Grazing management – sorting fact from fiction

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When I moved to Hamilton 40 years ago, not knowing anyone in the area, I was advised not to discuss sex, politics and religion.. I quickly found out that 'grazing management' should be added to this list as it is industries equivalent controversial topic! Scientists, advisors, consultants and producers all have very strong views on the 'best' grazing system. Until recently, a large group of 'mainstream' scientists (i.e. Morley 1995) strongly advocated set stocking based on CSIRO research undertaken in the 1960's. However, a growing number of 'holistic' advisors such as Terry McCosker in Queensland and Judy Earl in NSW strongly promote rotational grazing systems.

In more recent year, there has been some coming together of these divergent views with review papers prepared by Horton (1998) and Saul and Chapman (2002). However, there is still a whole industry living on selling advice and products promoting different grazing systems. Rural publications and journals constantly feature articles promoting extreme or the 'best' grazing systems that will solve every pasture and animal problem known to man! Many people seem to want to make grazing management decisions and advice complicated so that producers need to have an advisor there every month to help them.

My view is that the basic principles as to why rotational or set stocked systems give different results in particular circumstances are not mysterious, surprising or complex. It's a matter of thinking about what happens when we increase stocking density and reduce choice in a given area or spread out stock and allow them to choose what they eat. Once these things are understood, producers should be able to make informed

So how do we make sense of the conflicting reports and information? As in many things, while extreme views are good to sell papers, the truth is somewhere in the middle and producers need to determine the best system to suit their farm, lifestyle, animal system, pastures and farm environment. So let's try and understand the pros and cons of different systems. Despite what some people and publications might say, there is no 'best' grazing system for all conditions. It's a matter of considering what resources you have, what you want to achieve and the type of season that you are in and then determining what is the most appropriate system for this situation. For people particularly interested in this topic I recommend people read papers by Horton (1998) and Saul and Chapman (2002) which can be downloaded from the GSSA website. Both these reviews contain comprehensive reference lists.

Some definitions

By grazing management I specifically mean the way that the animals are allowed access to the pasture, i.e. all of the pasture all of the time = set stocked; 4 paddocks 1 mob moved every 1-2 weeks = simple rotation; 10+ paddocks 1 mob = moved every 2-5 days = intensive rotational grazing or "cell grazing" to some people. Second, the differences between the systems discussed below are where there is evidence to back the claim. Often other benefits are claimed but few have any scientific proof. For example, a commercial grazing management site claims benefits of reversal of desertification, better food security, cleaner water and removal of CO_2 from the atmosphere; fairly wide ranging benefits!

Effects of different grazing systems on pastures

Pasture growth.

Rotational grazing results in 5-15% higher growth as has been shown by recent studies by Lisa Warn at Broadford, Raquel Waller at Hamilton, the SGS group near Balmoral (Chapman *et al.* 2003) and current work underway at Orange lead by Warwick Badgery. There are also interstate and overseas reports that support this overall increase in the amount of pasture grown Rotationally-grazed pastures spend more time in the second ('Phase 2') or optimum growth phase rather than being grazed to <1000 kg/ha.

However, it is vital that the rested pasture is grazed before the oldest leaves die and decay. The time for this to occur varies with species and time of the year, i.e. longer in winter and much shorter in spring. For high fertility, temperate sown pastures in southern Australia, the optimum rest time is likely to be 20-60 days, much less than the 80-120 days that is commonly recommended for cell grazing on native, low fertility pastures.

Also, the pasture growth benefits would be expected to be greatest when pastures are short (<1000 kg/ha) in autumn and winter and least when there is an early autumn break or in spring when food-on-offer is >2000 kg/ha.

Pasture composition.
Recent research shows that rotational grazing favours grasses and set stocking favours clovers. This is not surprising given that grasses grow erect and clover is prostrate. A set stocked pasture kept through winter at 800-1200 kg/ha will have higher clover content than a rotationally-grazed pasture that fluctuates between 500-1500 kg/ha. A pasture that alternates between short and long will favour the more erect species. Also, low ground cover in autumn (<1500 kg/ha) will favour sub clover germination.

Pasture nutritive value.
Pasture quality in rotationally-grazed systems is usually slightly lower than in set stocked systems but this will depend on the rotation length. Forage quality declines over time and if forage is 6-10 weeks old, then it will be of lower quality than in set stocked paddocks where new growth is continually available. However, if the speed of the rotation is synchronised with pasture growth rate (slow in winter, fast in spring), then there will only be a small decline in quality. Lower legume content of rotationally grazed pastures can also lead to lower intake of livestock. Rotational-grazing systems with long spells between grazing that allow rank pasture (>3000 kg/ha) to develop will result a large decline in pasture quality and subsequent animal production.

