THE ROLE OF TAGASASTE (CHAMAECYTISUS PROLIFERUS) IN FARMING SYSTEMS OF SOUTHERN AUSTRALIA

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ABSTRACT
Farm scale economic analysis of a recently developed alley cropping system based on the fodder shrub tagasaste (*Chamaecytisus proliferus*) was carried out using the optimising model MIDAS. The model was used to assess the potential application of this new farming system to infertile sandplain soils in southern Australia by comparing the profitability of improved serradella based annual pasture (*Ornithopus compressus* and *O. sativa*), tagasaste in plantations and tagasaste alley cropping. The third option was the most profitable, increasing sheep carrying capacity by 76% and resulting in 45% of the model farm being planted to tagasaste alley cropping at 150 trees/ha and 6% to tagasaste plantations (2000 trees/ha). The results suggest the feed value of tagasaste could economically drive improvements in the ecological sustainability of sandplain farming systems through large scale revegetation, providing the assumed tree/crop interactions are supported by empirical studies.

KEYWORDS
economic analysis, alley cropping, tagasaste, serradella, sheep, grazing

INTRODUCTION

Large scale, on-farm research has established that up to 10% of the arable land on mixed wool and grain producing farms in coastal sandplain areas of southern Australia can be profitably planted to the fodder shrub tagasaste (*Chamaecytisus proliferus*) as a substitute for the traditional grain feeding of sheep during the summer/autumn drought typical of this Mediterranean-type climate zone (Mattinson and Oldham, 1989). More recently, farmers have developed an alley cropping system where crops are grown in the inter row between widely spaced hedgerows of tagasaste (Lefroy, 1994). This has been done in an attempt to reduce wind erosion and control rising ground water tables while also maintaining the option to crop and provide supplementary feed for sheep. Wind erosion is a significant hazard during autumn and early winter under the existing annual based farming system. Rising water tables and subsequent dryland salinity has resulted from the replacement of deep rooted native vegetation with a shallow rooted annual grassland of crops and pastures. Alley cropping system may represent an economic incentive to improve the ecological sustainability of sandplain farming systems by increasing the proportion of deep rooted perennial species in the landscape.

METHODS

MIDAS (Model of an Integrated Dryland Agricultural System) is a bioeconomic model of mixed crop and livestock farming in Western Australia that uses the linear programming technique to select management strategies which maximise profit subject to resource, technical and environmental constraints (Kingwell and Pannell, 1987). Given a detailed set of relationships between all crop and livestock activities provided by the user, the model calculates the optimal mix of resources and activities, including crop and pasture rotations, flock structure, stocking rate and feeding strategies. The model recognises soil type heterogeneity and rotations and defines production specifications for each rotation on each soil type.

A 3000 ha farm consisting of a mix of soil types typical of sandplain areas of south western Australia was used as the basis for the modelling. Three new options were then progressively introduced to the conventional mix of pastures and crops. These were serradella based annual pastures with 50% higher production than conventional pastures, tagasaste in plantation and tagasaste alley cropping. While the serradella and tagasaste plantation options compete directly with the conventional options for land, the alley farming option is compatible with all other annual pasture and crop rotations, but if selected reduces the arable area by 8%. It was assumed that the trees had no positive or negative effect on the yield of inter row crops and pastures.

Four options were then run through the MIDAS model farm. The conventional options were based on current practice. The plantation and alley cropping options were based on experimental results and commercial experience (Oldham et al., 1991; Oldham, 1992; Lefroy and Melvin, 1996). The flock structure was a self replacing ewe flock in which all sheep were maintained in score 2 condition or better, requiring supplementary feeding in autumn and early winter. Wool price was set at 300 c/kg and a borrowing limit of $200,000 imposed. In the serradella, plantation and alley cropping models, the costs of establishing pasture and trees were amortised over 20 years at 12% to give an annual cost component. Annual maintenance costs for fertiliser and tree cutting were also included. The alley cropping layout consisted of double rows of tagasaste separated by a 60 m wide alley with the trees occupying 8% of arable land. Based on experimental results, it was assumed the trees produce 1.5 kg of edible dry matter per metre of single row in plantations and alleys (3000 kg/ha and 480 kg/ha respectively). Grazing of tagasaste in alley cropping was linked to the availability of pasture or crop residues in the inter row.

RESULTS AND DISCUSSION

Table 1 shows the impact on sheep numbers, landuse, profit and % tree cover of introducing the three new options. The serradella substituted directly for conventional pasture, resulting in greater winter carrying capacity and an increase in the optimal flock size of 31%. As there was no proportional increase in autumn feed however, the grain feeding bill increased significantly resulting in a small increase in farm profit. When tagasaste in plantations was added as an option, it replaced serradella pasture and autumn grain feeding, with 5% of farm area being planted to maximise profit. As tagasaste is available in autumn when the marginal value of each additional kilogram of feed is far higher than in winter or spring (Abadi Ghadim and Morrison, 1992), farm profit increased significantly (up 77 %), primarily through the elimination of grain feeding.

Adding the option of growing tagasaste in the alley cropping layout resulted in a further increase in sheep numbers (37%) and profit (18%) over the tagasaste plantation model. This reflects the increased efficiency of land use in alley cropping as the trees produce 16% of plantation level production while occupying only 8% of arable land. It also reflects the more effective utilisation of annual pastures and crop residues in autumn and early winter as grazing restrictions which normally apply due to wind erosion hazard in the conventional system were lifted with alley cropping.The total area of arable land planted to tagasaste increased from 5% to 9.6%, reflecting its shift from an autumn grain substitute to a summer, autumn and winter feed.

The alley farming option resulted in 45% of the farm being planted to tagasaste at 150 stems/ha and a further 6% to plantations at 2000 stems/ha. This suggests that the ecological objective of increasing the proportion of deep rooted perennials in the agricultural landscape could be driven by significant increases in profit. Achieving this in practice will depend largely on the assumption that the trees have no net effect on inter row crops and pastures. In reality there is likely to be competition for water in dry years (Ong, 1994) and beneficial shelter effects in seasons with extreme weather events (Kort, 1988). While yield modifiers could be used to identify the sensitivity of profit to a wide range of tree/crop interactions, empirical studies presently underway are required to establish the actual range. The value of using the MIDAS model to analyse this recent innovation is its ability to take into account the complex interactions in a mixed crop and livestock system, highlighting the implications of change and assisting identification of critical research questions.

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Table 1
Sheep numbers, landuse, profit and % tree cover resulting from the addition of serradella, tagasaste plantation and tagasaste alley cropping as options in the MIDAS model.

		Model			
		Conventional	+Serradella	+Tagasaste	+Alley
Sheep number	dse*	6,456	8,625 (31%)	9,027 (36%)	11,415 (73%)
Crop area	ha	1,000	1,000	1,000	1,000
Profit	$	51,331	59,635 (16%)	90,800 (77%)	102,302 (95%)
Feed cost	$	10,500	38,150 (263%)		
Tree cover @ 2000 stems/ha	%			5	6
@ 150 stems/ha					45
arable land taken up				5	9.6

* dse (dry sheep equivalent) = the amount of feed required to maintain a 48kg dry sheep from one year to the next.