A Multiple Indictor-Multiple Causation Analysis of Pasture Management and Prescribed Grazing Practices by Beef Cattle Operators

By

Kristen Oliver, Kimberly L. Jensen, Dayton M. Lambert, and Christopher D. Clark,
Department of Agricultural & Resource Economics, University of Tennessee

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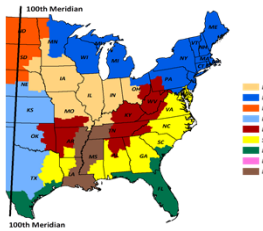
Background and Objectives

- Pasture management and grazing practices affect animal productivity, farm profitability, soil carbon storage and soil and water quality.
- Poor pasture and grazing management practices can cause soil erosion, nitrogen leaching, and runoff into streams and waterways.
- This study analyzes the use of various pasture and prescribed grazing management practices and the influence of farm and farmer characteristics on farmer propensity to use these practices.
- The results of this study further understanding of pasture and prescribed grazing practice use and inform educational and environmental management programs for cattle farmers with grazing lands in the eastern US.

Heavy Use Areas
Photo Source: Cosgrove, Undersander, and Cropper (1996) http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044239.pdf

Geotextiles
Photo Source: Bicudo, University of Kentucky Extension, http://www.bae.uky.edu/jbicudo/geotextile.html

Cross-Fencing for Rotational Grazing
Photo Source: Blount County, TN Extension Office http://www.blounttn.org/soil/Agri_Cons_Prac.asp



Research Methodology

Data

- Random sample of beef cattle, cow/calf, and backgrounding/stockering operations east of the 100th meridian (n = 8,875) was surveyed for this study.
- Survey fielded by USDA/NASS in 2013.
- 2,201 responses, with 873 respondents providing answers to all questions used in this analysis.
- Survey included questions about pasture management, prescribed grazing practices, farm and farmer characteristics, including farmer attitudes.

Modeling

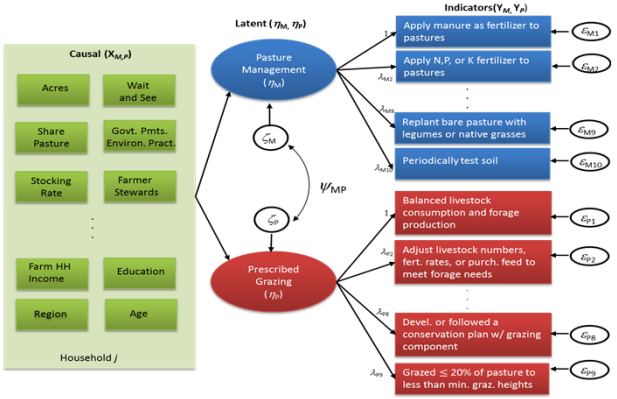
Multiple Indicator Multiple Causation Modeling (MIMIC) was used consisting of *a)* a measurement model defining the relationships between a latent variable (propensity to use pasture management and prescribed grazing practices) and its indicators (e.g., use of specific practices, such as soil testing) and *b)* a structural model specifying the effects of causal variables (e.g., farm and farmer characteristics) on the latent variable (Figure 1). The MIMIC model is:

(1) $y_{jn}=\lambda_n\eta_{jn}+\varepsilon_{jn}$

(2) $\eta_{jn}=\gamma_n' x_{jn}+\zeta_{jn}$

where y_{jn} is a vector of indicator variables, and x_{jn} is the causal variables matrix. The unobserved latent variable is η_{jn} for the jth household and nth latent variable (n=M, P), where M=Pasture Management and P=Prescribed Grazing. A logististic link function is used to model adoption of specified practices. The MIMIC model is extended by allowing for correlation (ψ) between the latent variables, M and P.

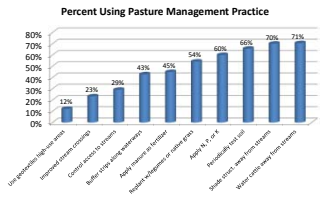
Figure 1. Multiple Indicator Multiple Causation For Adoption of Pasture Management and Prescribed Grazing Practices



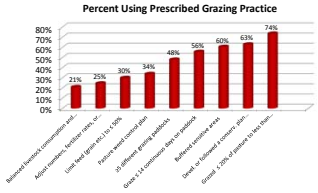
Results

- The most frequently used pasture management practices were watering cattle away from streams, placing shade structures away from streams, and periodically testing the soils (Figure 2a).
- The most frequently used prescribed grazing management practices were adjusting numbers, fertilizer rates, or purchasing feed to meet forage needs, having a pasture weed control plan, and using balanced livestock consumption and forage production (Figure 2b).
- The covariance between the latent variables is significant and positive (Table 1).
- The model coefficients for the indicator variables (practices) are all significant and positive.
- Age and farm size have no significant effect on the propensity to use either set of practices.
- College and higher income positively affect use of both sets of practices.
- Wait and see attitude, Prairie location, and share of labor off-farm have negative effects on the propensity to use both sets of practices.
- Belief that government payments are needed to encourage adoption of environmental practices and that farmers are stewards of the land each have positively correlated with propensity to use prescribed grazing practices.
- Stocking rate and planned family takeover of farm have positive effects on the propensity to use pasture management practices, while the share of farm allocated to pasture has a negative influence.

