PROGRAZE™

Profitable, sustainable grazing

SEGMENT 1

PRODUCTION, PROFIT AND SUSTAINABILITY PASTURE ASSESSMENT

In this segment you will learn:

- How productive perennial base pastures address problems of land degradation.
- How to assess pasture quantity and quality.
- Of those pasture characteristics that impact on livestock production.

PRODUCTION, PROFIT AND SUSTAINABILITY

The efficiency with which the farm's rainfall is managed significantly influences its viability, both financially and environmentally.

This efficiency influences the level of pasture production and therefore potential stocking rate and so farm profitability. Inefficient use of rainfall contributes to sustainability or land management problems which impact on the individual grazing enterprise and its water catchment. Such problems include:

- Salinity
- Soil acidity
- Soil erosion
- Poor quality water entering dams, streams and rivers.

A strategy to achieve profitable grazing enterprises while, at the same time, addressing these sustainability issues, is to utilise as much of the rainfall as possible for pasture growth (maximising kilograms of pasture dry matter per millimetre of rainfall) and to minimise the loss of water from run-off and deep drainage. This can be achieved by growing and maintaining vigorous, well managed, productive pastures, particularly those dominated by adapted perennial species. These pastures use rainfall efficiently to generate feed for livestock while protecting the soil surface and minimising deep drainage below the plant roots which is the cause of much environmental decline – a potential win/win situation for land managers.

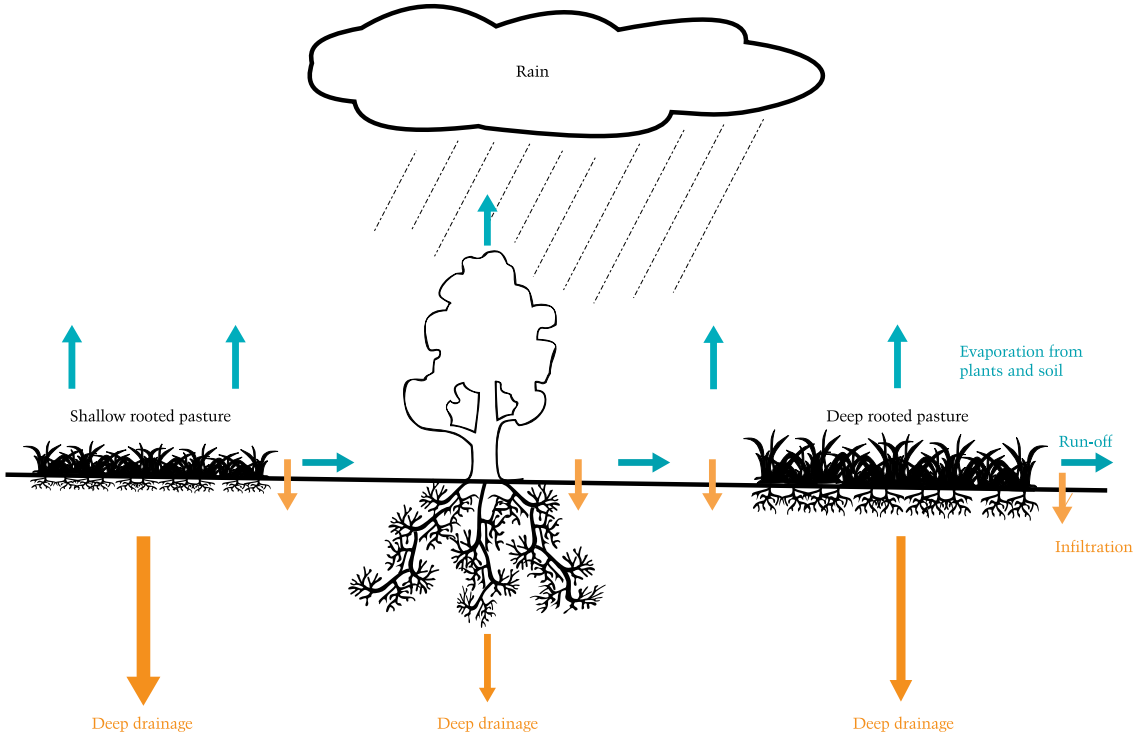
As we progress through PROGRAZE the link between productive pastures and sustainability issues will be expanded, as will your knowledge and skills to manage these pastures. However, as a basis for understanding how rainfall may eventually impact on both production and sustainability, some knowledge of the water cycle is required.

