Holding a measuring stick up to the Cicerone farmlets: how are they shaping up?

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Abstract. Three management systems varying in level of inputs and in grazing management are being evaluated on whole system farmlets on the Northern Tablelands of NSW. The systems include one based on high inputs of fertiliser and sown species (Farmlet A), another with moderate inputs (Farmlet B) and a third which focuses on intensive rotational grazing (Farmlet C).

Preliminary data are presented on 10 characteristics of the farmlets ranging from measurements of soil to pastures, livestock weights, animal productivity, product quality and economic outcomes.

Farmlet A, with its higher levels of soil phosphorus and sulfur and of sown species is showing high levels of individual animal performance and increased carrying capacity by some 50% over the other farmlets. Farmlet C is demonstrating lower levels of internal parasites than the other farmlets, however individual animal growth and wool production are lower.

Thus far, in spite of higher production coming from Farmlet A, its cumulative cash position is considerably lower than that of Farmlet B which has supported less stock but with relatively little expense. Farmlet C on the other hand, has thus far shown the lowest cumulative cash position due to the high capital cost of the necessary additional fencing and watering points incurred in 2000. Further investigations are required to enable the measurement of any long-term effects on soil, plant, animal, economic and off-site effects in order to assess sustainability and profitability.

Introduction

Because grazing enterprises vary so much between different climatic and geographic regions, as well as varying family/corporate circumstances and aspirations, it is challenging to make valid comparisons between different systems. Provided comparisons are made within a confined area which experiences the same climatic events and provided any differences in land capability have been taken into account, whole-farm analysis has the capacity to shed light on how management affects the whole system.

The question needs to be asked: "What does a 'successful' whole farm grazing enterprise look like?" How does one know if it's working? Ideally, things should be getting better over time – but are they? If one wants to measure a grazing system, how many component parts are there to measure? And how do the various parts interact with one another?

Research has suggested that some of the most important criteria supporting sustainable grazing enterprises are the use of deep-rooted, fertiliser-responsive perennial grasses (Lambert *et al.* 1996) especially when combined with a persistent pasture legume (Scott *et al.* 2000). However, it is clear that many factors must be measured in order to assess profitability and sustainability, including soil, pasture, animal, production, economic and environmental factors.

To answer this challenging question at a scale which is credible to graziers and to researchers, the Cicerone Project – a producer led research and adoption group located on the Northern Tablelands of NSW – has been measuring as many aspects of 3 different management systems as is feasible. A description of some of the background to setting up the farmlets has been provided by Scott (2003). The central question being asked is 'how is whole farm sustainability and profitability affected by different levels of pasture inputs and by rotational grazing? The 3 farmlets being studied are as follows:

A. Aim is to increase from about 50% sown, fertiliser-responsive perennial pasture species (mainly phalaris) to 100% (mainly sown to tall fescue, phalaris and white clover), high soil nutrient status [aim is for 60 ppm Colwell phosphorus (P) and 10 ppm sulfur (S)], high carrying capacity, and high per animal and per hectare production. Has 8 paddocks and flexible grazing rotations.

B. Originally contained about 50% sown, fertiliser-responsive perennial pasture species,(mainly phalaris), moderate soil nutrient status (aim is for 20 ppm Colwell P and 6.5 ppm S), a moderate carrying capacity, and moderate per animal and per hectare production. Has 8 paddocks and flexible grazing rotations.

C. Originally contained about 50% sown, fertiliser-responsive perennial pasture species (mainly phalaris), moderate soil nutrient status (aim is for 20 ppm Colwell P and 6.5 ppm S), aiming at a high carrying capacity, moderate per animal and high per hectare production. Has 33 paddocks and employs intensive rotational grazing with short grazing and long rest periods.

The treatment differences and management guidelines for these farmlets were chosen as those most relevant to the questions raised during discussions by grazier members. They were developed with a high level of participation from up to 60 producer members of the Cicerone Project involved in several meetings over a period of several months, prior to the final choice being made.

Methods

The 3 farmlets (each approx. 50 ha), located on "Chiswick" 17 km south of Armidale, NSW, were allocated land parcels of equivalent productive capacity by ensuring that each had the same area of land of different soil types (principally grey brown podzolic), equivalent topography and recent fertiliser history. The long-term average rainfall for the area is 810 mm whilst the annual rainfall for the years 2000 to 2003 has been 659, 678, 652 and 790 mm, respectively.

