ECONOMICS OF PASTURE IMPROVEMENT IN THE WESTERN WHEATBELT.

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Pasture improvement has many merits and it is a profitable practice in the western wheatbelt. This Primefact is intended to provide growers, advisers and lenders with some ideas and to assist them with producing their own pasture budgets, setting financial goals and production targets. The economics of pasture improvement are more complex than analysing a cropping enterprise. There are more variables to consider and some of the costs are spread over the life of the pasture.

There are numerous scenarios and some unforeseen economic benefits to be consider. Pasture improvement activities will often indirectly benefit the future cropping returns from the paddock; and they can also improve the health of stock which can further increase livestock productivity. These benefits should be calculated and attributed to the pasture improvement efforts.

Unfortunately these indirect benefits are difficult for an accountant to identify and journal into a simple budget, but it may be possible to identify the value of pasture improvement, later when evaluating the Whole Farm Budget, by identifying the improvements in crop or stock enterprises.

Maximising the profitability of pasture improvement is principally achieved by capitalising on the in-creased volume and quality of the forage. The potential profitability of pasture improvement is also de-pendent on a farmer's agronomic and animal husbandry skills. Pasture improvement should also be aimed at more than just doubling the volume of feed to support twice as many stock; producing the same quality of product. A pasture improvement program should incorporate additional economic livestock improvements or gains such as:

- Increasing the fleece weight of each sheep;
- Improving the fleece quality and value e.g. less tender wool and/or higher yield;
- Reducing vegetable fault levels;
- Reducing mortality rates across all age groups;
- Increasing the weaning percentages;
- Increasing the daily weight gain of lamb and beef - to market a heavier carcase;
- Increasing liveweight gains in conjunction with premium market opportunities;
- Capitalise on summer rainfall events to produce quality feed and not weed growth;
- Reducing the annual cost of hand feeding and labour involved;
- Minimising the impact of drought on livestock and the soil resource;
- Reducing crop weed populations in paddocks.

To maximise profits from improving pastures; look for opportunities, analyse gains, and measure the

economic responses. Without measurement and documentation there is no real improvement.

A Merino ewe flock competition in West Wyalong highlighted considerable variations between the flocks. The variations in the flocks are improvement opportunities. There were a few variable factors relating to fibre style that were due to the genetic attributes of the bloodlines.

The bulk of the other flock difference related to pasture quality and husbandry skills. The main flock variables where lambing percentages ranged from 66% to 105%; average wool cut ranged from 6.20 kg to 8.24kg per ewe (the ABS district wool cut average is only 5.7 kg/ewe); the fibre ranged from 21.5 microns to 23.5 microns; fleece yields ranged from 63% to 74%; vegetable fault ranged from 1.0% to 7.5%, and the hand feeding periods ranged from 6 to 20 weeks.

When a grower initiates a pasture improvement program there is an expectation to also improve on some of the above flock issues. By improving a three flock issues, each by just 10%, a grower may achieve a 30% lift in his Merino enterprises' gross margin.

IMPROVING PASTURE

Pasture improvement really starts with utilising perennial forage species. Most perennial species have the potential to provide feed year round in this region, when there is adequate rainfall (35 mm per month). Perennial species also recover quickly from a drought event.

Annual species are a useful addition to a pasture mix; as these plants spread by seed and then colonise the bare areas in a pasture that would otherwise be occupied by weeds, and this maintain the high level of quality of the feed on offer, and reduces the need for a herbicide application (and associated costs). Spraying for weeds will also reduce the forage production of a paddock. Annual legumes are also important for providing nitrogen to perennial grasses.

Lucerne is the most commonly utilised perennial species in the western wheatbelt. Lucerne is grown on the more productive soils which rotate with wheat and barley crops. A lucerne pasture's lifespan is usually determined by the cropping frequency of the paddock, with most lucerne swards having a 3 to 6 year lifespan. A productive lucerne pasture has the potential to produce 8,000 to 10,000 kg/ha per year in this region. A productive lucerne pasture in the western wheatbelt has at least nine mature lucerne plants per square metre, to maximise forage production, suppress annual weed species and prevent soil erosion.

The average monthly rainfall in this region is about 35mm; a productive lucerne pasture has an average daily growth rate of 30 kg of forage per hectare per day (with a sufficient supply of phosphorus). The daily growth rate of a highly winter-active lucerne sward in this region; ranges from 10 kg/ha/day in winter to 160 kg/ha/day in spring.