THE WATER CYCLE

When rain falls, besides evaporation from the soil surface, water moves via three pathways in a pasture based system (Figure 1.1):

- Across the soil surface (run-off).
- Infiltrates the soil and is used by plants (transpiration), the main reason soil dry out.
- Infiltrates the soil and drains past the root zone of plants to the water table (deep drainage).

Figure 1.1 The water cycle on a pasture system.



Run-off

Water moves across the soil surface when soils are saturated, during periods of high intensity rainfall or when the soil surface limits infiltration. Effective ground cover slows the rate of run-off, promoting infiltration.

Run-off is required to fill dams and maintain water flows in our streams and rivers however.

Run-off is a natural process if it is clean water leaving our farms. Ground cover is the key to limiting the movement of our soil.

Water used by plants

Water that infiltrates the soil surface and enters the root zone of plants has the potential to contribute to their growth. It is this water that underpins the potential productivity, and so profitability, of the grazing system. A grazing system can only survive in the long-term if managed to ensure the efficient use of rainfall by pasture plants.

Deep drainage

Deep drainage is water which drains past the root zone of plants and into the water table. This water is not only lost to pasture production, it is the major cause of salinity, contributes significantly to soil acidity and removes nutrients from the root zone of plants through leaching. Deep drainage will always occur in very wet periods and is needed to recharge the water table. Our aim is to restrict deep drainage to wet period only.

SUSTAINABILITY IMPACT OF POOR WATER USE

Soil erosion/nutrient loss

Run-off from unprotected soil carries soil and nutrients leading to erosion and a lowering of water quality entering dams, streams and rivers. The impact is well recognised and includes the silting of dams, the presence of algal blooms in dams and rivers and water being unfit for use by humans or livestock. In addition, there are costs associated with replacing lost nutrients and repairing areas impacted by erosion.

Soil Acidity

When water drains through the soil, it carries with it nitrate nitrogen, causing soil acidification (lower pH). Pastures dominated by nitrogen fixing legumes accentuate the problem. Soil acidity may restricts plant growth, resulting in a decline in pasture productivity. Optimising soil water usage, with productive deep rooted perennial pastures can reduce deep drainage, encourage the uptake of nitrogen and so reduce the likelihood of acidification. The use of lime, acid tolerant species and sound pasture management all play an important role in addressing acidification.

Salinity

Salinity results from the deep drainage of water through the soil profile and into the water table. This causes the water table to rise, bringing with it naturally occurring salt. As water tables rise, the result is saline soils and waterways – environments unsuitable for plants, livestock and people. The loss of these environments is a substantial cost to the community. Pasture species selection and their management can minimise deep drainage through increased water use. Dryland salinity is associated with the reduction of trees in our landscape and cycles across years lagged to extend wet periods. The big increase in salinity seen in the 80s was influenced by the wet 70s.

MANAGING FOR PRODUCTIVITY AND SUSTAINABILITY

Pasture and grazing management influences the way water moves across the soil surface and through its profile. Productive pastures, profitable grazing systems and improved sustainability are all about efficient water (rainfall) usage.

Efficient water use in the grazing situation requires decisions about:

- *Pasture species*: greater use of deep rooted perennial species that stay green longer – using more water and producing more feed over extended periods for livestock.
- *Pasture management*: optimising pasture growth, persistence,

- *Ground cover preservation*: encouraging rainfall to enter the soil for use by pasture, protecting the soil surface from run-off and ensuring the quality of run-off water.

In some landscapes productive pastures alone will not be sufficient to reduce deep drainage to sustainable levels. In rainfall areas of less than 600 mm, or 750 mm in the northern summer rainfall zone, good pasture and grazing management are likely to be sufficient.