The management differences commenced in July 2000 when several pastures were sown on Farmlet A and higher rates of fertiliser were first applied to that farmlet. All farmlets carry self-replacing ewe flocks and breeding cattle with approximately 75% of dry sheep equivalents (DSE) as sheep and 25% as cattle.

The measurements taken on the farmlets include soil testing of all paddocks annually since 2001. Also, an annual assessment of botanical composition has been carried out on all paddocks. Pasture growth rate has been measured monthly since mid-2003. Animal liveweight and feacal egg counts have been measured at regular intervals since the commencement of treatments. Also wool production and quality has been measured for all sheep in all years. The fleece characteristics have been used with a price grid to assess the economic outcomes for each farmlet. Anthelmintic treatment has been administered as required, determined by faecal egg count monitors and larval differentiation. Records have also been kept of labour inputs to each farmlet as well as detailed records of all other capital and variable expenses as well as income from both sheep and cattle. Factors not measured to date include soil moisture, runoff, deep drainage and soil pH to depth. Also, only limited financial analysis has taken place to date and the results presented should only be used for comparisons among treatments.

Results

Some of the key results to date are summarised in Figure 1 below.

Differences in soil P are readily apparent reflecting the substantially larger applications of fertiliser made on Farmlet A since 2000. Similar relative differences among farmlets have occurred in S levels (data not shown). The high P levels in 2003 are believed to reflect the mineralisation of organic P that occurred following the very dry season in 2002 (G. Blair, pers. comm.).

There have been large changes in the botanical composition of the pastures especially in the percentage of fertiliser responsive species (e.g. sown and volunteer perennial grasses and legumes) over the past 4 years with Farmlet B showing a loss of this class of plants whereas the composition of Farmlet C is more stable. Farmlet A has shown a large increase in these species due to continuing replacement of the pastures which were present in 1999 before management changes were implemented; nevertheless, there has been an apparent decline in the last year. Since the commencement of treatments in July 2000, there have been few periods of high soil moisture and hence there has been little growth of legumes in any farmlet to date.

Herbage mass has shown a steady decline from commencement when pastures had accumulated large

