Determining Implicit Prices for Hay Quality and Bale Characteristics

Margaretha Rudstrom

Markets for dairy quality hay have emerged as dairy farms purchase more feed off the farm. Previous research on hay markets used proxies for quality since objective measures of quality were unavailable. A hedonic pricing model incorporating direct measures of quality (moisture, crude protein, and relative feed value (RFV)), proxies (cutting), and bale-type variables was estimated using data from a hay auction. Large round and square bales and medium round bales were discounted relative to small square bales. The implicit price for RFV was $0.55/ton in 2001-02.

Structural change in the U.S. dairy industry has led to the emergence of a growing market for quality hay. High-quality hay in dairy rations is required for greater milk production. Many large dairy farms now purchase all feed inputs, including hay, rather than producing feedstuff on the farm. The shift from traditional dairy farms that produced most or all of the hay on the farm to large dairy farms with high production levels per cow has resulted in a demand for high-quality forages. The purpose of this study is to estimate the implicit values of quality and packaging characteristics associated with high-quality hay in a major dairy area.

Understanding the characteristics of the emerging hay market has far-reaching implications for both dairy and crop producers. Sourcing an adequate supply of dairy-quality hay in a bale type that suits dairy operations will become a more important for farmers who outsource cropping. Dairy farmers exiting the industry could be in a strong position to supply hay to dairies. Row crop producers interested in diversification could include alfalfa in the crop rotation. Maynard, Harper, and Hoffman quantified the economic benefits of such a strategy. Understanding how hay quality and packaging impacts price is an added dimension to the decision of including alfalfa in cropping decisions and machinery purchase decisions.

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Measuring Quality

Hay is composed of a bundle of nutritional and package characteristics. Very little research has been done on valuing both the nutritive and packaging characteristics of hay. One exception was Pardew’s study that assessed the effects of hay marketing services and quality characteristics on prices received by Nevada alfalfa hay producers. Three proxies of hay quality were used—percent of second cutting included in the sale, the date of first cutting, and a dummy variable if the alfalfa was sold to a dairy producer. While the proxies for quality had a significant positive effect on price, these measures may not be adequate in areas such as the Midwest where weather conditions are a major factor in the nutritive quality of harvested hay.

There are objective measures of hay quality. Crude protein (CP) and relative feed value (RFV) are two quality measures commonly used by dairy farmers and nutritionists. Protein is required in diets of high-producing dairy cows and can come from many sources, including hay. RFV combines measures of digestibility and intake to derive an index number that reflects forage quality (Linn et al.). The RFV assesses the digestibility of the forage, and hence the ability of dairy cows to utilize forage protein. Appropriate quality hay for lactating dairy cows, frequently referred to by producers as dairy-quality hay, is good to premium under the USDA quality designations. Premium hay has a RFV of 150–180 and good has a RFV of 125–150 (USDA).

Hay is packaged as small, medium, or large round or square bales. Small bales typically weigh 80 pounds or less and can be handled manually. Medium bales weight approximately 1,000 pounds and can be handled with conventional front-end loader tractors. Large bales can weigh in excess of 2,000 pounds and require larger tractors to move and maneuver the bales for storage and feeding. Bale shape and size may influence the cost and convenience of transportation, storage, and feeding, causing buyers to prefer a particular type of bale. In addition, the type of feeding facility, storage facility, and feed mixing equipment on a dairy farm can dictate bale preference.

Hay markets tend to be local, as buyers tend to not travel great distances to purchase hay. Because of the bulkiness of the bales, hay is typically not transported over large distances. Many markets provide limited information on hay quality. Some auctions provide information on cutting and a few on RFV. Buyers often use the cutting and visual appearance of the hay as a proxy for quality.

The emergence of internet hay auctions has been a recent phenomenon. The Upper Midwest Haylist and the Illinois Hay and Straw Directory are examples of the many internet hay auctions. Most internet hay auctions list sellers’ contact information and details about the hay being sold. The information is generally limited to bale size, bale type, and lot size. Some sites list cutting. Interested hay buyers contact hay sellers directly to complete a sales transaction.

The USDA Agricultural Marketing Service (AMS) reports average selling prices, RFV ratings, and quantity of hay sold. Hay markets do not provide an explicit premium for measurable units of quality. Yet, it is important to the buyers of dairy-quality hay. Neither AMS nor local hay auctions report explicit premiums for hay quality or bale type and size. Both buyers and sellers of hay are interested in information on quality and packaging premiums or discounts.
A hay auction in Sauk Center, Minnesota operates every first and third Thursday from October through May. Sellers, primarily from Minnesota, North Dakota, and Manitoba, deliver hay to the auction site where it is tested for RFV, CP, and moisture prior to the auction by the Stearns County Dairy Herd Improvement Association (DHIA) laboratory. The RFV, CP, moisture, and cutting are identified to buyers prior to bidding. Hay lots different sizes are auctioned off one at a time and sold to the highest bidder.