However, in the southern winter rainfall zones receiving 600 mm/year or more, and summer rainfall zones receiving 750 mm or more, pastures alone are unlikely to be sufficient to reduce deep drainage to satisfactory levels in some parts of the landscape. In these areas, trees need to be integrated into the grazing system to prevent excessive amounts of deep drainage.

To indicate how effective trees are in reducing deep drainage, studies in a winter rainfall area showed annual crops and pasture allowed about 100 mm per year of deep drainage, perennial pastures about 50 mm and trees about 5 mm.

Apart from the nature of the vegetation and the amount and distribution of rainfall, soil type has a significant impact on the level of deep drainage.

OTHER SUSTAINABILITY ISSUES

While management of the water cycle is critical to achieving profitable and sustainable grazing systems, there are other issues we need to be aware of – some of these are mentioned below.

Weeds

Weed invasion indicates a grazing system out of balance and represents a significant cost to livestock production. Well managed productive pastures compete strongly with weeds and are a low cost way of controlling them. It is also the most efficient way to prevent weeds colonising in pastures. The loss of productive pasture to weed monocultures is becoming an increasing problem across the state.

Sodicity

Sodicity is a naturally occurring common problem with many soils and especially sub soils. An excessive quantity of exchangeable sodium in the soil causes clay dispersion, which in turn predisposes soils to sealing, erosion and water run-off. Pasture and livestock production can be adversely effected.

Good ground cover reduces run-off and the risk of erosion. A dense well managed pasture increases soil organic matter, which may reduce the adverse effects of sodicity.

Other Issues

There are other factors important to the sustainability of the grazing business which are not dealt with in PROGRAZE, these include:

- Soil structural decline
- Preservation of native flora and fauna (including biodiversity)
- Tree decline
- Feral animals
- Social and rural community issues
- Competition from other rural industries.

SUMMARY

The PROGRAZE approach to improving the link between profitability and sustainability:

- Understand the water cycle and how it drives both productivity and sustainability, and the way it should be managed to achieve both outcomes. Recognise the role of trees in controlling deep drainage.
- Use well adapted perennial pasture species that suit the environment and enterprise. Using effective management and robust production systems capable of using water efficiently will reduce the rate of acidification, potential salinity and weed invasions.
- Manage pasture species to enhance their persistence and stability to achieve more reliable ground cover, efficient rainfall use, reduced water and nutrient run-off, erosion, deep drainage and weeds.
- Use inputs such as herbicides and fertilisers strategically to achieve dense healthy productive pastures, the basis for a profitable and sustainable grazing system.
- Closely matching feed supply to livestock requirements results in the more efficient use of resources, leading to better use of water and generally higher production per mm of rainfall. Be prepared to de-stock pastures in drought to minimise the devastating effects on pastures.

Further reading and information

More specific information on the sustainability issues can be obtained from NSW Department of Primary Industries and your Local Land Services office.

Other sources of information include:

- CSIRO Land and Water, GPO Box 1666, Canberra, ACT 2601 (www.clw.csiro.au)
- Murray-Darling Basin Commission, GPO Box 409, Canberra, ACT 2601 (www.mdbc.gov.au)
- Land and Water Resources Research & Development Corporation, GPO Box 2182, Canberra, ACT 2601 (www.lwrrdc.gov.au)

PASTURE ASSESSMENT

During this course major emphasis will be placed on developing pasture assessment skills. Such skills provide the basis on which to build sound pasture and grazing management. Pasture assessment will be a component of each segment of PROGRAZE and Pasture Recording Sheets are included at the end of this segment which allows you to retain a record of each assessment undertaken during the course.

By the time most people complete the course they will, through 'eye balling' (visual assessment) a paddock, be accurate in estimating the amount of pasture present and its quality. However, after completing the course you should occasionally consider 'recalibrating' your eye by following one of the procedures described later in this segment.

WHY ASSESS PASTURE?

- To match animal requirements and pasture production.
- To achieve more precise supplementary feeding.
- To enable accurate feed planning.
- To more effectively manipulate pasture production and composition.
- To ensure ground cover is sufficient to protect soil from rain and run-off, and to encourage infiltration.

