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

By

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By Beef Cattle Operators

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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, nutrient leaching, and runoff into streams and waterways.

This study analyzed 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 understand the use of pasture and prescribed grazing practices and inform educational and environmental management programs for cattle farmers with grazing lands in the eastern US.

Research Methodology

Data
- Random sample of beef cattle, cow/calf, and background/backfiring operations east of the 100th meridian (n = 8,875) was surveyed for this study.
- Survey fielded by USDA/NSAS in 2013.
- 2,201 responses, with 879 respondents providing answers to all questions used in this analysis.
- Survey included questions about pasture management, prescribed grazing practices, farm and farmer characteristics, and farmer attitudes.

Modeling

Multiple Indicator-Multiple Causation Modeling (MIMIC) was used consisting of 1) 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 2) 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:

\[ Y_j = \beta_0 + \beta_1 X_{j1} + \beta_2 X_{j2} + \epsilon_j \]

where \( Y_j \) is a vector of indicator variables, and \( \beta_1, \beta_2 \) are the causal variables matrix. The unobserved latent variable is \( \eta_j \) for the \( j \)th household and \( \eta \)th latent variable (mIMC, P), where A-Pasture Management and P-Prescribed Grazing.

A logistic link function is used to model the probability of specified practices. The MIMIC model is extended by allowing for correlation (\( \psi \)) between the latent variables, \( \Phi \).

Results

- The most frequently used pasture management practices we were waterring 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 prescribed livestock consumption and forage production (Figure 2b).
- The correlation 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 both sets of practices.
- College and higher income positively affect use of both sets of practices.
- Waiting and see attitude, Prairie location, and size of labor from 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.
- Sharing rate and planned family member have positive effects on the propensity to use pasture management practices, while the share of farm allocated to pasture has a negative influence.

Data Analysis

- Figure 2a: Percent using pasture management practice
- Figure 2b: Percent using prescribed grazing practices

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

<table>
<thead>
<tr>
<th>Practice Management (n)</th>
<th>**</th>
<th>%</th>
<th>P Prescribed Grazing (n)</th>
<th>**</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjust livestock numbers</td>
<td>0.666</td>
<td>0.774***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjust fertilizer rates</td>
<td>0.350</td>
<td>0.240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilize pastures</td>
<td>0.789***</td>
<td>1.341***</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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, waterering cattle away from streams and using shade structures away from streams appear to be more readily used, while improved stream crossings and water quality increase are less so.
- In addition, adjusting cattle numbers or fertilizer rates, or purchasing feed to meet forage needs is more commonly used prescribed grazing practices, while having conservation plans with grazing components and buffer sensitive areas are less commonly used. Financial considerations, off farm labor, education, and attitudes toward risk influence propensity to use pasture management and prescribed grazing.

- Attitudes toward the environment and government payments influence propensity to use prescribed grazing.