Following every hay auction at Sauk Center, the Stearns County DHIA lists the transaction prices and lot information, including cutting and RVF on their website. This level of reporting is the exception rather than the rule in hay auctions. It provides an opportunity to examine the implicit value of a number of dairy-quality hay characteristics.

There are two research objectives for this paper. The first is to assess the importance of quality and bale size and type in determining the market price of hay. Including measurable quality traits in the hedonic pricing model provides buyers and sellers additional information on valuing hay. CP and RFV are quality characteristics that dairy producers and nutritionists commonly use in balancing rations and more accurately reflect the needs of lactating dairy cows than the quality proxies of cutting. Reporting objective measures of hay quality may be of economic benefit to sellers. This is especially true for hay producers who sell in internet auctions where little or no quality information is typically provided by sellers.

The second objective is to determine whether there are premiums or discounts associated with different sizes and types of hay bales. This information will be useful to hay buyers and sellers. Sellers can use the information to help decide the type of baling equipment to purchase. Buyers can take advantage of price discounts that might be the result of packaging, while maintaining a desired level of hay quality.

Hedonic pricing models allow values or implicit prices to be placed on individual commodity characteristics. That is, the price paid for a commodity is a function of its characteristics. Very little research has been done on valuing both the nutritive and packaging characteristics of hay. Further, no hedonic hay price models have used direct measures of quality. The proxies for quality used by Pardew had a significant positive effect on price. This research adds to the literature by evaluating the effect of incorporating more specific quantitative measures of quality on market prices.

**Model Development**

Hedonic pricing models have been used to value characteristics of a number of agricultural commodities (Wilson; Neibergs; Samikwa, Brorsen, and Sanders; McConnell and Strand; Jabbar; Jordan et al; Oczkowski; Misra and Bondurant; Wahl, Shi, and Mittelhammer; Brorsen, Grant, and Rister). While most of these studies examine a market for a final or consumer good, this study considers a market for an intermediate good, or input into a production process. Hay is an input that has value in milk production because of its nutritive and packaging characteristics.
The framework for the analysis lies in derived input demand. Following the discussion in Rosen on the production decision, a hedonic model for a production input is developed. Rather than specifying production as a function of commodity inputs, production is expressed as a function of the commodity characteristics. Let \( x_j \) be the input characteristic \( j \) used in production. Production of output \( q \) can be represented as

\[
q = F(x_1, x_2, \ldots, x_n).
\]

In the hay market, CP is an example of an input characteristic. The amount of a characteristic is a function of the amount of an input, \( v_i \) and the amount of the characteristic contained in the input. The amount of an input characteristic \( j \) is

\[
x_j = G(v_1, v_2, \ldots, v_i, x_{j1}, x_{j2}, \ldots, x_{jn})
\]

where \( v_i \) is the amount of input \( i \) and \( x_{ji} \) is the amount of characteristic \( j \) contained in one unit of input \( i \).

Assuming profit-maximizing behavior, the profit function becomes

\[
\pi = pF(x_1, x_2, \ldots, x_n) - \sum_{i=1}^{n} r_i v_i
\]

where \( p \) is output price and \( r_i \) is price for input \( i \). Derived demand for input characteristics are obtained by differentiating (3) with respect to \( v_i \), the amount of input \( i \) resulting in

\[
\frac{\partial \pi}{\partial v_i} = p \sum_j \frac{\partial F}{\partial x_j} \frac{\partial x_j}{\partial v_i} - r_i = 0.
\]

Examining the terms in equation (4) provides a basis for valuing the characteristics of production inputs. The term, \( p \frac{\partial F}{\partial x_j} \), is the marginal value, or implicit price, of the \( j \)th characteristic. The term \( \frac{\partial x_j}{\partial v_i} \) is the marginal yield of characteristic \( j \) provided from one unit of input \( i \). Equation (4) provides the basis for the hedonic pricing model for inputs, where the input price is a function of the input characteristics.

Quality and bale characteristics influence the price of hay. Moisture content (MOISTURE), crude protein (PROTEIN), and relative feed value (RFV) are three variables used to directly measure hay quality. It is hypothesized that moisture content will negatively impact price, while CP and RFV will have positive impacts. Hay with high moisture content is more susceptible to spoilage, and therefore should have a lower selling price. Higher CP and RFV indicate higher quality and should be of greater value to dairy hay buyers.