Visual assessment of pasture involves being able to:

- Estimate the quantity of pasture available. This is referred to as herbage mass and is measured in kilograms of dry matter per hectare (kg DM/ha). Herbage mass, as well as fodders in general, are usually described in terms of their dry matter. This is due to the considerable variation in water content of pastures and conserved fodders and that water has no nutritional value to livestock. So to be able to assess and make valid comparisions between feeds, in respect to their livestock production potential, it needs to occur on a dry matter basis.

  Primary factors in determining herbage mass is pasture height, its density and dry matter.

  Sometimes the term herbage mass is used to describe the total pasture available. Alternatively, it might be used to describe a component of the pasture, for example, the green portion only. With pasture assessment it is important to recognise the proportion of green and dead material in the pasture mix. Be sure you know which element is being discussed. The influence of herbage mass on animal production is dealt with in Segment 2.
- Predict the quality of pasture available. The most useful measure of pasture quality is digestibility. Digestibility is the proportion of pasture or feed which once consumed can be utilised by the animal. It is expressed as a percentage. Digestibility may refer to the total pasture but often a more useful measure is the digestibility of pasture components, for instance, the green or dead component. Another useful measure of pasture quality is its legume content.
- Estimate ground cover. Ground cover reduces or even eliminates the adverse impacts of rain and run-off, providing protection against soil erosion. Ground cover encourages the infiltration of water into soil for use by pastures.

  There will be an appropriate ground cover which should be a minimum target for your situation. This figure will vary with slope, soil type and the amount and intensity of rainfall. For example, from research undertaken on the North Western Slopes of NSW a 70% minimum has been established for many situations. The Department of Land and Water's SOILOSS program can be used to establish these minimum targets.

  Groundcover includes existing pasture, weeds and other herbage, as well as litter. To estimate ground cover simply stand in a representative part of the pasture with your feet half a metre apart. Visualise a square 0.5×0.5 m in front of your toes. Looking vertically into the pasture, estimate the percent area covered by plant material and litter. By doing this a number of times across the paddock and averaging the results this method should give a good indication of paddock groundcover.

The influence of digestibility and legume content of pasture on livestock production are also discussed in Segment 2.

During the course, emphasis will also be placed on developing skills in recognising pasture species that are of significance to pasture and animal production.

MEASURING HERBAGE MASS

The method we will use to measure herbage mass is what is known as the median quadrat technique. This technique will be demonstrated to you during the first segment of the course, but after that it is likely your course coordinator will have used the technique prior to your arrival to obtain pasture estimates on a number of plots. The technique is described in Appendix 1 of this manual.

As indicated earlier, following the course it is likely you will need to 'recalibrate your eye' two or three times a year. This can be done by following the median quadrat technique or by taking pasture cuts with a single quadrat. While the median quadrat technique is preferred, the single quadrat technique has the advantage of being a simple technique.

If the single quadrat method is used it involves firstly making a square quadrat with an internal measurement of 500 mm × 500 mm (0.25 sq m).

The technique then requires selection of a small relatively even area of pasture, say 2 m × 2 m, and peg the four corners. Then, within this area, select an area the size of the quadrat that is representative of the whole.

Place the quadrat over this area and cut the pasture to ground level. Dry this sample via methods described within the median quadrat technique (see Appendix 1) and weigh the dry sample to the nearest gram. Multiplying the weight in grams by 40 results in an estimate of kg DM/ha (a quadrat of the size described above is 1/40,000 of a hectare). It is then a matter of going back to the pegged area, relating the estimate to the pasture present and so 'recalibrating your eye'.

The emphasis during both the course and through the suggested post-course recalibration, is the development of participant's visual assessment skills by measuring relatively small pasture areas.

These skills are used to assess paddocks, the assessments of which form the basis of grazing management decisions.

