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Implications of alternative feral goat management strategies for natural resource management polices in NSW rangelands

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Abstract:

This paper presents a brief summary of an economic analysis of alternative feral goat management strategies (no control, opportunistic harvesting, value added and goat-proof fencing) and their implications for natural resource management policies in NSW rangelands. Opportunistic and value added strategies are profitable for landholders. The profitability of investment in goat proof fencing to support livestock production could be comparable to current goat management practices if moderate increases in carrying capacity can be achieved through improved grazing management. Financial incentives that are based directly on measured resource condition (e.g. ground cover) and encourage investment in exclusion fencing and improved management would be preferable to incentives supporting goat harvesting activities. These activities are not necessarily favourable to resource conservation as they are driven by goat price rather than population and are, in any event, profitable for landholders. A 'no control' strategy has adverse economic consequences for pastoral properties.

Keywords: economics, feral goat, policy, NSW

Introduction

In Australian rangelands feral goats (*Capra hircus*) are generally considered as agricultural and environmental pests because they compete with domestic animals for resources, promote resource degradation and threaten biodiversity (Harrington, 1976; Harrington, 1982; Russell *et al.*, 2011; Parkes *et al.*, 1996). On the other hand, feral goats also provide income for pastoralists and are the basis of an export industry. The choice of policy mechanisms to reduce feral goats for environmental conservation therefore depends on an assessment of the costs and benefits of alternative management scenarios available to producers. In this paper we evaluate alternative feral goat control strategies and their implications for natural resource polices in the rangelands of western NSW.

Methods

The study was based on synthesized 'representative' properties in the Bourke, Cobar and Broken Hill districts(Khairo *et al.*, 2011). The feral goat control strategies modelled were:

1. **No control:** no control is carried out because of reduced goat price and/or other impediments;
2. **Opportunistic harvesting:** irregular harvesting when commercially attractive; modelled at two levels - current practice and maximum possible harvest through additional capital investment;

3. **Value added**: opportunistic harvesting with goat proof paddock/s established to grow out underweight animals; modelled at two levels – no reduction in domestic livestock, domestic livestock reduced to accommodate the goat paddock;
4. **Livestock with goat-proof fencing:** fencing to exclude feral goats from livestock paddocks, with opportunistic goat harvesting on the remainder of the property; modelled at three levels – boundary fencing, single paddock in 'good' country, single paddock in 'goat' country.

Economic framework

The cost-benefit analysis framework outlined by the Department of Finance (2011; 2006) was used to estimate and rank the Net Present Value (NPV) and Benefit:Cost Ratio (BCR) of the goat management strategies. The specific equations used are:

$$NPV = \sum_{t=1}^{T} \frac{B_t - C_t}{(1+r)^t} \quad (1)$$

$$BCR = \sum_{t=1}^{T} \frac{B_t}{(1+r)^t} / \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} \quad (2)$$

Where B_t and C_t are benefits and costs in year t, respectively, r is the discount rate and T is the time frame (20 years). The management strategy with the highest NPV and BCR greater than one is the most desirable. Sensitivity analysis was conducted using @RISK software that establishes the linear relationship between NPV and key input variables. The sign Negative and positive values of the regression coefficient indicates the direction of change in NPV with change in the key variables.

The costs of feral goat control strategies include fixed, variable and operating costs and environmental damage. The benefits are revenue generated from goat sales, net gains from increased domestic livestock production and improvement in natural resource condition. Sheep and goat gross margins and other key assumption used were adapted from the whole farm models developed by Khairo *et al*. (2008). Environmental costs and benefits could not be directly quantified.

Results and discussion

The pay-off matrix for feral goat management strategies in the Bourke district is presented in Table 1. Results for other districts were similar and are not presented.

Table 1: The pay off matrix for feral goat management strategies in Bourke district

Evaluation Criteria	No-control	Opportunistic		Value added		Livestock with goat-proof fencing		
		Current	Max. harvest	Constant livestock	Reduced livestock	Goat country paddock	Good country paddock	Boundary fence
PVB	127,331	407,346	462,477	614,017	639,459	425,094	384,086	331,100
PVC	376,359	163,910	170,358	217,660	229,645	308,231	175,767	714,678
NPV	-249,029	243,436	292,119	396,357	409,815	116,863	208,319	-383,577

BCR	0.34	2.49	2.71	2.82	2.78	1.38	2.19	0.46
Ranking (NPV)	7	4	3	2	1	6	5	8
Desirability	x	√	√	√	√	√	√	x
PVB – present value of benefits; PVC – present value of costs; NPV – Net present value BCR – Benefit:cost ratio								

The 'value added strategy with reduced livestock' provides the best return. Use of a goat paddock to grow out underweight goats is superior to use of such a paddock for livestock grazing. Opportunistic harvest scenarios are also superior to use of a 'goat paddock' for livestock grazing only. Fencing of good quality country for livestock production generates better returns but still less than the opportunistic harvest or value added strategies. The no-control and boundary fencing scenarios return negative NPV.

The sensitivity analysis (Table 2) shows that all scenarios are more sensitive (positively or negatively) to changes in goat price than goat population.

