MANAGING PASTURES FOR BETTER UTILIZATION AND ANIMAL PRODUCTION

Ken Archer
NSW Agriculture and Fisheries
Agricultural Research Centre
Tamworth 2340

Pastures are the major source of nutrients for livestock in Australia. The major component of pasture is fibre and the most effective method of utilising this material is to convert it into animal products using the special digestion mechanisms of the ruminant. However, the proportion of the potentially usable pasture which is harvested and converted into animal products will vary markedly. While total utilization of a pasture is not desirable due to adverse affects on persistence, the aim should be to convert as much as possible. Pasture which is not eaten will decay, and is potential income foregone.

Pasture management for efficient utilization is a complex process affected by many interacting factors. In this paper, I will firstly review some of the more important relationships between animal performance and pasture characteristics which affect utilization, and then describe a planning procedure for improving utilization, largely based on methodology developed in New Zealand.

RELATIONSHIPS BETWEEN PASTURE CHARACTERISTICS AND LIVESTOCK PRODUCTION

Herbage mass

This is the average amount of pasture on offer at any particular time, and is usually expressed as kg dry matter/ha. The mass of green herbage present determines the potential growth rate of the pasture (Fig. 1). Growth rate initially increases as green herbage increases, but eventually leaf death balances growth and pasture mass stabilises. The objective of pasture management should be to maintain the pasture within the optimum limits for maximum growth, while reducing leaf death to a minimum.

Fig. 1

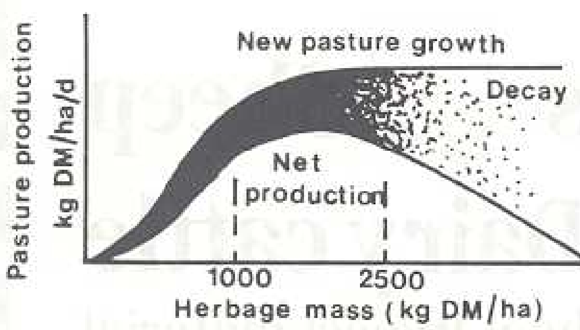

Fig. 2

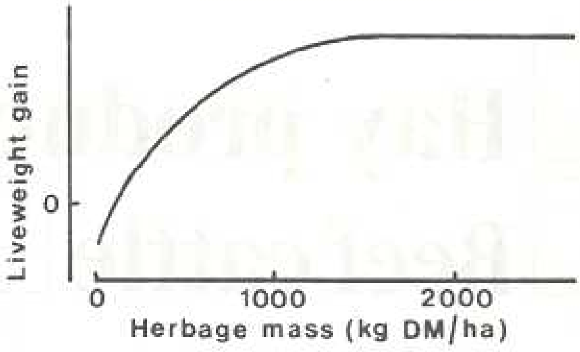

Figure 1. Relationship between herbage mass and pasture growth for temperate pastures (adapted from Korte, Chu and Field 1987)

Figure 2. Relationship between herbage mass and intake by sheep grazing temperate pastures (Willoughby 1959).

Herbage mass also affects intake. As herbage mass declines, the ability of the animal to consume pasture also declines and both intake and animal performance will be reduced. This relationship is shown in Fig. 2, and indicates that intake of sheep will start to decline when herbage mass falls below about 800-1000 kg dry matter/ha (Willoughby 1959), which is very similar to the herbage mass required for maximum pasture growth rates. The ability of managers to assess herbage mass is therefore critical.

Nutritive value

Nutritive value may be measured in terms of % digestible dry matter (or organic matter), metabolizable energy (MJ ME/Kg DM), protein content (%), and so on. The effects of nutritive value are two-fold. Firstly, as pasture quality increases, a higher proportion of the pasture is converted into animal tissues. Secondly, because the rate of degradation in the rumen is higher, animals can eat more high quality pasture (Fig. 3).