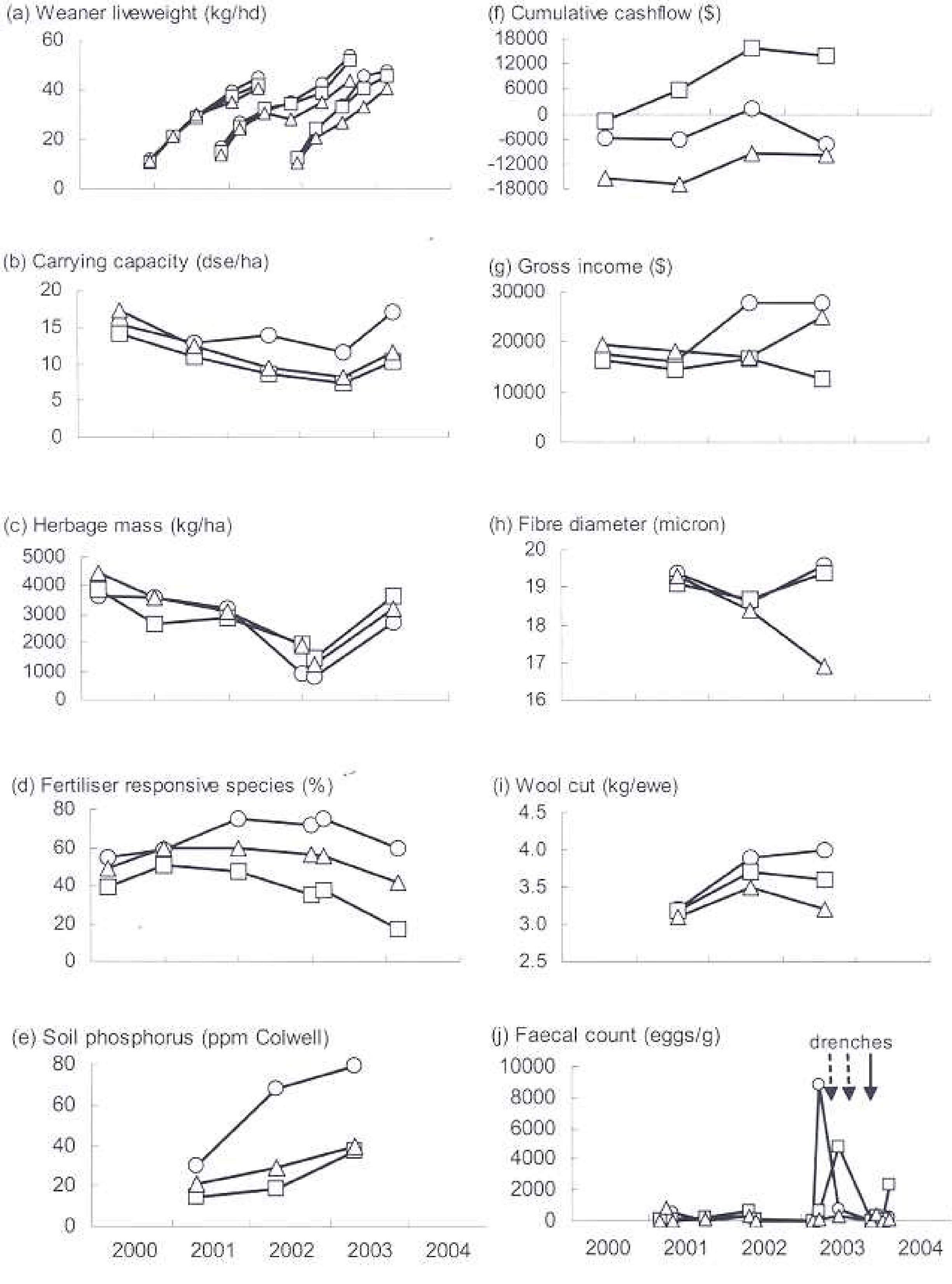

Figure 1. Changes in a range of sustainability and profitability characteristics (animal, pasture, soil, financial, production, product quality) over years 2000-2004 on the Cicerone farmlets (O = Farmlet A; □ = Farmlet B; Δ = Farmlet C). Vertical arrows in Figure 1. indicate drench times: dotted arrow = drenches on Farmlets A and B lambs; solid arrow = drench on all Farmlet lambs.

biomasses due to little grazing prior to 2000. The low values in 2003 on Farmlet A reflect the higher stocking rates and higher digestibility (not shown) of these pastures. Since that time, herbage has accumulated at a similar rate in spite of large differences in carrying capacity among farmlets.

The carrying capacity of the farmlets has diverged especially since 2002 as Farmlet A has been assessed as capable of carrying more animals due to its higher growth rates (not shown). By 2004 Farmlet A had a carrying capacity some 50% greater than either of the other farmlets.

In spite of the higher stocking rate on Farmlet A, the weaner growth rates have increased over years and are as high or higher than on Farmlet B and both Farmlets A and B are showing higher growth rates than on Farmlet C, especially in 2002 and 2003.

Drought was prevalent throughout most of 2002 which saw low worm egg counts across all farmlets. Large differences in worm burdens between the farmlets became apparent following heavy rain in mid-February 2003. Subsequently there was a dramatic increase in worm numbers for lambs on Farmlets A and B, whilst Farmlet C lamb egg counts remained low in spite of receiving less drenches than lambs on Farmlets A and B. More detailed results of faecal egg counts from 2000 until June 2003 were reported by Healey *et al.* (2004) who concluded that Farmlet C shows superior worm control. To date, the intensive rotational grazing on Farmlet C has proved effective against *Haemonchus contortus* (Barber's Pole Worm), the most important roundworm of sheep on the Northern Tablelands.

The differences in ewe greasy wool cut per head (and wool produced by other classes of sheep not shown here) have been increasing over time with Farmlet A and B ewes cutting 25% and 12.5% more wool per head respectively than Farmlet C ewes in 2003.

Fibre diameter was similar on all farmlet sheep in 2001 and 2002 but in 2003 there was a marked drop in average micron in the sheep on Farmlet C relative to the other farmlets in spite of using randomly allocated ewes and rams across farmlets.

The gross income received from sheep, cattle and wool sales shows considerable differences occurring from 2002 on, with Farmlet A having the highest gross income but this was closely followed by Farmlet C and then Farmlet B in 2003. The accumulated cash flow position reflects the benefits over 4 years of the low cost strategy of Farmlet B which has only received moderate inputs of fertiliser and fencing infrastructure. Farmlet A has spent considerable amounts on pasture sowings, some of which have only lasted one year and then requiring resowing. Farmlet C commenced with a sizeable negative position due to the considerable costs of the initial fencing and watering points needed for intensive rotational grazing.