As noted earlier, the USDA hay classification is based on RFV. While is it possible to use discrete variables representing good and premium hay to model quality, more information can be gleaned by using the continuous measure of RFV. Small changes in RFV, say 10 points, might not move hay from one class to another yet may have value for hay producers. It is possible to affect RFV of hay through production decisions, in particular maturity of the forage at cutting.
Depending on the region of the country where hay is produced, three to four cuttings of hay can be taken from a field over the production year. Dairy farmers tend to prefer later cuttings, and use cutting as a proxy for quality when objective measures of quality are not available. It is typically more difficult to ensure the first cutting occurs at the optimal stage of forage growth, as spring rainfall can be unpredictable. It is hypothesized that subsequent cuttings would be higher quality (lower probability of rainfall and therefore a higher likelihood of cutting when the forage is at optimal quality) and therefore have a positive impact on hay price. Three dummy variables represent the seasonal impacts of cutting: D2 is second cutting; D3 is third; and D4 is fourth.

Additional dummy variables are used to indicate the bale type and size. There are five types of bales considered in this study: large round (LR); medium round (MR); large square (LS); medium square (MS); and small square (SS). Because small round bales are not widely produced, they were omitted from the model.\(^1\) Dairy hay bales generally require a particular shape and size that fits their feeding and hay handling systems. Loaders that easily handle square bales may not be suitable for round bales. Equipment that can handle medium bales may be too small for large bales. Bale size is not independent of shape in the buying decision. Thus, bale shape and size are modeled as joint characteristics. SS bales provided the basis for comparisons. There are no a priori expectations on how bale type and size influence price.

Hedonic price functions estimate neither supply nor demand functions (Rosen). They model reduced form effects that show how product attributes or quality characteristics affect the price of the commodity in a competitive market. Given that reduced form models account for supply and demand conditions, the value of the hay characteristics may vary year to year in response to changes in the underlying supply and demand conditions. A dummy variable (YEAR) is used to capture different supply and demand conditions across years.

A semilog hedonic model is used in the analysis.\(^2\) Buyers and sellers cannot separate quality characteristics like RFV and CP. Bale characteristics could be separated but the combination of size and type are important to hay buyers. The semilog specification reflects this nonseparability of the quality characteristics. Further, the marginal value of one characteristic might depend on the level of another. Semilog specification allows for the marginal value of RFV to be a nonlinear function of all the hay characteristics. The model estimated was:

\[
\ln(\text{PRICE}) = \beta_0 + \beta_1 \text{MOISTURE} + \beta_2 \text{PROTEIN} + \beta_3 \text{RFV} + \beta_4 D2 \\
+ \beta_5 D3 + \beta_6 D4 + \beta_7 \text{YEAR} + \beta_8 \text{LR} + \beta_9 \text{LS} + \beta_{10} \text{MR} + \beta_{11} \text{MS}. \tag{5}
\]

Table 1 shows the variable definitions and summary statistics.

The marginal value of a characteristic is the change in price given a one-unit change in the characteristic and is the implicit price of that characteristic. For a continuous variable, marginal value is given by the partial derivative of (5) with respect to the continuous characteristic, \(x_i\), and is represented as

\[
\frac{\partial P}{\partial x_i} = \beta_i(e^{x_i}). \tag{6}
\]
Table 1. Summary statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOISTURE</td>
<td>Percent moisture</td>
<td>16.02</td>
<td>2.17</td>
</tr>
<tr>
<td>PROTEIN</td>
<td>Percent CP</td>
<td>21.50</td>
<td>4.11</td>
</tr>
<tr>
<td>RFV</td>
<td>Relative feed value</td>
<td>146.41</td>
<td>30.03</td>
</tr>
<tr>
<td>PRICE</td>
<td>Price ($/ton)</td>
<td>93.89</td>
<td>27.34</td>
</tr>
<tr>
<td>YEAR</td>
<td>Dummy = 1 if 2001-02</td>
<td>0.64</td>
<td>0.48</td>
</tr>
<tr>
<td>LR</td>
<td>Dummy = 1 if large round bale</td>
<td>0.12</td>
<td>0.32</td>
</tr>
<tr>
<td>LS</td>
<td>Dummy = 1 if large square bale</td>
<td>0.09</td>
<td>0.29</td>
</tr>
<tr>
<td>MR</td>
<td>Dummy = 1 if medium round bale</td>
<td>0.01</td>
<td>0.11</td>
</tr>
<tr>
<td>MS</td>
<td>Dummy = 1 if medium square bale</td>
<td>0.71</td>
<td>0.46</td>
</tr>
<tr>
<td>SS</td>
<td>Dummy = 1 if small square bale</td>
<td>0.07</td>
<td>0.25</td>
</tr>
<tr>
<td>D1</td>
<td>Dummy = 1 if first-cutting hay</td>
<td>0.25</td>
<td>0.43</td>
</tr>
<tr>
<td>D2</td>
<td>Dummy = 1 if second-cutting hay</td>
<td>0.43</td>
<td>0.49</td>
</tr>
<tr>
<td>D3</td>
<td>Dummy = 1 if third-cutting hay</td>
<td>0.27</td>
<td>0.44</td>
</tr>
<tr>
<td>D4</td>
<td>Dummy = 1 if fourth-cutting hay</td>
<td>0.06</td>
<td>0.23</td>
</tr>
</tbody>
</table>

