AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

REVIEW OF MARKETING AND AGRICULTURAL ECONOMICS
VOL. 47, No. 3 (*December*, 1979)

Field Testing of the Toft and O'Hanlon Drought Tactic Model

R. A. Henderson and H. I. Toft*

Introduction

In Toft and O'Hanlon (1979), a dynamic programming model was presented as a tool for aiding graziers to minimize costs associated with sheep and cattle in a drought. The present study was aimed at a further field testing of the model.

Methodology

The study involved ten graziers in the Glen Innes district. These graziers were interviewed and the data required for the model elicited. In addition, the graziers were asked to state what actions they would follow for each month of a drought whose duration was not definitely known. For each grazier, two stock classes were considered—breeding cattle and ewes. These were stock classes chosen as representing the largest portion of the stock held on each property. The study therefore involved analysing twenty sets of stock class data.

In the present study, the provisions in the Toft and O'Hanlon model for constraints to be placed on cash outlay, and numbers agisted and sold were not used. This was done because the study was concerned with identifying the least cost path through the drought. The results from the model were then used as a bench mark to determine the extent of deviation from the optimal pathway of the graziers' suggested actions.

The opportunity loss of sub-optimal decisions

In the first part of the current analysis, uncertainty regarding the duration of drought is accounted for by considering the probabilities of drought lengths elicited from each grazier. Given that drought length is a random variable, let EC_G denote the expected costs associated with the grazier's suggested sequence of actions during a drought and EC_D denote the minimum expected costs associated with the optimal sequence of actions as determined by the dynamic programming model. If $EC_G > EC_D$ then the grazier incurs an expected opportunity loss of $(EC_G - EC_D)$. That is $(EC_G - EC_D)$ represents money which could have found profitable alternative use and can therefore be considered as an expected opportunity loss. This data is documented in Table 1.

* University of New England. The authors wish to acknowledge contributions made throughout this project by Mr J. P. Makeham.

Table 1: Calculation of Expected Opportunity Loss

Grazier	Stock class C = cattle S = sheep	Expected cost of following grazier actions (EC_G)	Expected minimum cost from D.P. solution (EC_D)	Opportunity loss ($EC_G - EC_D$)	Percentage opportunity loss of following grazier actions $\left(\frac{EC_G - EC_D}{EC_G} \times 100\right)$	Average percentage opportunity loss/grazier*
		$	$	$		
1	C	8,155	6,348	1,807	22.60	23.02
	S	6,285	4,812	1,473	23.44	
2	C	28,763	17,320	11,443	39.78	28.84
	S	87,557	71,884	15,673	17.90	
3	C	12,631	11,503	1,128	8.93	33.21
	S	33,669	14,310	19,359	57.49	
4	C	5,469	4,635	834	15.25	34.74
	S	8,215	3,761	4,454	54.22	
5	C	1,866	1,661	205	10.99	22.34
	S	4,350	2,885	1,465	33.68	
6	C	10,996	9,079	1,917	17.43	24.42
	S	19,725	13,530	6,195	31.41	
7	young ewes	9,943	7,925	2,018	20.30	26.46
	old ewes	2,975	2,005	970	32.61	
8	C	3,296	2,869	427	12.96	34.64
	S	4,192	1,831	2,361	56.32	
9	C	55,550	44,824	10,676	19.24	29.88
	S	48,430	28,805	19,625	40.52	
10	C	15,241	11,475	3,766	24.71	42.24
	S	76,874	30,920	45,954	59.77	

* Average Percentage Opportunity Loss for all graziers = 29.98.

In the second part of the analysis probabilities of drought lengths are ignored. Let C_G be the cost of following the sequence of actions suggested by the grazier and C_D the cost of following the actions determined from the model, if the drought continued for the longest possible period. The "actions determined from the model" are the sequence of actions which minimize expected cost given that drought length is a random variable. Thus if the drought were to continue for the longest possible period, the cost C_D may not be the least possible over this period. For three of the twenty stock classes considered C_D was greater than C_G. This data is given in Table 2.

Results of Study

The first point to note from Table 1 is that the average reduction in expected cost is approximately 30 per cent for these ten graziers. Secondly, when graziers are considered individually opportunity losses range from 22 per cent to 42 per cent, which are considered substantial opportunity losses.

From Table 2 it can be noted that the dynamic programming model offers an average improvement of 18 per cent where the drought continues for the "longest possible period" allowed by the probability distribution of drought length. This is still a substantial reduction in cost. There are however three instances where, if the drought were to continue for the longest possible period, the actions suggested by the graziers would result in a lower cost than the actions suggested by the model. In these three instances however the expected cost of following the model solution, given that drought length is a random variable, is less than that of following the actions suggested by the graziers. In these three instances either the actions suggested by the grazier or those indicated by the model may be considered preferable depending on attitude to risk.

A point to note is that the results obtained in this study were derived without any constraints imposed on possible actions. In reality however, constraints need to be imposed to cover non-economic effects such as the graziers' preferences and prejudices as well as their financial status and commitments. The model however has provision to allow such constraints to be imposed. It is considered that with the constrained model the difference, between the model results and the costs of following actions suggested by graziers, would have been reduced. However the results obtained suggest that the model would still allow substantial reduction in expected costs if constraints allowed in the model were made effective.