Fig. 3

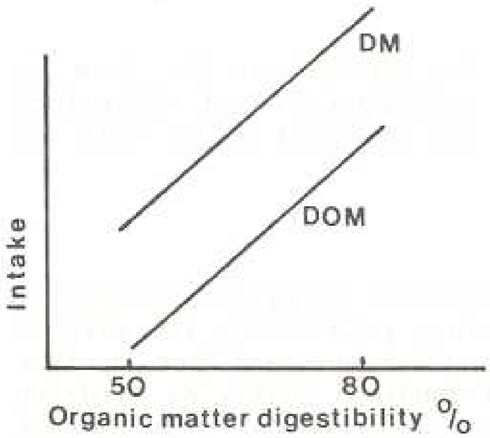

Fig. 4

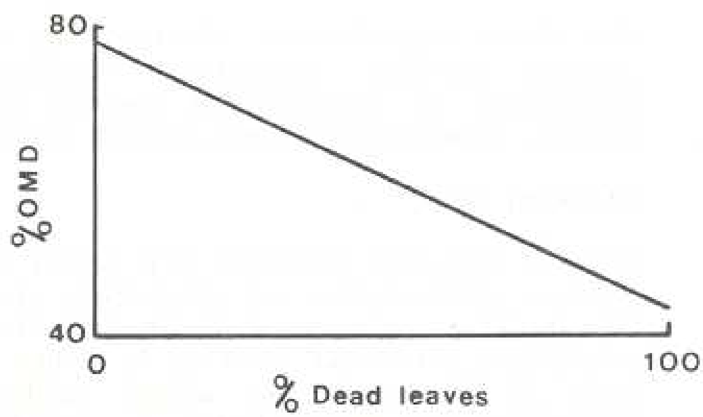

Figure 3. Effects of organic matter digestibility on intake (Archer and Robinson 1988).

Figure 4. Effects of % dead on organic matter digestibility (adapted from Archer and Decker 1977).

Botanical composition of the pasture

The species composition of a pasture will affect both the quantity and quality of the pasture. In general, grasses are more productive and persistent than legumes, but legumes have a higher nutritive value and their intake is higher due to a faster rate of breakdown in the rumen. Thus animals grazing legume pastures generally have a much higher growth rate than animals on grass pastures. It is also generally true that introduced grasses have a higher nutritive value than native grasses. However, we have shown that many of our native grasses are higher in nutritive value than commonly believed (Archer and Robinson 1988 - Table 1), and if properly managed, will contribute significantly to animal performance.

Table 1. In vivo digestibility (%) of selected introduced and native pasture species (Archer and Robinson 1988).

	Early spring	Late spring	Summer
	%	%	%
Trifolium repens cv. Haifa	82	72	-
Festuca arundinacea cv. Demeter	70	62	6
Phalaris aquatica cv. Sirosa	76	-	66
Danthonia linkii	73	62	63
Microlaena stipoides	-	66	67
Bothriochloa macra	-	58	60
Themeda australis	-	58	65

The other important aspect of pasture composition is the proportion of green leaf, stem and dead matter in the sward. Green leaf is the most important component due to its higher nutritive value, and animals will selectively graze this component in preference to the stem or dead material. A typical relationship between % dead and % digestibility is shown in Fig. 4.

PRACTICAL GRAZING MANAGEMENT

The above experimental observations can be applied on the farm to improve pasture production, quality, utilization and livestock production by manipulating factors such as stocking rate, type of animal, grazing system and joining times.

Stocking rate

This is the most powerful tool which can be used to effect changes in pasture utilization, and ultimately whole farm production. The effects of stocking rate on individual animal performance and per hectare production are shown in Fig. 5 (Jones and Sandland 1974). As stocking rate is increased, per animal production declines but per hectare production increases rapidly. The optimum situation is to sacrifice some individual animal performance to optimise per hectare production. As stocking rate increases above the optimum, a point is reached where both per animal and per hectare production will crash.

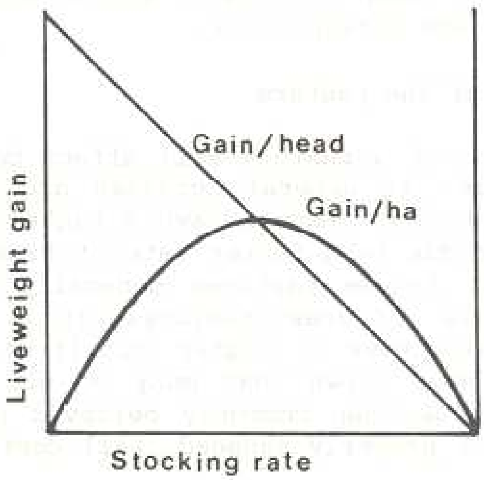

Figure 5. Effects of stocking rate on animal production per head and per hectare.

In practice, the optimum stocking rate is difficult to determine because pasture growth varies enormously with season and rainfall, while animal requirements are much more stable and predictable during the year (Fig. 6). The skill in any pasture management program is to balance seasonal demands of the livestock with changes in seasonal pasture growth rates, as will be described later.

Type of animal

Cattle are able to utilize taller, coarser pasture than sheep, which tend to graze lower and more selectively than cattle. Goats select less legume than sheep and browse on shrubs etc. Breeding animals can be maintained on lower quality pastures during early pregnancy, thus allowing higher quality pastures to be used for fattening stock. A breeding enterprise also has large fluctuations in feed requirements which can be matched to seasonal feed production. Thus advantages can be taken of the grazing patterns and feed requirements of different classes of stock to utilize more effectively different types of pastures on the farm.