For a discrete variable, the marginal value is calculated as the difference in predicted price with and without the ith characteristic and evaluated at the mean values of the continuous variables as

\[
\Delta P = [e^{(i)}|_{x_i=1}] - [e^{(i)}|_{x_i=0}].
\]

The marginal values for each characteristic were calculated for each production year.

Price flexibility shows the percentage change in price for a 1% increase in a characteristic from its mean, all other factors held constant. It provides an indication of the sensitivity of price to changes in the level of a characteristic. It is calculated as

\[
F_{p,x_i} = \frac{\Delta P}{\Delta x_i} \times \frac{x_i}{P} = \begin{cases} 
\frac{e^{\beta y x_i} - 1}{\gamma} & \text{if } x_i \text{ is continuous} \\
\frac{e^{\beta y} - 1}{\beta} & \text{if } x_i \text{ is binary}
\end{cases}
\]

where \(\gamma\) is defined to be a 1% change in the characteristic. This measure is of particular interest for CP and RFV. It allows producers to evaluate the monetary benefits of increased hay quality. The price flexibility for discrete characteristics is the percentage change in price due to its presence, all other factors held constant.

Data

Lot information and selling prices were reported on the Stearns County DHIA website (Stearns County DHIA). Data from 2000–01 and 2001–02 production years were included in the analysis. The data are pooled cross-sectional, though not time-series in the true sense of the word because the auction days are not consecutive. The analysis only included lots that contain hay from a single cutting.
There were 26 hay auction days in the data set. Total hay volume sold was 22,120 tons in 1,281 lots or transactions. The average lot size was 17 tons and the average amount of hay sold per auction day was 850 tons. The hay had an average moisture content of 16%, CP of 21.5%, and 146 RFV over the two years (table 1). The average selling price was $93.89/ton. MS bales were the most prominent bale type, accounting for 71% of the lots auctioned. About 43% of the lots were second-cutting hay.

**Results**

The data were tested for heteroskedasticity using the Park–Glejser test (Pindyck and Rubenfeld). The parameter estimate for RFV was statistically significant. Thus, equation (5) was estimated via weighted least squares, with the weight being $RFV^{-0.807}$. The $R^2$ was 0.99 and the correlation between the actual price and predicted price was 0.98. The predicted price for hay in 2000–01 was $82.88 and $95.90 in 2001–01 for first-cut SS bales. This compares with an average price of $79.62 and $104.69 in 2000–01 and 2001–02, respectively.

Table 2 presents parameter estimates and their statistical significances. As expected, moisture had a significant negative impact on price. Hay with higher moisture contents are more susceptible to mold and spoilage problems. RFV had a significant positive impact on price. While CP was not significant in this model, it did have the appropriate positive sign. This result should not be surprising as hay generally is included in the diet as a source of fiber, while protein in dairy rations typically comes from dense sources like soybean meal.

Hay buyers often use cutting as a proxy for quality when objective quality measures are not available. Dummy variables for subsequent cuttings had significant positive parameter estimates. The cutting dummy variables could be capturing differences in hay composition as well as nutritive quality. First-cutting hay tends to have more stem and less leaf material than later cuttings. Because leaves are