As these skills are being developed, common circumstances where errors occur are:

- Where clover makes up a significant proportion of the pasture there is a tendency, as pasture height increases, to over estimate herbage mass. This is due to clover being very 'showy' and lacking density beneath the leaf canopy.
- Pasture density needs to receive the same emphasis as height when making assessments.
- There is also a tendency to over estimate herbage mass when pasture is in the early vegetative stage, leafy and actively growing. Remember, herbage mass is based on the amount of dry matter available and pastures in this condition can be in the range of 10–20% dry matter. That is, 80–90% water.
- Conversely, where a pasture contains mainly mature dead material there is a tendency to underestimate herbage mass. You might say: 'Well what the heck, this is poor quality pasture anyway'. Such pastures, when little or no green feed is available (often the case in the southern parts of New South Wales during summer), makes an important contribution to livestock production even if they require some supplementation. These pastures may be 80–90% dry matter.
- Plant species such as thistles or tussock etc, that you know will not be consumed by livestock during the period relevant to the assessment should be ignored when assessing The following is a guide you may find useful for visually predicting the approximate green herbage mass of a dense pasture. Firstly, estimate the height of the green component. Then calculate its herbage mass by allowing 1000 kg DM/ha for the first 3cm of height, plus 200 kg DM/ha for each additional centimetre. For less dense pastures, such as lucerne and fodder crops, it will be necessary to multiply this calculation by a figure that is less than 1. For example, for a good dense stand of lucerne this figure is likely to be about 0.4 while for a sparse native pasture with a lot of bare area or standing dead pasture the figure may be as low as 0.1. herbage mass.

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MEASURING PLANT HEIGHT

The average plant height of a pasture, along with pasture density and dry matter, are the factors that determine herbage mass. You will learn in the next segment how herbage mass impacts on cattle and sheep production but you will also learn that plant height can independently impact on production as well.

Plant height becomes increasingly important as the indicator of livestock production as plant density of the pasture declines. Average plant height is obtained by simply measuring, at random, the height of individual plants and averaging these measurements.

MEASURING DIGESTIBILITY

Digestibility is mainly influenced by the pasture's stage of maturity. Information in Segment 2 of the manual will assist you in getting into the 'ball park' on digestibility. In addition, in some locations, previous pasture research and pasture monitoring projects are other sources of digestibility information.

During the course, pasture samples will be collected to obtain digestibility estimates via laboratory analysis. It may be that you would find it useful to have a digestibility profile on your pastures. The collection technique is important. Samples which arrive for testing in an unfit state will result in a meaningless analysis.

The collection technique is described in Appendix 2. Samples must be placed in an esky with ice immediately after collection, or oven dried.

Also nutritive value analysis, which includes a prediction of digestibility, energy and protein content, on fodders is useful for determining feeding levels when supplementing or drought feeding livestock. Appendix 5 provides average values for commonly used feeds. More information on feeds can be found on the NSW DPI'S web site www.dpi.nsw.gov.au.

MEASURING BOTANICAL COMPOSITION

The proportion of species in a pasture can give a quick estimate of pasture quality. As the proportion of less desirable species increases, so pasture quality declines. By monitoring you keep track of changes in composition and so corrective measures can be applied before the decline is too great, and costly resowing is required.

The simple 'pointed stick' technique is used to monitor the species present in a pasture. The stick is randomly thrown across the paddock and the plants that are nearest the ends of the stick are recorded. Assessing botanical composition is best done in southern NSW in early winter after the autumn break. Plants have then established full ground cover. In the north of the State this is likely to be early spring.

The technique is undertaken using a 1 cm thick dowel about 30 cm long with pointed ends – or a nail can be partially driven into each end of the stick.

The stick is thrown ahead, at random, while walking across the paddock. After throwing, identify the pasture component touched or directly below the end of each nail head. Record these on a sheet similar to Table 1.1. A blank copy of this form, which can be photocopied for on going use, is available at Appendix 6.

Repeat the process 50–100 times throughout the paddock. Fifty observations of a double ended stick will give you 100 observations (hits). The total hits for each pasture component divided by the total number of hits, indicates the percentage of each species in the pasture.

Table 1.1 Recording sheet to determine pasture composition. (Number of times each pasture was encountered. Each time a recording is made cross off a number).

