	10	5	3
Spear grass	*Austrostipa oligostachya*	5	2	2

Deferred grazing gives a chance for plants to set seed.

Three deferred grazing regimes and two fertiliser levels (fertilised and non-fertilised) are used in the experiment. The three deferred grazing regimes are:

1) Long-term deferred grazing (October/ November – autumn break), targeting increased plant density and ground cover;
2) Short-term deferred grazing (October/ November – January), targeting increased plant density and ground cover while reducing the risk of fire; and
3) Late-start deferred grazing (November/December – autumn break), targeting increased plant density and groundcover by native and other perennial grass species while suppressing annual species such as silver grass.

Preparation of soil samples in the lab for further analysis.

The two fertiliser levels are combined with the three deferred grazing regimes to identify how pastures respond to these grazing regimes under contrasting soil fertility. In addition, two control treatments, one with nil grazing or fallowing for the first year and the other with set stocking, are used for benchmark comparisons.

Pasture evaluation experiment

Where existing hill pasture has little or no desirable plant species (native and other perennial grass), introduction of well-adapted perennial species is the most efficient way to improve the productivity and sustainability of steep hill country.

This experiment aims to test a wide range of grass and herb species for high water use and superior adaptability, productivity and persistence. Twenty-four cultivars/ lines including deep-rooted perennial grass, native grass, sub-tropical C4 grass and perennial herbs, were established in August 2002, and will be examined for five years (Table 2).

Table 2 Pasture species/cultivars sown in the evaluation experiment in 2002.

Species	Common name	Cultivar/line	Comment
Phalaris aquatica	Phalaris	Australian	Standard prostrate
Phalaris aquatica	Phalaris	Atlas PG	Early, drought tolerant
Phalaris aquatica	Phalaris	Holdfast	General purpose
Phalaris aquatica	Phalaris	Landmaster	Persists on shallow soil
Dactylis glomerata	Cocksfoot	Currie	Early, drought tolerant
Dactylis glomerata	Cocksfoot	Porto	General purpose
Festuca arundinacea	Tall fescue	Fraydo	Early, drought tolerant
Festuca arundinacea	Tall fescue	Resolute AR542	Early, safe endophyte
Festuca arundinacea	Tall fescue	AU Triumph	General purpose
Lolium perenne	Perennial ryegrass	AVH 4	Early, drought tolerant
Lolium perenne	Perennial ryegrass	Avalon	General purpose
Lothopyron ponticum	Tall wheatgrass	Dundas	Summer active C3
Bromus stamineus	Grazing brome	Gala	Low input performer
Plantago lanceolata	Plantain	Tonic	Perennial herb
Chichorium intybus	Chicory	Grouse	Perennial herb
Austrodanthonia fulva	Wallaby grass	Ligule 179 (NS)	Native C3
Austrodanthonia richardsonii	Wallaby grass	Taranna (NSWA)	Native C3
Microlaena stipoides	Weeping grass	Wakefield (UNE)	Native C3
Themeda australis	Kangaroo grass	NSW (Betts)	Native C4
Ehrharta calcycina	Perennial Veldt grass	Mission	Sub-tropical C4
Panicum maximum	Green Panic		Sub-tropical C4
Setaria sphacelata	South African pigeon grass	Narok	Sub-tropical C4
Pennisetum clandestinum	Kikuyu grass	Whittet	Sub-tropical C4
Chloris gayana	Rhodes grass		Sub-tropical C4

A view of the pasture evaluation experiment.

Demonstration of best-bet management practices

The demonstration site will be established in autumn 2003. Results from the large-scale grazing experiment and existing knowledge on hill pasture management will be used as guidelines for the work. Treatments of deferred grazing, fertiliser application and set-stocking will be imposed, and their subsequent effects on water and nutrients runoff and water quality compared. The work not only has value for large-scale demonstration, but also contributes significantly to understanding the role that steep hill country plays on recharge control and water quality.

Researchers and farmers inspect a potential site for the demonstration.

Preliminary results of the large-scale grazing experiment

Despite the occurrence of a large number of native species in the grazing experiment, as shown in the flora species survey, the density of those species was much lower than annual grass at the start of the experiment (Table 3). Native grass accounted for only 23% of the total plant density whereas annual grass (predominantly silver grass) and onion grass dominated the sward (over 65% of the total plant density).

Table 3 Plant population density (tillers or plants/m^2) of native grass, other perennial grass, annual grass, onion grass, and legumes at different locations of the slope in October 2002.

Slope	Native grass	Perennial grass	Annual grass	Onion grass	Legume
Top	4390	540	9560	2100	280
Mid	1730	1520	4420	1370	130
Bottom	2030	1650	4720	1420	70
%	23%	10%	52%	14%	1%

The annual grasses complete their life cycle around November, leaving the ground bare when the residue of these species are removed through summer grazing. In March 2003, the ground cover of the set-stocking treatment was 55%, much lower than that of the deferred grazing treatments (75 – 90%).

An advantage of native species is their ability to grow in summer.

Further information

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