Pasture persistence.
In general, rotationally-grazed pastures have a higher perennial grass content that set-stocked pastures. Rotational grazing forces the stock to consume all of the forage available rather than just selecting out the palatable sown species. This means that species such as fog grass and onion grass that will be completely ignored under set stocking will be at least partially consumed with rotational grazing. As discussed later, this forced grazing will have consequences on animal production. Rotational grazing also allows the desirable perennials a chance to recover after grazing so that they are not continuously grazed every time a new shoot appears.

To really increase the amount of a particular grass or reduce a serious weed will need grazing management targeted to that species. Phalaris requires rotational grazing through winter and spring to encourage tillering. Perennial ryegrass needs a long spell between mid-November and late January to allow seed-heads to develop (so new plants can grow in autumn). Also, new tillers form under the reproductive stems. Cocksfoot is similar to ryegrass as it can regenerate from seed and new tillers. Recent work by Maggie Raeside at Hamilton has shown for tall fescue, rotational grazing to the three-leaf stage in autumn and winter provides optimal persistence but set stocking is required in spring to keep the fescue under control. Finally, if you have low clover content in your pastures, changing to rotational grazing will make the problem worse.

It's interesting that many of the intensive grazing systems used in Australia originated in the rangelands and savannahs of Africa. These are often called 'fragile' environments and no doubt if continuously stocked, desirable plants and shrubs will be decimated. There is balance between the fragility of the ecosystem and the need for rests from grazing. In the high rainfall permanent pastures in the UK, pasture composition can be easily maintained under continuous grazing whereas in the Gobi desert all desirable plants have disappeared. We need to consider how much help the species we are trying to grow need in a given environment.

Effects of grazing management on animal production

Animal production per head.

Experiments during the 1940-1960's showed little or no improvement in animal production from rotationally pastures compared with set-stocked systems (Morley 1995). Recent work by Waller, the SGS team and Badgery with breeding ewes show about 5% lower production per head than for set-stocked sheep. For wethers, results from Broadford show no reduction in the wool cut per head of rotationally-grazed compared with set-stocked sheep. Lower production per head for ewes is probably due to a combination of a lower proportion of legumes in rotationally-grazed pastures and rotational grazing forcing sheep to consume lower quality pasture that would normally be avoided. The greater the demands on the stock for growth or lactation, the greater the impact of lower pasture quality, hence why ewes and lambs are penalised to a greater extent than wethers.

Animal production per ha.

The same animal experiments at Hamilton, Balmoral, Broadford and Orange show that rotationally-grazed pastures allow a 10-20% higher stocking rate to be carried while maintaining the same minimum feed-on-offer. Rotational grazing leads to a 5-15% increase in pasture growth as discussed previously and increased utilisation of pasture grown so more stock can be carried.

Animal health.

There appears to be little if any difference between set-stocked and rotational systems in worm levels in southern Australia. However, problems such as ryegrass or phalaris staggers need to be considered if using rotational grazing in summer-autumn, especially in southern Victoria. Morley (1969) highlighted the problems with a higher death rate in ewes rotationally grazing phalaris in autumn.

The other issue to consider is the potential impact of a contagious disease in a large mob run at a high density. Problems like bacterial enteritis (yersiniosis) and abortion storms may be a bigger problem when large mobs of sheep are run at high stocking rates.

Stock facilities, water and management.

It's important to remember that if implementing rotational grazing, larger mobs will need more water on hand. Also, the larger mobs will require wider laneways and bigger holding yards. Whether rotational grazing increases management time is a matter of opinion. Some people consider that having fewer mobs to feed and check means reduced work load. Others believe the need to be constantly moving stock is a big time waster. It's really down to personal preference and management style.

Effects of grazing management on environmental issues

Nutrient transfer.

Set-stocked animals, especially sheep, have camp areas where a high proportion of dung and urine is deposited. This can lead to acidic subsoils due to the high N content in urine with a shallow alkaline top layer of soil. Transfer of P and K will also occur from the paddock to the camp area. Work by CSIRO suggests that if camps make up 5% of the paddock, it will lead to transfer of 2-4 kg P/ha from the rest of the paddock. In other words, rotational-grazing systems need about 3 kg/ha less P applied each year than set-stocked systems.. Soil monitoring at the Broadford grazing trial supports this view.

Bare ground.

Set-stocked pastures can easily be overgrazed in autumn while the stock remain in good condition. This is especially so on clover-dominant pastures in hilly country. For example, at Broadford, set-stocked pastures had only 70% ground cover compared with over 90% in rotationally-grazed pastures, despite the latter pastures running a higher stocking rate. More even grazing in the rotational paddocks and higher perennial grass content reduces bare ground compared with set-stocked situations.

Water use.