Figure 2. Use of Pasture Management and Prescribed Grazing Practices



(a)



(b)

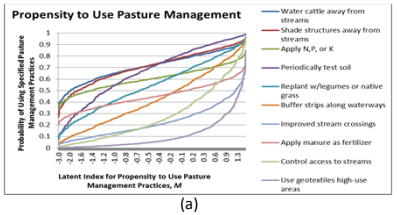
Table 1. MIMIC Estimates for Use of Pasture Management and Prescribed Grazing

Pasture Management Practices (*M*)	λ_k	α_k	Prescribed Grazing Practices (*P*)	λ_k	α_k
Apply manure as fertilizer to pastures	0.463***	0.237	Balanced livestock consumption and forage production	0.960***	-0.312
Apply N,P, or K fertilizer to pastures	0.444***	0.626***	Adjust numbers, fertilizer rates, or purch. feed to meet forage needs	0.741***	0.513
Water cattle away from streams	0.662***	1.271***	Limit feed (grain etc.) to ≤ 50%	0.774***	-0.769*
Buffer strips along waterways	1.232***	0.148	Pasture weed control plan	0.350***	0.240
Structures away from streams	0.789***	1.341***	≥5 different grazing paddocks		
Improved stream crossings	0.878***	-1.037**	Graze ≤ 14 continuous days on paddock	0.882***	-1.776***
Control access to streams	1.453***	-0.666	Buffered sensitive areas	1.996***	-3.973***
Use geotextiles high-use areas	1.538***	-2.203***	Devel. or followed a conserv. plan w/grazing component	1.807***	-3.366***
Replant w/legumes or native grasses	1.078***	0.692	Grazed ≤ 20% of pasture to less than min. graz. heights	1.019***	-1.719***
Periodically test soil	1.395***	1.549**			
Adoption Propensity Component					
Age	-0.001			0.004	
College	0.257***			0.322***	
Farm Acres (100)	-0.001			0.001	
Family Takeover When Retire	0.159*			0.013	
Share of Labor Off-Farm	-0.330**			-0.266*	
Household Income<30K	-0.166			-0.026	
Household Income 30-49K	-0.359***			-0.246*	
Household Income 50-99K	-0.241**			-0.176*	
Share Pasture	-0.442**			-0.211	
Stocking Rate (A.U/acre)	0.202***			-0.065	
Heartland	-0.231			0.064	
Prairie	-0.826***			-0.485***	
E. Uplands	-0.003			-0.014	
S. Seaboard	0.064			-0.076	
Northern	-0.569***			0.138	
Wait &See Attitude Toward New Practices (1-5 Agreement Likert)	-0.205***			-0.166***	
Farmers are Stewards of Land (1-5 Agreement Likert)	0.095			0.087**	
Govt Payments Needed to Encourage Environmental Practices (1-5 Agreement Likert)	0.039			0.203***	

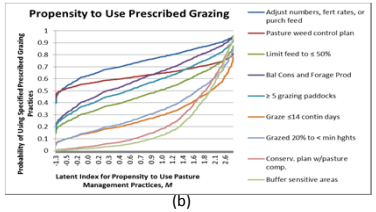
Log-Likelihood -9384.001 ψ_{MP} 0.788*** (N=873)

* Significant at 90% confidence level, ** at 95% confidence level, *** at 95% confidence level.

Figure 3. Use Curves for Specified Practices and Propensity to Use Management Type



(a)



(b)

The likelihood of watering cattle away from streams and keeping shade structures away from streams increase quickly with increases in propensity to use pasture management practices, while use of improved stream crossings and geotextiles increase more slowly (Figure 3a). The likelihood of adjusting cattle numbers or fertilizer rates, or purchasing feed to meet forage needs and balancing consumption and forage production increase relatively quickly with increases in propensity of using prescribed grazing practices, while following conservation plans with grazing components and buffering sensitive areas increases more slowly (Figure 3b).

Conclusions

Results from this study suggest that propensity to use pasture management is positively correlated with propensity to use prescribed grazing. Among individual pasture management practices, watering cattle away from streams and keeping shade structures away from streams appear to be more readily used, while improved stream crossings and geotextiles increase are less so. In addition, adjusting cattle numbers or fertilizer rates, or purchasing feed to meet forage is more commonly used prescribed grazing practices, while having conservation plans with grazing components and buffering sensitive areas are less commonly used. Financial considerations, off-farm labor, education, and attitudes about risk influence propensity to use pasture management and prescribed grazing. Attitudes toward the environment and government payments influence propensity to use prescribed grazing.