Graziers wanting a productive pasture that persists for 10 to 20 years may choose to sow a perennial grass species. Grasses are often sown in paddocks with soils that are too acidic for lucerne or those paddocks predisposed to flooding and too wet for lucerne. Many cattle producers also prefer grasses over lucerne to minimise the risk of bloat.

THE COST OF PASTURE

As lucerne is the most widely adopted perennial species in this region, and it is convenient to use lucerne in the examples in this Primefact. Sowing a pasture is the main improvement cost. It is simple to calculate the cost of sowing a pasture. Table 1(below) identifies the typical cost of sowing an "elite" lucerne pasture; is $106.12/ha in the western wheatbelt. "Elite" simply means there was no cereal cover-crop. Calculating the cost of cover-cropping is more complex. Please read 'The Economics of Lucerne Establishment' No: 119.

Treatments/ha	$/ha	Totals ($/ha)
2 x Scarify	$14.96	
1 x Sowing	$9.24	
2 x Boomspray	$3.52	$27.72[1]
3 kg Lucerne seed (farmer dressed)	$21.00	
50kg MAP fertiliser (11kg P)	$40.00	
0.8L Treflan 480	$5.40	
1.0L Diuron 500 + Uptake Oil	$8.00	
100ml Lemat 290 (earthmites)	$4.00	$78.40
Total cost per hectare		**$106.12**

Table 1: The Cost of Elite Establishment of Lucerne 2010.

Working costs are based on 2010 prices. Total Tractor Hours @ 0.63 hours/ha @ $44.00/hour.

The establishment or improvement cost needs to be put in perspective; so we can set financial objectives and production targets. The establishment costs are spread over the lifespan of the pasture. This establishes the annual pasture cost ($/ha/year) and in conjunction with a livestock enterprise (gross margins); and this allows the merit of the pasture improvement to be evaluated.

Using the costings in Table 1; a paddock which has been sown down to lucerne for only 3 years before re-cropping; the annual cost is then $35.37/ha per

year. The annual cost may be reduced to $17.68/ha per year where the pasture has a productive life of 6 years. Establishing the costs appropriate to your own situation; is fundamental to setting income goals and adjusting stocking rates.

BUDGETING

The first step towards profitable pasture improvement is to budget carefully and to objectively analyse your livestock enterprises and their earning potential. NSW DPI provides a range of budgets its' web-site that may help with this exercise and with other enterprise assessments. It is important to then pro-gress past the livestock enterprise and to evaluate the earning potential of the pastoral area, as a live-stock product. The principle aim of the exercise is to convert feed to cash!

There are many different livestock products, and economists have developed a concept that enables producers to make objective comparisons. This concept in Australia is known as the Dry Sheep Equivalent or DSE. This concept takes the Gross Margin value per animal unit and then expresses that value relative to the units of feed eaten by the animal. The livestock enterprises can then measured in $ per unit of feed. That feed unit can be grain, hay, silage or pasture.

With pasture as the common feed unit the grazier can compare very different livestock products when contemplating changing the farm enterprise mix. It also allows the evaluation of pasture improvement. There are four simplified scenarios provided in this Primefact.

The DSE unit is now based on a 50 kg Merino wether and the fodder to maintain it in "store" condition. Please note, that some Merino wethers in the western wheatbelt are equal to 1.2 DSE. A western Merino ewe is equal to 2.1 DSE. Note that a 400kg steer would equate to 9 DSE in this region, but in it may be rated at 11 DSE on the colder tablelands districts. If you are unsure about an enterprises' DSE rating, consult your District Livestock Officer.

That 50kg wether needs to consume one kilo (dry.wt - below 5% moisture content) of "good" quality pasture per day to maintain itself in "store" condition. What constitutes "good" quality pasture? The forage should have metabolisable energy value of 8 mega joules and have an 8% crude protein content per kilo of fodder. When the quality of feed falls below these parameters the wether will metabolise its own fat reserves to survive.

The wether needs to only eat 30 kg of "good" quality forage/month (or 365 kg/year) to maintain itself. Some forage in the paddock is trampled, soiled, spoiled or eaten by insect pests. The wether is really only able to utilize half the forage available in a paddock, so in crude terms, you would initially think to budget on a DSE being roughly equal to 730 kg of "good" quality forage/wether/year; to set the forage production targets and subsequent stocking rates.

Be mindful that while the wether only needs to eat 1kg of forage/day to maintain itself, it may in fact eat 1.5 kg/day because it wants to, and he will subsequently get fat. Need and want are two different things, and you need to account for the want or risk a famine event.