Theoretically rotationally-grazed, perennial pastures should use more soil water over summer and autumn as there should be more opportunity for green pasture to remain and transpire water between grazing. However, Clifton *et al.* (1997) have shown little difference between the water-use of rotationally-grazed or set-stocked pastures. These temperate species are relatively dormant over summer and so there is little effect of rotational grazing. However, with new more summer-active cultivars such as Banquet ryegrass or summer-active tall fescue, bigger differences in water-use might occur. In the longer term, if the rotational-grazing system encourages a greater proportion of perennial species then water-use will be greater than in an annual-based system

Soil health.

At times, claims are made about the effect of rotational grazing on soil health, soil carbon, organic matter, etc., especially as many of the cell/holistic grazing systems promote leaving a lot of material on the soil surface to decay into the topsoil. If you grow a lot of pasture and then only use a smaller proportion of what is grown, it is logical that soil carbon will slowly increase but this is unlikely to be profitable. However, as indicated previously, the results from many grazing trials show only a 5-15% increase in pasture growth under rotational grazing. If utilisation stocking rates remain constant, then it would take a long time for this additional growth to increase soil carbon. The biggest change to soil carbon is likely to occur if higher soil fertility is used to increase growth by 30-40% combined with a change to using deeper-rooted perennial species.

Greater root depth is claimed to occur under cell-grazing systems. Again there is some logic to this as root growth is proportion to above-ground production and this may partly explain enhanced persistence of perennials in rotational systems. However, root characteristics are very variable and there is little clear evidence of increased rooting depth from rotational grazing compared with set-stocked pastures maintained within normal grazing boundaries.

A major deficiency is our limited knowledge of the long-term impact of different grazing systems on environmental issues. It is likely to take 10-20 years to see significant differences in many soil parameters. The lack of credible data forces a reliance on anecdotal evidence or measurements over time in the same paddock and these results are nowhere as accurate or reliable as a well established comparison of the different systems.

Differences between simple rotations and intensive (cell grazing) systems. Studies at Hamilton and in north east Victoria have shown small (5-10%) increases in per hectare animal production from intensive compared with simple systems. This could be expected as in the intensive system with high intensity grazing for short period, the stock continually have access to fresh pasture and pasture regrowth occurs with limited re-grazing. However, these intensive rotational systems require significant capital expenditure for fencing and water supply. Simple rotational-systems can be implemented relatively cheaply by boxing mobs and moving between paddocks.

Research results contrast with farmer experience

It is apparent from the above comments that the results from carefully managed grazing experiments show relatively small impacts on animal production per hectare, though probably greater impacts on persistence of desirable perennials and ground cover. It is interesting to note that the early research work (i.e. Morley 1995) concentrated on the impact of the different grazing systems on animal productivity and profitability. If the longer-term benefits of rotational grazing on the pastures and soil are not considered, it’s not surprising that the researchers considered the additional costs of using rotational grazing did not justify the small increase in production per head or per hectare.

However, in the last 10-20 years there has been strong interest and uptake of rotational grazing marketed under a variety of names such as time-control grazing, cell grazing, holistic grazing, short-duration grazing, etc. (McCosker 1991, Earl and Jones 1996). This has been particularly apparent in the central highlands and slopes of NSW and Tasmania, especially those with a range of native, volunteer and sown species. While marketing and salesmanship may maintain interest for a while, the fact that many producers have adopted and continue to use rotational-grazing systems suggests that they see and achieve a much greater benefit than has been measured on nearby research trials. According to one commercial website, adoption of holistic management leads to a 93% increase in stocking rates and a 69% improvement in production per head. Even allowing for some journalistic license, these are much greater differences that those observed in research trials. Why is this so?

The excellent paper by Brien Norton in the Australian Society of Animal Production (1998) helps reconcile the apparent dichotomy between the experimental results and farmer experiences. Consider a 100 ha paddock north of Cavendish in western Victoria. It contains several valleys, a number of large red gums, some dry gravelly tablelands, some south- and east-facing slopes. We might expect to run about 1000 spring lambing ewes or around 15-17 DSE/ha in this paddock provided it has reasonable fertility and species.

If you drove around this paddock in summer the tablelands would be bare and covered in large sheep camps; the slopes, especially if south facing, will probably have a lot of low-quality dry feed and areas around the trees and water points will be quite bare. In winter, the pasture on the tablelands will be very short (<1000 kg/ha) with a high clover content but the south and east slopes will have perhaps 1500-2000 kg/ha of volunteer species such as onion grass, fog grass, silver grass, etc. Basically, the 1000 ewes are able to wander wherever they like, graze whatever they like when they like and generally avoid eating things like onion grass, capeweed and silver grass.