Grazing systems

Rotational grazing vs set-stocking

There is little evidence to support the use of rotational grazing systems in preference to set-stocking for livestock performance, especially in the more extensive grazing industries. Sub-division on farms is obviously necessary for livestock management, pasture establishment, separating different classes of livestock and so on. However, apart from a few pasture types, most notably lucerne, few advantages of rotational grazing have been clearly and consistently demonstrated. One problem is that animal performance can be adversely affected by rotational grazing due to restrictions on pasture intake and pasture quality especially towards the end of each grazing period. This gives rise to an undesirable saw-tooth pattern of liveweight gain.

Mob stocking

In New Zealand, a specialized intensive form of rotational grazing, referred to as mob-stocking, has been developed. Again there is little direct evidence from grazing studies to support this practice, but it has gained wide acceptance in New Zealand. I do not have any experience with this system, but my understanding is that it is essentially used as a method of rationing feed to breeding stock during winter to restrict their intake when both feed requirements and pasture growth rates are relatively low. The result is that feed availability and quality at lambing or calving is improved. Such systems should be carefully appraised before being introduced under the less reliable rainfall conditions and less intensive grazing systems practiced in most parts of temperate Australia.

Manipulation of pasture species

A knowledge of specific responses of individual pasture species to various grazing practices allows managers to manipulate the species composition of pastures. Examples include: the use of heavy summer grazing followed by a winter rest to control Aristida (wiregrass) and encourage Danthonia in natural pastures (Lodge and Whalley 1985); the need to spell some of the newer phalaris cultivars (e.g. Sirolan) in spring to maximise production and survival of dormant crown buds required for autumn regrowth (Hill and Watson, 1989); the response of seed production in subterranean clover to grazing up until flowering (Collins 1978); and the benefits of maintaining at least moderate grazing pressure to enhance the persistence of white clover in pastures with perennial grasses (Archer and Robinson 1989).

I refer you to the Proceedings of the 25th Annual Conference of the Grasslands Society of Victoria (1984) for more information on the benefits and effects of various grazing systems on pasture and livestock production.

PLANNING FOR IMPROVED UTILIZATION

In practice, the objective is to manipulate livestock classes, livestock numbers and the timing of livestock management practices to achieve more efficient pasture utilization. This objective must be balanced against the constraints of maintaining optimum levels of livestock performance and pasture productivity and persistence. This can best be achieved with thorough planning and careful, regular monitoring of both pastures and livestock. Most farmers do this either intuitively, or by using methods based on their own experiences and observations. The system which I will describe is a more formalised and objective approach to pasture management and is based on procedures developed in New Zealand by Milligan, Brookes and Thompson (1987). The system has three main levels of planning; the Feed Profile, Feed Budget and Grazing Plan. Similar systems are also being developed and used in the Australian dairy industry, such as that described at the 1986 Grasslands Conference by Jim Collins (1986).

Feed profile

This is a long-term plan over at least one year based on average conditions, and is used to develop overall policy decisions such as stocking rates, types of livestock, lambing dates and stock sales and purchases. Potential stocking rate for the farm is calculated by dividing the average annual pasture growth by the average annual feed demands. Due to peaks and troughs in the pasture growth curve (Fig. 6), this potential is never attained, so the objective is to match feed demands with changes in seasonal pasture production as closely as possible. To develop a feed profile the amount of pasture available is determined on a monthly basis. This is referred to by Milligan, Brookes and Thompson (1987) as "pasture cover" and is calculated as follows:

Pasture cover = Pasture cover + Pasture growth - Animal demands
(end of month) (start of month)

The result is a profile of pasture cover, expressed as kg dry matter/ha for each month of the year, as shown in Fig. 7 for New Zealand conditions. The profile indicates periods of the year with extremes in pasture cover, which will in turn indicate how overall stocking policy may be revised, or when management action may be required. "What if" questions can be considered, for example, to determine the effects of sowing more improved pasture, or a change in livestock enterprise. The aim in New Zealand is to maintain a pasture cover approximately between 800-2500 kg/ha, which is the range for maintenance of maximum pasture growth rates and animal intakes, without suffering undue loss of pasture quality or loss of herbage through decay. Target values for herbage mass at critical times of the year can also be pre-determined and subsequently monitored.