The daily intake of a sheep is influenced by forage sweetness, plant architecture, tallness of the plants in a pasture, the prevailing weather, and the animal health. It is therefore advisable to budget on a DSE being roughly equal to 1,000 kg of "good" quality forage/wether/year. This also makes it easier to quickly set the forage production targets and subsequent stocking rates.

PASTURE UTILISATION

Turning pasture into meat, wool or milk is not a simple calculation. The utilisation of feed is highly variable. Individual lucerne paddocks have recorded utilisation levels as high as 80%, but most farms only utilise 20% of the total feed produced in a year. The wastage of pasture is influenced by stocking rate, grazing period, time of introduction, plant architecture, bitterness, rankness of the plant growth, landscape, paddock size, etc.

Pasture utilisation is very complex and this Primefact has taken a simple approach to make the scenarios easy to understand. Consult with your local District Livestock Officer and run the scenarios through the Grazfeed program to fine tune stocking rates and potential weight gains in your paddocks.

There are many pasture improvement scenarios with varying degrees of complexity. This Primefact contains four rudimentary pasture improvement scenarios which may assist with formulating a pasture improvement plan.

Table 2 below is a parametric budget or "ready-reckoner" which generates $/ha relative to an enterprise's DSE value and stocking rate. The parametric budget can be used to make quick validations. It can also be used to explore opportunities. Once you have established a goal (GM $/ha), you can then easily indentify the combinations of stocking rate DSE/ha and the necessary $/DSE to achieve the goal.

DSE per hectare	Gross Margins ($ per hectare)							
	$10/DSE	$15/DSE	$20/DSE	$25/DSE	$30/DSE	$35/DSE	$40/DSE	$50/DSE
1.5	15	23	30	38	45	53	60	75
2.0	20	30	40	50	60	70	80	100
2.5	25	38	50	63	75	88	100	125
3.0	30	45	60	75	90	105	120	150
4.0	40	60	80	100	120	140	160	200
5.0	50	75	100	125	150	175	200	250
6.0	60	90	120	150	180	210	240	300
7.0	70	105	140	175	210	245	280	350

Table 2: Parametric Budget Comparing Stocking Rate Against Potential DSE Values to Produce a Guide to Gross Margin GM ($/ha)

Note: All variable stock costs have been deducted to give Gross Margin as $/DSE.

VALUING PASTURE IMPROVEMENT

A grazier, like any other business, requires a satisfactory return on their financial investment. The financial goal is to triple each dollar invested in each enterprise, to achieve a 5% Business Return (Farm Business Return/ Equity).Be mindful that we have simplified the focus in the scenarios to calculate the increase in forage production to identify a rewarding DSE a carrying capacity of a paddock. We have not attempted to account for the need to purchase extra stock to utilise the extra forage; and there are other options. Seek professional accounting advice when planning to purchase extra stock, to establish the merits and break-even points.

Many western farmers that have improved pasture paddocks have not purchased more sheep because they lack the necessary labour units and cannot get the extra shearers; and have chosen to swap 100 ha of pasture for 100 ha of crop. Other farmers have diversified into a heavy export lambs enterprise which has a higher DSE value and a higher DSE requirement (3.2 DSE/ewe).

SCENARIO 1 - PASTURE IMPROVEMENT PAY $

This scenario is a simple pasture improvement of a 100 hectare paddock using lucerne. The aim is to produce more feed in order to run more same stock, producing the same quality wool product. The lucerne pasture has a life of three years. To make the improvement exercise worthwhile, it is necessary to calculate the volume of the extra feed to be produced and the target stocking rate?

This farmer has a typical mob of Merino wethers for this region; each wether is cutting 6.5 kg of 23 micron wool, valued at $8.51/kg clean ($4.95/kg greasy). The wether enterprise has gross margin (GM) of $20.00/DSE. This grazier originally ran his wethers on ‘unimproved pasture’, with a stocking rate of 1.5 DSE/ha. This grazier is achieving a GM of $30.00/ha without any pasture improvement – see the box in Table 2. Note: these “unimproved” paddocks are rather bare for five months of the year. This farmer needs to hand-feed for at least 6 weeks each year.

Taking the cost to establish a lucerne pasture ($106.12 /ha) and spread it across a three year stand life. The annual cost of improvement is $35.37/ha. The goal is to achieve a threefold return on the monies in-vested to make it a worthwhile exercise, so the initial goal is $106.12 /ha per year.

However, we need to also consider the original gross margin of $30.00/ha that was achieved without improvement. This is a real value and it needs to be combined with the initial goal of $106.12/ha, which now increases the goal to a gross margin of $136.12/ ha per year to justify the exercise.