Table 2: Regression coefficients for sensitivity analysis

District	Variables	No control	Opportunistic		Value added		Livestock with goat-proof fencing		
			Current	Max. harvest	Constant livestock	Reduced livestock	Goat country paddock	Good country paddock	Boundary fence
Bourke	Price	-0.90	0.93	0.93	0.93	0.93	0.92	0.92	-0.87
	Population	-0.34	0.29	0.28	0.28	0.29	0.22	0.34	-0.32
Cobar	Price	-0.92	0.95	0.95	0.94	0.94	0.99	0.72	-0.94
	Population	-0.36	0.29	0.29	0.32	0.32	0.10	0.26	-0.19
Broken Hill	Price	-0.93	0.94	0.93	0.93	0.93	0.99	0.92	-0.97
	Population	-0.30	0.28	0.29	0.32	0.32	0.25	0.29	-0.29

Breakeven stocking rates

The relative increase in carrying capacity necessary for the boundary fencing strategy to breakeven is modest (Table 3) and could probably be achieved with improved grazing management. Differences between districts reflect the extent of boundary fencing feasible and consequently the feral goat harvesting opportunities that remain outside the fence. Even the increases in carrying capacity, through improved grazing management, required for exclusion fencing options to equal the best feral goat management strategies are not unreasonably high if they can be achieved over the whole property.

Table 3: Breakeven stocking rates

District	Current carrying capacity (DSE/ha)	Increase in carrying capacity[1] for boundary fencing to breakeven (%)	Increase in carrying capacity required to equal best feral goat management strategy (%)					
			Within the fenced area			Over the whole property		
			Goat country paddock	Good country paddock	Boundary fence	Goat country paddock	Good country paddock	Boundary fence
Bourke	0.20	10	290	124	43	14	6	43
Cobar	0.25	4	640	220	63	59	20	51
Broken Hill	0.25	0.2	102	21	14	10	2	8
[1] Within the fenced area; Proportion of whole property fenced – Bourke 100%, Cobar 80%, Broken Hill 60%								

Policy implications for natural resource management

Current management practices (opportunistic harvesting and value added) are profitable for landholders and require no support from government. Further, since harvesting operations are driven more by goat price than by population, financial support for such activities is unlikely to contribute to resource conservation objectives. Further, the feral goat population has increased in recent years despite significant commercial off take (Ballard *et al.*, 2011; Pople and Froese, 2012). While commercial harvesting encourages the maintenance of goat populations rather than control for environmental objectives (Parkes *et al.*, 1996) further development of the rangeland goat industry may contribute to resource conservation if it improves price stability.

Since (probably) achievable improvements in carrying capacity can result in favourable returns from exclusion fencing, any attempt to improve natural resource outcomes by public investment may be best directed at encouraging improved grazing management e.g. through incentives for achievement of ground cover targets as described by Hacker *et al. (2010)* and Moss *et al.(2012)*. Such incentives could be short term, and designed to encourage capital investment and improved management, or incorporated as part of longer term drought assistance policies (Hacker *et al.*, 2010).

References

Ballard, G., Fleming, P., Melvolle, G., West, P., Pradhan, U., Payne, N., Russel, B. & Theakston, P. (2011).Feral goats population Trends in Western New South Wales Rangelands, In *Unpublished final report to the Western Catchment Management Authority*.

Department of Finance (2006). Handbook of Cost-Benefit analysis. Australian Government Publishing Service, Canberra.

Hacker, R. B., Jessop, P. J., Smith, W. J. & Melville, G. J. (2010). A ground cover-based incentive approach to enhancing resilience in rangelands viewed as complex adaptive systems. *The Rangeland Journal* 32(3): 283-291.

Harrington, G. N. (1976). The effects of feral goats and sheep on the shrub populations in a semi-arid woodland. *The Rangeland Journal* 1(4): 334-345.

Harrington, G. N. (1982).The feral goat: . In *Goats for Meat and Fibre in Australia*, Vol. 11, 70 (Ed P. J. Holst). CSIRO, Canberra.

Khairo, S. A., Hacker, R. B., Atkinson, T. L. & Turnbull, G. L. (2011). Economic Analysis of Feral Goats Control within the NSW Rangeland. In *Economic Research Report*, Vol. 47, NSW DPI, Trangie.

Khairo, S. A., Mullen, J. D., Hacker, R. B. & Patten, D. A. (2008).'The profitability of alternative sheep enterprises in the Pastoral Zone of NSW' In *Economic research report* Vol. 31 NSW DPI. Trangie:

Moss, J., Sinden, J. & Stayner, R. (2012). Estimating the cost of protecting groundcover on privately managed properties in the Australian rangelands: the case of the West 2000 Plus Enterprise-Based Conservation scheme. *The Rangeland Journal* 34(1): 75-87.

Parkes, J., Henzell, R. & Pickles, G. (1996). *Managing Vertebrate Pests: Feral Goats.* Australian Government publishing Service, Canberra.

Pople, T. & Froese, J. (2012).Distribution, abundance and harvesting of feral goats in Australian rangeland1984-2011. Biosecurity Queensland, Brisbane.

Russell, B. G., Letnic, M. & Fleming, P. J. S. (2011). Managing feral goat impacts by manipulating their access to water in the rangelands. *The Rangeland Journal* 33(2): 143-152.