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MAINTAINING PRODUCTION AND MEETING CONSERVATION GOALS ON GRAZING PROPERTIES IN THE RANGELANDS – A SUBTROPICAL EXAMPLE.

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INTRODUCTION

Beef production is the most widespread land use in subtropical rangelands. Producers in these and other rangelands face many challenges to maintain profitability (e.g. declining terms of trade, increasing land prices, changing market requirements, alternative land uses). At the same time there have been adverse changes in land condition (e.g. soil erosion, loss of desirable pasture species and biodiversity, increases in native and exotic weeds) and community demand is growing for more environmentally friendly land use and management. Some management options (e.g. timber management, riparian exclosure) involve opposing impacts on production and conservation goals, and their use necessarily involve trade-offs.

We describe an approach for examining such trade-offs in a consistent manner based on financial performance (using a herd economic model) and ecological health (using a set of attributes and indicators relating to maintenance of ecosystem function and conservation of biodiversity). Application of the approach is illustrated for a hypothetical beef enterprise in the Burnett region of south-eastern Queensland.

METHODS

A (decision-tree) framework has been developed for exploring economic and ecological dimensions of a given development option (MacLeod and McIvor 2006). The process involves defining the performance of existing property management and the development option in economic and ecological terms. *Economic assessment* utilises a property scale economic model that can examine 11 management options; including pasture development, grazing management, production feeding, weed control, infrastructure development and timber management. Projected impacts on carrying capacity and animal performance are combined with the costs to assess changes to the financial performance of the property (i.e. gross margin, net profit, return to capital and capital value). *Ecological assessment* uses 8 landscape health attributes (Table 1), with projected impacts of the 11 management activities rated on a scale from –3 (large negative impact) to +3 (large positive impact) (Table 1). The first 6 attributes describe the maintenance of ecosystem function and stability, and the remaining 2 describe conservation of biodiversity. A “best bet” prediction procedure (Barlow et al. 2003) was used to provide qualitative estimates of the impacts of the development practices on the attributes. The individual attribute scores can be aggregated into a general score, compared with the economic results and an assessment made of the nature and magnitude of any trade-offs involved. Options can be modified until an acceptable compromise is reached or no feasible improvements can be made.

Application

The approach is illustrated for a hypothetical beef enterprise located in south-eastern Queensland (e.g. Gayndah), considering 2 options that manipulate tree and shrub densities; viz (a) clearing tree regrowth to promote pasture growth and (b) planting trees to promote conservation objectives (e.g. salinity abatement). The property is 7000ha and comprises 3 land types: silver-leaved ironbark on granite (70% of area); narrow-leaved ironbark on non-cracking clay (20%); and blue gum on alluvial cracking clay (10%), of which 50% is riparian land. Trees have been totally cleared from 3900ha; of which 800ha is sown pasture. Another 1000ha of silver-leaved ironbark country was cleared but the trees have regrown to such an extent that animal production has declined to the original levels for uncleared land. The enterprise breeds and fattens stock with a herd of 600 breeders, targeting north Asian markets, and is valued at $5.6 million, including land, improvements, plant and livestock. The production impacts of the 2 options are described in terms of effects (+/-) on a range of production

parameters – carrying capacity, liveweight gain, branding% and mortality% (baseline values are shown in Table 2), translated into financial impacts though gross margins and profit; and annual operating costs (including treatment reinforcement costs) and initial treatment costs.

Table 1. Components, attributes and indicators of ecological health.

Component A. Maintenance of ecosystem function and stability

Attribute 1. Soils and hydrology
- (a) Soil water supply (infiltration/runoff, leaching, rooting depth)
- (b) Physical properties (structure, surface crusting/sealing, bulk density)
- (c) Chemical properties (pH, organic matter, nutrient levels)
- (d) Biological activity (fauna, earthworms, microbial activity, litter)
- (e) Erosion (ground cover, soil movement/loss/accumulation, topsoil depth)
- (f) Dryland salinity (area, watertable depth, salt levels in soils and streams)

Attribute 2. Pastures (cover and composition, perennial grasses)

Attribute 3. Weeds (species, density/cover)

Attribute 4. Feral animals (species, density)

Attribute 5. Riparian areas
- (a) Water quality (physical, chemical, biological)
- (b) Stream health (vegetation, bank and bed stability, fish population)

Attribute 6. Atmosphere (greenhouse gas emissions)

Component B. Conservation of biodiversity

Attribute 7. Native vegetation and habitat
- (a) Area and proportion of original vegetation and habitat
- (b) Regional ecosystems (proportion, threatened)
- (c) Condition
- (d) Configuration
- (e) Structure/balance

Attribute 8. Native animal populations (size and viability)

The impact of the 2 management options on each environmental health attribute are assessed as outlined above (negative, nil, positive - small, medium, large). .

Table 2. Baseline animal production values for Burnett case study property.

