An economic perspective on pasture research priorities

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Summary. The MIDAS farm model was used to estimate the value of pasture in the West Australian wheatbelt. It was found that increasing pasture productivity is potentially a high return area for investment in research. High marginal values of green feed in the late autumn and early winter indicate that research should focus on improving green feed availability in this period to increase farm stocking rates and/or reduce supplementary grain feeding. Research which predominantly leads to increased spring growth of pasture, will have little effect on the farm profitability. This general finding applies across different regions and differing cropping programs.

Introduction

One of the important tasks for researchers is to define a goal for their research that will provide the highest net sustainable income to farmers. The potential impact of research on this goal needs to be identified. The magnitude of the changes in pasture productivity and its ultimate effect on farm profitability are necessary for estimating the impact that pasture research has on farm income. Information of this kind is relevant in making a case for pasture research. It is also important in deciding how to allocate resources between alternative pasture research projects.

On the crop-sheep farms of Western Australia's (WA) low rainfall wheatbelt (300-350 mm annual rainfall), green feed from annual pastures is available only during winter and spring (May-October). During the dry months of summer and autumn, sheep graze dry pastures, crop residues and green feed from perennial fodder shrubs if available.

Most pasture research programs of interest to us influence pasture production at the margin: for instance, research is more likely to increase pasture production by 10 or 20 per cent, rather than grow pasture where none would otherwise grow. Thus if we are to estimate the value of pasture, then we need to determine its marginal value. The marginal value of pasture can be defined as the increase in net income resulting from the additional pasture produced.

Estimation of the marginal value of pasture is not simple for several reasons. One reason is that pasture is an intermediate product which is an input into the livestock enterprise and not sold directly in the market place. Another reason is that the marginal value of pasture varies seasonally so that it is inadequate to estimate a single value. In addition, the marginal value of pasture varies across regions where differences in rainfall, temperature, soil types and seasonal variation can affect its value. A further complication is that it needs to be considered in the context of the whole farm. This is especially so for a mixed crop-sheep farm where the interdependencies of cropping and livestock activities mean the value of pasture can not be considered without taking account of the cropping enterprise.

One way of estimating the marginal value of pasture is through appropriate farm models designed to account for complexities of the farm system (2, 7). In WA, models of integrated crop-sheep farms have been used to help determine priorities for pasture research. The main emphasis has been to identify soil types at which pasture legume selection programs should be targeted (2).

In this paper, results from analyses of the marginal value of pasture and other sources of green feed are presented for WA's wheatbelt farms. Marginal values are compared for different regions and for different months of the year. Reasons for the differences are discussed and implications are drawn for research.

Methods

MIDAS (Model of an Integrated Dryland Agricultural System), the economic analysis tool used in this study, is an optimisation model which can be used to find the most profitable way of utilising pasture and the marginal value of pasture at different times of the year. The model also meets the requirements of representing interactions between sheep and cropping enterprises. These interactions are modelled within MIDAS through the resource, biological and technical relationships between different enterprises on the farm. Parameters that describe the biological relationships within each enterprise are also included. For instance, in the livestock section of the model there are parameters which account for the energy requirements and intake capacity of different classes of sheep on a monthly basis, quantities and energy concentrations of pasture and stubble produced, deterioration of pasture and stubble over time and the influence of grazing on pasture production. Pasture consumption is constrained so sufficient seed and soil coverage is left to allow subsequent pasture regeneration and to prevent soil erosion. MIDAS is described in greater detail in various publications (3, 4, 5).

Two versions of MIDAS are used in this study representing the eastern wheatbelt (centred around Merredin), and the northern wheatbelt (east of Geraldton). Moderately depressed wool and sheep prices are assumed which correspond to the medium term outlook for these commodities (e.g., $3/kg for 22 micrometre greasy wool). The models were modified slightly to allow additional increments of green feed to be conveniently introduced, and the marginal value of the feed to be estimated.

A single optimum solution was obtained for each model and the marginal value of green feed recorded for the months January to October. The marginal value of 1 kg of a forage plant, capable of providing green feed in summer and autumn was estimated for the January to April period (11 MJ/kg). This was aimed at determining the likely value of fodder shrubs for the late summer and autumn feed gap. The marginal value of 1 kg of green pasture was also estimated for the period May (12 MJ/kg) to October (9 MJ/kg). The resultant changes in sheep feeding strategy and stocking rate were recorded. The runs were repeated with both models being constrained to 30 per cent and then 80 per cent of the farm in crop. Once again the marginal values of feed were recorded for the January to October period.