To establish the stocking rate to achieve this result, divide the goal ($136.12/ha) by $20.00/DSE. Using Table 2 (see the box in the central area of the table, you may need to round to the nearest number) and looking across establishes a stocking rate of 7.0 DSE/ ha. In pastoral or forage terms, the 7.0 DSE/ha (1,000 kg forage/DSE) equates to 7,000 kg/ha of grazable forage per year. Note; it is advisable to budget for an extra 1,000kg/ha of plant material (not for grazing) to protect the soil resource from blowing away. Total forage requirement is 8,000 kg/ha.

This level of forage production is achievable for a productive lucerne sward; but 6,000 kg of forage/ha/ year is a stretch for a short-lived annual species like sub-clover in this region. It maybe possible for annual pastures to produce 8,000 kg of forage/ha in this region; if a deep rooted and long seasoned species like Zulu arrowleaf clover was in the sub-clover mix. Pasture improvement would also substantially reduce the need for hand-feeding over the late summer/autumn period.

SCENARIO 2 - PASTURE PERSISTENCE PAY $

This scenario involves a farmer with the same quality of stock as the farmer in scenario 1, but this farmer has better agronomic and grazing management skills and is able to get six years of productive life out of the 100 ha lucerne pasture.

When the improvement cost is now spread over six years; the annual cost is reduced to $17.68/ha. Multiple the annual cost by three for merit, and add the $30.00/ha from the original unimproved situation. This farmers' goal is $83.04/ha. It is two-thirds the goal of the farmer in the first scenario.

With similar wethers and a $20.00/DSE, this grazier requires a stocking rate of 4.2 DSE/ha. This requires the pasture to produce just 5,200 kg of forage/ha of grazable forage per year. This figure includes the 1,000 kg of material to maintain soil coverage. This level of feed production is easily achieved with lucerne and is now in the reach of sub-clover pastures in most years in this region.

Simply improving grazing management skills to extend the life of a lucerne pasture can easily produce very achievable goals and tangible financial results.

SCENARIO 3 - IMPROVED MANAGEMENT PAY $

This farmer has a mob of Merino wethers with above average fleece production, cutting 7.5 kg per wether, due to better animal selection and husbandry practices. Without complicating calculations; we keep the 23 micron and $4.95/kg (greasy) value. Increasing fleece weight by 15% in this scenario increased the DSE value by 25% and improved the gross margin to $25.00/DSE.

This farmer (as with scenario 1) maintains his 100 ha lucerne stand for three years. The goal is still to generate $136.12/ha/year, and at $20.00/DSE (as with scenario 1) it required a stocking rate of 7.0 DSE/ha. By improving the DSE value to $25.00/DSE through selecting superior stock and better care, the stocking rate on this paddock could be reduced to 5.2 DSE/ha and still attain his goal. This level of feed production is easily achieved with a lucerne pasture and is in the reach of sub-clover in most years.

If this farmer also had the grazing management skills (as in scenario 2) and achieved a six year productive lifespan with the lucerne pasture, then the stocking rate could be lowered to 3.1 DSE/ha; to achieve the goal of $83.04/ha/year. You do not have to increase stocking rates greatly to capitalise on pasture improvement when flock parameters and husbandry skills are improved. This grazier is has more than doubled his original earnings ($30/ha in scenario.1 on "unimproved" pasture) and has doubled the carrying capacity of the existing pasture land which then allows for an increase in the cropping enterprises to further increase business income; and this also avoids the need to buy any additional livestock to utilise the additional forage.

SCENARIO 4 - PRIME PASTURES PAY $

Another simple scenario is to assess the economic viability of pasture improvement for a high value enterprise such as trading steers (or prime lambs). In this scenario, lucerne is used to replace a barleygrass pasture. It may also provide an insight into the merits for renovating the pasture paddocks that have been devastated by the recent drought event.

The average unimproved pasture in this region often produces less than 2,000 kg/ha of grazeable feed per annum and the quality is often only at the maintenance level for a wether. The steers could at best only utilise 50% of the barleygrass on offer due to its prostrate plant architecture. At least another 10% of the material would be wasted with trampling and soilage (covered by dung).

It is reasonable to expect that a new elite sown lucerne pasture would produce at least 5,000 kg of grazeable feed/ha, between May and December, in that first year. Many farmers have cut new lucerne pastures for hay, to off-set the cost of elite establishment. Hay yields are often 6 to 8 t/ha. With hay at $150/t had a GM of $385/ha. Note the average moisture content of hay is 15% to 20%.