	Land type		
	Silver-leaved ironbark	Narrow-leaved ironbark	Blue gum
Carrying capacity (ha/AE)	8	10	5
Annual liveweight gain (kg)	140	100	150
Branding percentage (%)	80	80	80
Breeder mortality (%)	2	2	2
Steer mortality (%)	0.5	0.5	0.5

Example 1 – Tree regrowth management. While clearing or thinning remnant vegetation is no longer legal in Queensland, tree regrowth can be controlled. In this example 1000ha of the silver-leaved ironbark land type with significant tree regrowth is cleared, pushed into fire rows and burned. Post-clearing, the stocking rate increases from 8ha/AE to 4ha/AE, and total carrying capacity of the property increases from 1530 adult equivalents (AE) to 1658 AE (Table 3).

Table 3. Economic and ecological assessment of tree clearing option (Example 1)

Attribute	Existing	Revised	Change
Economic attributes:			
Total number of stock carried (AE)	1,530	1,658	+128
Total number of stock sold (Head)	492	532	+40
Property gross margin ($'000)	427	461	+34
Property net profit ($'000)	297	326	+29
Property return to capital (%)	4.5	4.8	+0.3
Property capital value ($'000)	5,585	5,832	+247
Capital cost of management change ($'000)	N/A	100	
Ecological attributes:			
1. Soils and hydrology	+2	+3	+1
2. Pastures	+1	+3	+2
3. Weeds	-1	-2	-1
4. Feral animals	0	0	0
5. Riparian areas	-2	-3	-1
6. Atmospheric emissions	-1	-3	-2
7. Native vegetation and habitat	-2	-3	-1
8. Native animal populations	-1	-2	-1
Total ecological score	-4	-7	-3

Example 2 - Tree planting. Tree replacement by planting is typically restricted to a few sites for quite strategic and often limited conservation reasons (e.g. salinity prevention or abatement). 100 ha of trees are planted on a recharge zone in an area of previously cleared silver-leaved ironbark. Post-planting, stocking rate on the treated area declines from 4ha/AE to 8ha/AE reducing total stock numbers on the property by 20AE to 1510AE (Table 4).

RESULTS

Example 1 - Tree regrowth management. The economic performance measures are all positive (Table 3). The $100,000 outlay increases turnoff by 40 head and net profit by $29,000 per year, with a 7% gain on return to capital. Under existing management, the overall health rating is a small negative score (Table 3), due largely to previous clearing of the native vegetation and poor condition of riparian areas; soils and pastures are in generally good condition. Additional clearing further reduces the attributes for conservation of biodiversity. Some attributes of ecosystem function and stability also decline and the positive effects on pastures are insufficient to counteract these and the overall score for ecosystem function and stability decreases. Therefore, there is a trade-off between production and environmental health. The economic results ($29,000 additional net profit) demonstrate why tree clearing has been a common development option in the past. The large negative environmental impacts (-7) support the increasing concerns about the practice and lend some support for the legislative intervention to limit its' application.

Example 2 - Tree planting. While total investment has increased, all the economic performance measures are negative (Table 4), due to the small reduction in grazing opportunity. The changed animal turnoff leads to a decrease ($5,000) in net profit and return to capital investment. Tree planting, however, has major positive impacts on hydrology and the atmosphere, plus small improvements in conservation of biodiversity, leading to an overall improvement in ecological health (Table 4). Under present management the property has a small overall negative score (as for example 1). There is a trade-off between production and environmental health, with tree planting predicted to have moderate positive impacts on ecological health (+6) while economic performance suffers with a decline in net profit ($5,000).

Table 4. Economic and ecological assessment of tree planting option (Example 2)

Attribute	Existing	Revised	Change
Economic attributes:			
Total number of stock carried (AE)	1,530	1,510	-20
Total number of stock sold (Head)	492	488	-4
Property gross margin ($'000)	427	423	-4
Property net profit ($'000)	297	292	-5
Property return to capital (%)	4.5	4.3	-0.2
Property capital value ($'000)	5,585	5,675	+90
Capital cost of management change ($'000)	N/A	100	
Ecological attributes:			
1. Soils and hydrology	+2	+3	+1
2. Pastures	+1	0	-1
3. Weeds	-1	-1	0
4. Feral animals	0	0	0
5. Riparian areas	-2	-1	+1
6. Atmospheric emissions	-1	+2	+3
7. Native vegetation and habitat	-2	-1	+1
8. Native animal populations	-1	0	+1
Total ecological score	-4	+2	+6

CONCLUDING REMARKS

The assessment approach is still in the initial stages of development and execution. Additional empirical support is required to quantify the linkages between management intensification activities and responses for the ecological health attributes and indicators. Nevertheless, the management choices that can be handled within the framework are wide-ranging (e.g. 11 different options), and the economic and ecological responses are essentially determined by biophysical properties of the grazing enterprise and market conditions.

The approach should assist land managers to screen land management options in a consistent manner and to clarify the actual nature and scope of trade-offs between economic advantages and ecological consequences. It seems to offer a distinct advantage over emerging environmental economics (non-market) valuation techniques which seek to lump economic and ecological values into common dollar terms, supposedly to enhance decision-making processes. However, aggregating these values simply masks the specific nature of what is actually being traded in the final choice. Moreover, the technique is relatively robust in contrast with the somewhat arbitrary nature of seeking to put direct economic values on what often remain largely intangible environmental services.

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