Results and discussion

Table 1 shows that the marginal value of pasture in the northern wheatbelt declines as the growing season (May to October) progresses. Extra feed is highly valuable in autumn (March to May) when it is at least $160/t, then, it plummets in mid to late winter when its marginal value is negligible. If the costs of establishing fodder shrubs to provide green feed in late summer and autumn (including the annual equivalent of establishment costs and opportunity costs of alternative uses of the land) are less than $160/t, then growing the shrubs would be profitable.

The analysis of how and why the extra increment of green feed is used during the year showed that any additional green feed in the months of January toJune substitutes for lupin grain feeding and/or allows stocking rate to be increased. Conversely green pasture is abundant in late winter or spring so that additional pasture is deferred and grazed as low quality dry feed in summer and autumn.

Table 1 shows that the seasonal variation in the marginal value of pasture is similar for the eastern wheatbelt. The main differences between the two regions are in early winter. In the eastern wheatbelt the marginal value of pasture for June ranges from $110/t to $160/t versus about $30/t or less for the northern wheatbelt. Figure 1 shows the regional differences in pasture production across seasons. The figures presented are for a mixed sward, continuously grazed pasture on red sandy loams. The difference in production early in the season is because the June temperatures in the northern wheatbelt are 2-3?C higher, resulting in more rapid pasture growth early in winter (1).

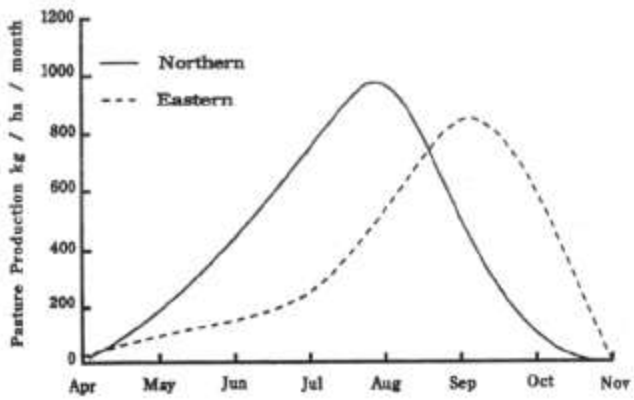
Figure 1. Monthly pasture production in two low rainfall wheatbelt regions of WA.

Table 1 shows that for the eastern wheatbelt, marginal values are similar at most times of the year for high and low levels of cropping except in May and June when the marginal value of pasture is higher at 80% cropping. At this level of cropping pasture is more scarce, stocking rate per hectare of pasture is higher and pasture growth is concentrated only on poorer soils, compounding the problem of early pasture growth.

Although there are small differences between regions and levels of cropping, it is generally true that the marginal value of green feed is high in autumn and early winter and very low in spring. This reflects the seasonal variation of pasture production in the dryland Mediterranean environment of WA's wheatbelt (Figure 1). This finding is similar to that of White for pastures in western Victoria (7) who found that the autumn and early winter pasture increment was more valuable than that of spring. However, the differences in marginal value of pasture reported by White are much less than those found in this study. The main reason for this is likely to be the much larger seasonal variation in pasture production in WA's wheatbelt, reflecting climatic differences and the impact of cropping on early pasture growth.

Table 1. Marginal value of pasture ($/tonne) at different times of the year for two regions and two levels of cropping.

Month	Northern wheatbelt 30% crop	Northern wheatbelt 80% crop	Eastern wheatbelt 30% crop	Eastern wheatbelt 80% crop
March	170	160	220	220
April	170	160	210	210
May	190	190	110	170
June	< 1	30	110	160
July-October	< 1	< 1	< 1	< 1



One option for increasing pasture production which has interested researchers, is to keep sheep out of pastures in the first four to six weeks after the opening rains in May. This pasture deferment can significantly increase subsequent pasture production (H. Fels, pers. comm., 1991). In spite of this, the above results show that deferring the growth of autumn and early winter pasture would require a large increase in subsequent pasture production in order to compensate for the much lower marginal value of the later pasture. Research into the deferment of pasture would be more promising in the eastern wheatbelt than the northern wheatbelt because, of the higher marginal value of pasture in the eastern wheatbelt during June.

An obvious implication for research is that it would pay to focus on research aimed at increasing green feed production early in the season rather than in the spring when the potential for improvement is probably at its greatest. White reached a similar conclusion for pastures in western Victoria (7). Possible ways of improving pasture production at the break of season are to increase the initial biomass and/or seed density which will increase early growth rate. Research may be warranted into different rotations and alternative pasture and fodder crop species to provide accelerated growth immediately after the break. Fodder shrubs (e.g., Saltbush, Tagasaste) may provide an economic means of generating extra autumn feed (6). Similar research is on the way for evaluating the marginal value of pasture under seasonal uncertainty.

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