Fig. 6

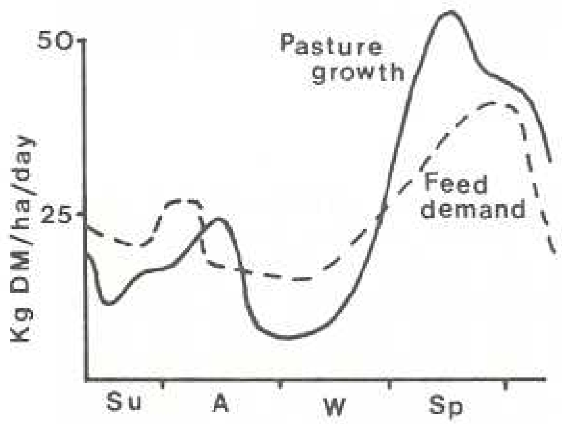

Fig. 7

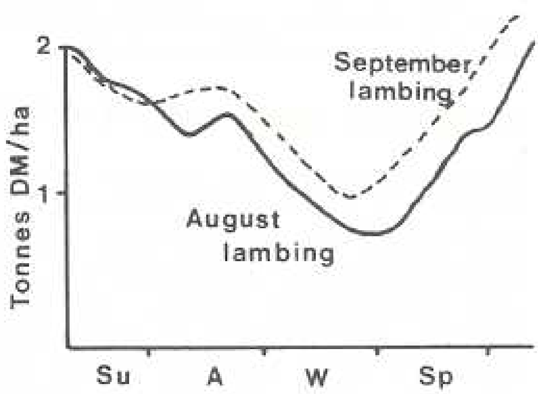

Figure 6. Seasonal pasture growth pattern and animal feed demands for a beef and sheep farm in New Zealand (Milligan, Brookes and Thompson, 1987).

Figure 7. Pasture cover (kg DM/ha) in relation to lambing time on the same farm.

Feed budget

This is based on actual conditions to determine short-term (1-6 month) feeding policies. The feed budget is used to monitor and fine-tune the overall policy, for example, to review stocking rates going into winter, or to determine the possible need for supplementary feeding during a particular period. Pasture supply and feed demands for a particular period are determined as follows:

Pasture supply =	Initial pasture cover +	Pasture growth -	Final cover	
(kg DM/ha)	(kg DM/ha)	(kg/day x no. days)	(kg DM/ha)	

Feed demands =	Animal numbers x	daily intake x	number of days
(kg DM/ha)	(per ha)	(kg DM/head/d)	

Pasture supply is then compared with feed demands to determine if sufficient pasture will be available to meet the required animal production target. A pasture deficit will mean either a review of stock numbers or the need for supplementation. A surplus could be conserved or utilized by purchasing more stock.

Grazing plan

This is necessary to determine which paddocks will be allocated to particular stock classes and the expected grazing times on each of the pastures in a pre-determined sequence.

A major advantage of this overall system is that the impact of a range of likely events, such as unseasonable dry conditions, can be pre-determined to allow the most appropriate contingency plans to be decided upon at the out-set. Regular monitoring of both the pastures and livestock is therefore required to indicate any divergence from the initial calculations. This requires the development of specific skills in objective assessment of pastures for characteristics such as herbage mass (kg dry matter/ha), botanical composition, percentage of green and dead, and quality (% dry matter digestibility). Livestock performance should also be carefully monitored, and this is best done by regular weighing or condition scoring.

PASTURE AND ANIMAL ASSESSMENT PROJECT

The development of pasture assessment skills is not difficult but does require a period of training. A project known as the Pasture/Animal Assessment Project or PAAP (supervised by the Author and Mr. Alan Bell, NSW Agriculture and Fisheries, Tamworth, and funded by the Wool Research and Development Fund), is partly aimed at the development of such skills. Another aim is to obtain pasture and livestock production data from as many pasture types and climatic conditions as possible to determine the validity of relationships between pasture and livestock production across a range of situations. This information will also be used to assist in the development and assessment of computerised feed planning systems. In future, it is proposed to assess remote sensing techniques (e.g. LANDSAT) to provide data on the herbage mass of pastures, and the use of evolving NIR (Near Infra-red spectroscopy) technology to provide rapid quality assessment.

CONCLUSIONS

Improved utilization of pasture on the farm can be achieved through an increased understanding of the relationships between the quantity, quality and structure of the pasture and the quantity and quality of the diet selected by the grazing animal. The practical application of this knowledge will require the development of skills in the visual assessment of these critical pasture characteristics.

Feed planning is considered a desirable method to introduce greater objectivity into pasture management decisions with the specific objective of improving utilization and increasing net farm incomes. Although the New Zealand system offers a useful model, its adoption in Australia will be more complex due to our greater range of pasture types and more variable climatic conditions. However, I am convinced that similar systems being developed in Australia, mainly in the form of computerised decision support systems, will be increasingly adopted by Australian producers as a valuable aid for planning pasture management and utilization.

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