Discussion

It is clear from the results collected to date that the performance of the different farmlets is diverging quickly with quite large differences already occurring in soil, pasture, livestock, production and economic factors. However, it is also clear that measurements on these farmlets will need to continue considerably longer if 'sustainability' is to be assessed adequately. For example, due to a desire to quickly achieve differences between farmlets, investments in new pasture sowings have at times occurred on up to 25% of Farmlet A in any one year and another paddock is being re-sown in 2004. Thus, more time is needed for system consolidation and the measurement of trajectories over time.

Also, there has as yet been little experience of 'good' seasons which will be necessary if we are to measure the effect of management on system productivity and sustainability (e.g. deep drainage) under favourable conditions. It is too early to state whether the decline in fertiliser-responsive sown pastures, especially on Farmlet B, will have longer term consequences. The decline in fertiliser-responsive grasses on all 3 farmlets over the past year is a concern as they are being replaced by less productive grasses such as *Poa*, *Bothriochloa* and *Holcus* spp. As noted by Lambert *et al.* (1996), this may be related to the loss of nitrogen and this in turn is likely to be due to the lack of a persistent legume component (Scott *et al.* 2000). Sanford *et al.* (2003) point out that increasing the legume content is possible using set stocking and yet the persistence of perennial grasses requires grazing rests, especially under high stocking rates. Resolving this dilemma is an important challenge ahead for the management of these farmlets.

The difference in fertiliser rates and pasture sowings has led to large changes in pasture growth rates since measurements commenced in 2003 (data not shown). Also regular assessments of herbage mass and digestibility carried out on a monthly basis (data not presented) show how different the diets are the 3 farmlets.

The above nutritional differences are also causing differences in the effects of nematodes. Even though sheep on Farmlet C, with its extended rest periods, has thus far shown superior worm control, it has lagged behind in body weight and other production factors. In response to this decline in animal production, the rest period has recently been decreased in an effort to raise the quality of nutrition and thus, it is yet to be seen if this may result in a change in worm burdens on this farmlet.

There is also more to be learned about the interaction between pasture availability and quality, stocking rate, the degree of twinning and their interactive effects on the production of wool with desirable staple length, tensile strength, micron and hence value.

How long is needed in order to assess system sustainability and profitability? As part of the definition of sustainability includes 'inter-generational transfer of resources' then, ideally, it would seem desirable to measure the system over at least 25 years, including the measurement of natural capital characteristics such the possible leaching of nitrogen to depth which is linked to soil acidification.

No measurements of soil hydrology have taken place to date. Also, there have been no measurements of changes in surface erosion or nutrient loss. Complete measurements of 'sustainability' will require such audits of natural capital and of any potential off-site effects to be carried out.

The relative economic performance of the farmlets will also require sufficient time to elapse in order to assess the benefits or otherwise of feedback loops from investments in species and soil fertility over extended periods. It is likely that it will only be by ensuring that sown perennial pastures persist over many years, that their value can be recouped sufficient to justify the initial expense. Also, considerable work remains to be done to extend the financial data gathered on these small farmlets, with their diseconomies of scale, to the economic implications for full-sized real farms.

Further, there is more to be done in assessing the numerous interactions between nutrition of the pastures, dietary intake, grazing management, livestock production, product quality and ultimately economic and environmental outcomes. In spite of the many interactions being examined, the different management treatments among farmlets have been maintained, providing a complex set of results which provide evidence of differences which are seen as credible by producer members of the Cicerone Project.

Future plans include developing novel means of summarising sustainability and profitability over time by optimising livestock production, persistence of valuable pastures, and profitability whilst minimising off-site effects.

As the management differences have only been imposed over 4 years to date, as some pastures are expected to persist for 10-20 years or more, and as there has thus far been mostly dry conditions, it is premature to conclude whether any farm system is superior to any other. In fact, as graziers have different objectives, there may never be any consensus reached about the superiority of any particular management.

In summary, to date, Farmlet A is supporting better pasture growth and increasing its carrying capacity in spite of dry times; Farmlet B is performing well in terms of animal growth and cumulative cash flow; and Farmlet C is maintaining desirable pasture species and is showing excellent parasite control.

Much more needs to be done to learn how to combine the various measurements to allow valid conclusions to be drawn over a sufficient time period. It is likely that over coming years, the findings from the Cicerone farmlets will continue to yield interesting results, providing comparisons of whole-farm performance, thus allowing graziers and researchers to learn more about system interactions in a way not possible from simpler experiments.

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