If we set up an experiment to compare different grazing systems, we might split this 100 ha into 20 four ha paddocks. We will need to exclude the gullies and some areas with a lot of trees to ensure the remaining paddocks have a consistent amount of tablelands, slopes and trees. Each of these paddocks is stocked with 40 ewes; i.e. still 10 ewes/ha. Some paddocks are set stocked, some are split into four areas to allow a simple grazing system, and some are split up into 20-30 paddocks to allow a very intensive grazing system. This all sounds very good and allows a direct comparison of set-stocked, simple and intensive-grazing systems.

However, the complication is that the new set-stocked system is not representative of the previous paddock situation. The 1000 ewes could all graze on the most favoured few hectares in the paddock and largely ignore other parts. With the set-stocked experimental treatment, there is a maximum of 40 ewes that can graze any one area. Also, the slopes and south facing areas will be a paddock with 40 ewes so have to be grazed whereas before it was largely ignored. Effectively, by splitting the large paddock into 20 smaller sections, we have eliminated the spatial and mob size effects that are important benefits of rotational grazing and have reduced the selective grazing that previously occurred. When we now impose a rotational grazing system within this small four hectare paddock, we can now run more stock/ha, due to increased pasture growth and improved utilisation. Evidence of the higher utilisation in small paddocks can be seen in the fact that invariably the small set-stocked paddocks will carry more stock per ha than was possible in the 100 ha paddock.

If we really wanted to compare the effect of implementing rotational grazing on the 100 ha paddock, we would need to have ten 100 ha paddocks, implement rotational grazing on five and leave five set stocked. The resources needed would be massive and cost quite astronomical and it's not going to happen!

So what we see is that there are several pasture supply benefits of implementing rotational grazing. Firstly, there is 5-15% higher growth as the pasture is allowed a recovery period. Secondly, where previously perhaps 25% of the paddock was <800 kg/ha and 25% >1500 kg/ha right through winter, using rotational grazing (or many small paddocks) will keep these area closer to the optimum growth stage leading to increased pasture growth. Perhaps most important, in the large paddock, 25% of the paddock was not really grazed. Forcing stock to graze these areas will lead to a large increase in carrying capacity. When you add all of these factors together, it is not surprising that farmers moving from 100 ha paddocks to smaller paddocks with larger mobs see potential to double stocking rates as suggested by Earl and Jones (1996). They have grown perhaps 10% more pasture but are now utilising the 30+% that was previously wasted.

However, there is a cost. In making stock eat the previously ignored lower-quality or less-palatable pasture, animal production will be penalised, certainly in the initial phase while the more desirable species are still in small amounts. Over time if the undesirable species are replaced by higher-quality species, there may be fewer penalties to animal production per head from the rotational system but the strong evidence is that rotational grazing systems with ewes and lambs produce less per head then set stocked systems.

The hypothesis outlined above also explains why producers with hilly, native pastures (northern Vic, NSW) have adopted rotational grazing more than those on the more uniform basalt plains of southern Victoria. The bigger the paddock, the more variable the pasture quality, the greater the slope and range in topography the greater the likely benefit of rotational grazing compared with set stocked systems.

Which system for your farm?

Below are nine questions. The more 'Yes' answers for your situation the more likely that adoption of some type of rotational grazing system will provide both production and environmental benefits. If you answer 'No' to most of the questions, it's unlikely that there will be major benefits to your system.

1. Are the paddocks on your farm larger than what is common in your region?
2. Do your paddocks contain several different soils types in the one paddock?

3. Do your paddocks contain variable aspects, topography or slopes within the one paddock?
4. Does pasture utilisation vary across paddocks; i.e. short pasture away from roads and buildings, and ungrazed areas near roads, southern slopes, etc?
5. Do you have a problem with persistence of desirable perennial plants?
6. Is your pasture clover dominant?
7. Is production per hectare more important than production per head?
8. Do you have mainly dry stock or are you mainly interested in producing store animals for sale or later finishing?
9. Are you in a lower rainfall, more fragile pastoral environment?

Based on the information above, some conclusions can be drawn on the most appropriate grazing system based on the type of property and the objectives of the grazing system.

1. Large paddocks, hilly terrain, variable pastures and species, hills grazed bare and lower sections under grazed – likely to be major benefits moving to rotational grazing.
2. Poor persistence of sown perennials and pastures dominated by annuals – will be benefits from rotational grazing but must be targeted to the particular perennial species.
3. Smaller paddocks, flat terrain, relatively uniform pastures – likely to be limited benefits from rotational grazing.
4. Mainly lactating stock and high production per head required **-** set stocking best option
5. Phalaris tends to dominate pasture – heavy set stocking best, rotational grazing will make phalaris even more dominant.
6. High fertility pastures over-grazed in summer – rotational grazing will increase ground cover.

Further reading

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