Due to the erect plant architecture of the lucerne, the livestock are able to better harvest the plant material, than prostrate plants like barleygrass or sub clover. There is less soilage and wastage from trampling with lucerne due to the row-spacing. Lucerne paddocks can often achieve a 70% utilisation rate. There is 5,000kg/ha of high quality available feed on offer in that paddock, of which 3,500kg/ha can be consumed by the steers.

With a typical feed conversion of 12% for cattle, the 'consumable' pasture should be converted into 420 kg of liveweight gain/ha. With a 50% carcass yield this equates to 210 kg/ha of beef. The value of beef (EYCI) is currently at $3.00/kg (or $1.50/kg live), thus grossing $630.00 of beef/ha. With a stocking rate of 5 steers/ha; the opportunity cattle costs are about $45.00/head (or $225/ha), the annual pasture cost at $35.37, and replacement of phosphorous (inc. spreading) at $25.00/ha; leaves a very rewarding GM of $345.00/ha.

Note: The feed conversions for live-weight gain is 15% for prime lamb breeds and 14% for Merino lambs should you wish to run a scenario for sheep. With the current lamb value at $4.50/kg and mutton at $2.80/kg; the financial reward for pasture improvement is outstanding. Do the maths.

ADDITIONAL BENEFITS

Farmers should also consider and cost the pastoral benefits that flow on to the cropping phase. The most obvious contribution is nitrogen. Research a Tamworth ARC suggests that lucerne "fixes" 25 kg of nitrogen per tonne of forage, per year.

A lucerne paddock producing 6.0t/ha of forage per year is estimated to have potentially "fixed" 150 kg nitrogen per hectare per year. After two years the soil nitrogen levels increase very slowly in subsequent years and rarely exceed 300kgN/ha, even after six years of lucerne.

Anecdotal reports from local farmers growing wheat following a productive lucerne phase suggest they have removed in excess of 10 tonnes of grain per hectare in total; from four consecutive wheat crops. This is over 200 kg of nitrogen/ha.

In contrast, wheat recovered from unimproved pastoral land produced only 4 tonnes/ha in total from four consecutive crops. Very similar results were produced in trials at Tamworth ARC from 1970 to 1978.

The extra 6 tonnes/ha of grain equates to at least 120 kg of nitrogen per hectare removed in the grain. This would be equal to an application of 400 kg/ha of urea fertiliser. With urea valued at $500.00 per tonne. The value of that nitrogen from the pasture improved using lucerne is calculated to be worth $200.00/ha (400 kg urea/ha x $0.50/kg urea), which is of direct financial benefit to the cropping phase.

DISCUSSION

Pasture improvement in the western wheatbelt has the potential to be very profitable practice. The level of financial success from pasture improvement is strongly correlated to a farmer's agronomic and livestock husbandry skills. It is advisable to take the time to develop:

- A physical plan, to improve pastures and livestock, with the assistance of your District Agronomist and Livestock Officer;
- Gross margin budgets for sowing the pasture and the livestock enterprise, with the assistance of your District Agronomist and Livestock Officer;
- An incisive whole farm budget, to produce an economic picture that extends over a 5 year period, with the assistance of your accountant.

Note: The preceding scenarios did not consider the need to buy in additional stock or to increase borrowings. The trend in recent years has been not to buy more stock due to the low value of wool, a lack of labour and shearers. Instead farmers have increased the stocking rate on the improved pastures; and to crop the surplus unimproved pasture paddocks. The average crop area of western district mixed-farms has increased from 25% of the arable land in 1990, to 36% cropping in 2010.

If you are considering purchasing additional stock to capitalise on pasture improvements, you may need to seek professional financial advice from an accountant to determine the feasibility of such a purchase.

There are very real limits to potential increases in feed levels and forage quality in western districts where the rainfall is 30 to 45mm per month. From the four scenarios it becomes evident that a close eye needs to

be kept on the input costs of pasture improvement to ensure profitability. This consequently imposes a limit on seed, pesticides and fertiliser inputs, but it is not advisable to compromise on sowing preparation and plant protectants.

When contemplating increasing seed and fertiliser inputs, it is advisable to trial test strips in a pasture paddock and then evaluate the results before large scale implementation. The responses achieved in the strip trials should be objectively measured and analysed before investing large sums of money in a whole farm pasture improvement program.

RECOMMENDED READING

Primefact 119. Economics of Lucerne Establish for the Western Wheatbelt.

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