The results reported here were for only ten case studies. Random selection was not used so that statistical inferences as to average per cent savings which would follow through application of the dynamic programming model cannot properly be made. Also the actions which each grazier suggested relative to each of two stock classes were hypothetical rather than observations in an actual drought situation. However, the suggested actions could presumably be taken to represent the grazier's preferred sequence of actions at the time of the interviews. In an actual drought situation the tactics selected may fare better in terms of expected cost and cost for a maximum length drought. However they could fare worse. Although field testing during non-drought situations forces responses to be hypothetical, it is felt that grazier co-operation in model development is more likely to be forthcoming in the less stressful non-drought situation.

Table 2: Cost if Drought Continued for Longest Possible Period

Grazier	Stock class C = Cattle S = Sheep	Cost of following grazier actions if drought continued for longest period (C_G)	Cost from D.P. Model if drought continued for longest period (C_D)	Opportunity loss ($C_G - C_D$)	Percent Opportunity loss of following grazier actions $\left(\frac{C_G - C_D}{C^G} \times 100\right)$	Average percentage Opportunity loss/grazier*
		$	$	$		
1	C	19,325	10,800	8,525	44.11	26.00
	S	16,780	15,458	1,322	7.88	
2	C	83,613	32,000	51,613	61.73	28.48
	S	211,284	221,352	−10,068	−4.77	
3	C	36,803	35,875	928	2.52	19.34
	S	72,570	46,350	26,220	36.13	
4	C	10,265	10,050	215	2.09	17.72
	S	13,052	8,700	4,352	33.34	
5	C	5,210	5,550	−240	−6.53	2.00
	S	12,405	11,100	1,305	10.52	
6	C	32,780	18,900	13,880	42.34	29.91
	S	47,625	39,300	8,325	17.48	
7	young ewes	32,450	26,600	5,850	18.03	6.34
	old ewes	7,000	7,375	−375	−5.36	
8	C	11,585	11,250	335	2.89	15.65
	S	10,521	7,532	2,989	28.41	
9	C	223,900	202,400	21,500	9.60	9.61
	S	183,661	166,000	17,661	9.62	
10	C	24,500	20,000	4,500	18.37	29.97
	S	150,300	88,000	62,300	41.45	

* Average percentage difference of total graziers = 18.49.

Use of the Model in Extension

The dynamic programming model has been field tested by research workers at the University of New England and by officers of the New South Wales and Victorian Departments of Agriculture.

The field testing carried out from the University of New England has consisted of two studies. The first, reported in Toft and O'Hanlon (1979) involved collecting data, then running the computer programme, and discussing the output with approximately twenty graziers. The second study reported in this note involved data collection and analysis for ten graziers. In both of these studies it has been found that the data could be elicited from and the output explained to graziers.

Questionnaires have been developed for use in data collection. Where card input is used with the computer programme a total of fourteen data cards are required. Emphasis has been placed on trying to make the computer output farmer readable.

Part of the data obtained through the questionnaire consists of a probability distribution of drought length. This has been elicited through use of the "visual impact" method, with graziers being asked to allocate matches or markers to different rows in a table where each row is associated with a particular drought length. Relative subjective likelihoods of various drought lengths are represented by the relative number of matches allocated.

Data required also includes feed costs, selling prices, agistment costs and cost of post-drought replacement. The collection of detailed feed costs, agistment costs and selling prices has been restricted to the first six months of a drought. Imputed costs and selling prices are then used in subsequent months based on the cost and price in the sixth month and the highest forecast cost and lowest forecast selling price during the drought. Replacement cost has been taken as the forecast replacement cost if the replacements were to be purchased.

Experience to date has also indicated that variations of the basic model could be required. For example, while the basic model includes a cost of lost gross margin on within drought sales as an annual figure which is then subdivided into monthly costs, the Victorian Department of Agriculture were interested in considering month-specific lost gross margins. A similar variation has been required in terms of feed costs with monthly feed costs collected to the end of the "longest" drought.

Wider applications of the model may benefit from occasional discussions with authors of the model to deal with any problems of operation and interpretation. During the development of the current dynamic programming model a separate computer programme was developed to give a separate calculation of the expected cost during a drought of a given sequence of actions. Such a programme could be used as a check of the calculations in the dynamic programming model of the expected cost of the optimal sequence of actions. Such a programme could also be used to calculate the forecast costs of plans suggested by graziers. Extensive field testing is a necessary antecedent to application of a model such as the current one, as indicated by Nuthall (1979). Results of field tests carried out so far seem to indicate that further extension field work and feed-back are warranted.

References

NUTHALL, P. L. (1979), "On the Development and Use of Automated Management Aids", This *Review*, Vol. 47, No. 1, pp. 17–26.

TOFT, H. I. and O'HANLON, P. W. (1979), "A Dynamic Programming Model for On-Farm Decision Making in a Drought", This *Review*, Vol. 47, No. 1, pp. 5–16.