Species																					Total
Improved grass,	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~	~~11~~	~~12~~	~~13~~	~~14~~	~~15~~	~~16~~	~~17~~	~~18~~	~~19~~	~~20~~	22
(e.g. ryegrass,	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
phalaris etc.)	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	44%
Clover or	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	~~9~~	~~10~~	~~11~~	12	13	14	15	16	17	18	19	20	1
medic	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	22%
Weeds	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	8	9	10	11	12	13	14	15	16	17	18	19	20	7
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	14%
Annual grass	~~1~~	~~2~~	~~3~~	~~4~~	~~5~~	~~6~~	~~7~~	~~8~~	9	10	11	12	13	14	15	16	17	18	19	20	8
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	16%
Bare ground	~~1~~	~~2~~	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	2
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	4%
Dead pasture	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	

You may want to categorise species or look at them individually. For example, all undesirable species may be called ‘weeds’; all sown species grouped together; annual grasses together etc. A blank sheet in provided in Appendix 6.

PASTURE SPECIES IDENTIFICATION

Developing skills in the recognition of pasture species will also receive emphasis during the course. If a species cannot be identified by your coordinator or individuals within the group, the coordinator will take responsibility for having the species identified by the next meeting of the group.

When collecting specimens for identification remember, it may require a flower or seed head to be successfully identified.

For future reference, you might consider starting a collection while undertaking the course. Following identification, placing specimens between sheets of newspaper is a cheap and reliable method of storage.

For information on identifying your pasture plants see the list of books in further reading at the end of the segment.

HERBAGE MASS DIGESTIBILITY AND ANIMAL INTAKE

Herbage mass and digestibility interact to determine the amount of pasture consumed by livestock. Assuming the animals are healthy, the level of pasture intake will determine animal production. There are critical levels of digestibility as there are with herbage mass. One can offset the other when high levels of production are not required.

Through pasture assessment and understanding this interaction, we can better match animals and pasture. This interaction is explained in Segment 2.

A major aim of a grazing enterprise is meeting market specifications. Using skills developed in PROGRAZE, along with strategies such as production targeting (see Segment 3), you will be in a better position to determine if you are on track to get animals to a particular target.

Once a market is identified, livestock production requirements can be determined (e.g. 1.3 kg growth per day in steers, 200 grams/day growth between 5 and 8 months in lambs). Similarly, you can better allocate stock to paddocks to keep them on target, as PROGRAZE will outline what the characteristics are of a pasture that will produce 1.3 kg/day growth in steers.

Where pasture is limiting, supplements may fill the shortfall. The amount of supplement needed by animals, like pasture, depends on the quality of the supplement, which can be determined by 'feed tests'. A knowledge of pasture and supplement quality will allow you to more accurately satisfy animal feed requirements.

Over the following segments a computer program known as GrazFeed®, will be used to determine how available pasture meets animal requirements. From this, a decision can be made as to the need for supplementary feeding and the amounts of supplement needed.

SUMMARY

Pasture assessment is used to determine the capability of the pasture for animal production and as a basis for pasture management decisions.

- The objective is to develop skills in visually assessing pastures (eyeballing) but this is calibrated on cutting, weighing and drying of pasture.
- Pasture assessment involves recognising pasture quantity and quality.

Quantity

- Herbage mass, the amount of pasture available in kg DM/ha.
- The amount of green and dead material.
- Herbage mass = total green + dead material.
- Herbage mass is primarily a function of a pasture's height, density and dry matter.

Quality

- The digestibility of a pasture.
- The percent legume on a dry weight basis.
- The species composition in a pasture.

Further reading and information

- *Grasses of temperate Australia – a field guide*. CA Lamp, SJ Forbes & JW Cade. Bloomings Press.
- *Plants of Western NSW*. GM Cunningham, WE Mulham, PL Milthorpe & JH Leigh. Inkata Press.
- *Grasses of NSW slopes*, *Grasses of coastal NSW*, *Grasses of NSW tablelands*; phone 1800 025 520 to order from Tocal college.
- www.dpi.nsw.gov.au

PROGRAZE PASTURE ASSESSMENT RECORDING SHEET

PROGRAZE group		**Pasture quantity**								**Pasture quality**					
Property/Paddock	Pasture Species	Total Herbage Mass (kg DM/ha)		Green (%)		Dead (%)		Total Green (kg DM/ha)		Legume (%)		Digestibility Green (%)		Digestibility Dead (%)	
		Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate	Actual	Estimate	Actual