**Table 2. Parameter estimates**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Parameter Estimate</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTERCEPT</td>
<td>3.74*</td>
<td>0.065</td>
</tr>
<tr>
<td>MOISTURE</td>
<td>-0.015*</td>
<td>0.003</td>
</tr>
<tr>
<td>PROTEIN</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>RFV</td>
<td>0.006*</td>
<td>0.0002</td>
</tr>
<tr>
<td>D2</td>
<td>0.038*</td>
<td>0.001</td>
</tr>
<tr>
<td>D3</td>
<td>0.107*</td>
<td>0.016</td>
</tr>
<tr>
<td>D4</td>
<td>0.063*</td>
<td>0.024</td>
</tr>
<tr>
<td>YEAR</td>
<td>0.146*</td>
<td>0.011</td>
</tr>
<tr>
<td>LR</td>
<td>-0.182*</td>
<td>0.027</td>
</tr>
<tr>
<td>LS</td>
<td>-0.155*</td>
<td>0.027</td>
</tr>
<tr>
<td>MR</td>
<td>-0.179*</td>
<td>0.059</td>
</tr>
<tr>
<td>MS</td>
<td>-0.033</td>
<td>0.021</td>
</tr>
</tbody>
</table>

*Statistically significant at 5% level.
more digestible than stems, dairy producers prefer hay with a higher leaf-to-stem ratio typically found in later cuttings.

Including objective measures of forage quality (RFV, moisture, and CP) had a significant effect on explaining hay prices. Using a likelihood ratio test, the null hypothesis that parameter estimates for moisture, protein, and RFV were not significantly different from zero was rejected at the 5% level. Objective quality measures appear to provide additional pricing information beyond that provided by quality proxies of cutting.

Parameter estimates for LR, LS, and MR bales were negative and significant. The parameter estimate for MS bales was not significant. Large bales weigh in excess of 2,000 pounds and require large tractors to move, likely reducing the number of buyers and demand. Because the hedonic model is a reduced form, the smaller demand for large bales results in a lower market clearing price, as seen by the negative parameter estimates.

The negative parameter estimate for MR bales may be related to bale shape rather than size, given the parameter estimate for MS bales was not statistically significant. Round bales do not stack as neatly or tightly as square bales, so fewer round bales can be placed on a trailer for transportation.

Marginal values for SS first-cut bales were calculated at the means of the continuous characteristics variables. The marginal value for discrete variables is the difference in expected price when the characteristic is present and when it is not calculated at the means of the continuous variables (table 3).

Marginal values were calculated for 2000–01 and 2001–02 (table 3). As mentioned previously, hedonic pricing models represent neither supply nor demand functions, but rather reduced form models. Given different supply and demand conditions in the two years, the marginal values were greater in 2001–02 in absolute terms than those in the previous year. Hay supplies were tight in 2001–02 due to drought conditions in North Dakota and Manitoba. The drought also increased

### Table 3. Marginal values and price flexibilities

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Marginal Valuea ($/ton)</th>
<th>Price Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2000–01</td>
<td>2001–02</td>
</tr>
<tr>
<td>MOISTURE</td>
<td>-1.27</td>
<td>-1.47</td>
</tr>
<tr>
<td>PROTEIN</td>
<td>0.29</td>
<td>0.34</td>
</tr>
<tr>
<td>RFV</td>
<td>0.48</td>
<td>0.55</td>
</tr>
<tr>
<td>D2</td>
<td>3.18</td>
<td>3.67</td>
</tr>
<tr>
<td>D3</td>
<td>9.32</td>
<td>10.79</td>
</tr>
<tr>
<td>D4</td>
<td>5.42</td>
<td>6.27</td>
</tr>
<tr>
<td>LR</td>
<td>-13.82</td>
<td>-15.99</td>
</tr>
<tr>
<td>LS</td>
<td>-11.87</td>
<td>-13.73</td>
</tr>
<tr>
<td>MR</td>
<td>-13.55</td>
<td>-15.68</td>
</tr>
<tr>
<td>MS</td>
<td>-2.70</td>
<td>-3.12</td>
</tr>
</tbody>
</table>

*aMarginal values are calculated at the mean of the continuous characteristic variables and SS first-cutting bales.*
demand for hay. Farmers who normally produced hay for use on their farm had to purchase hay.

The marginal value for moisture was $-1.27/\text{ton}$ in 2000–01 and $-1.47/\text{ton}$ in 2001–02. Moisture had the largest impact on price of the objective quality variables and it can be the most difficult quality factor to control in hay production. The threat of rain can cause farmers to bale hay at a higher moisture content rather than risk rain damage.

The marginal value of RFV was $0.48/\text{ton}$ in 2000–01 and $0.55/\text{ton}$ in 2001–02. It highlights the importance of modeling quality as a continuous rather than a discrete variable because relatively small changes in RFV can significantly impact hay price. For example, in 2001–02, each unit increase in RFV results in an additional $0.55/\text{ton}$. Increasing RFV by 10 points, from say 125–135, which does not move hay from the USDA good classification, increases price by $5.50/\text{ton}$. Given the average auction size was 850 tons, a 10-point change in RFV would result in additional $4,675 of revenue. Simple changes in production practices can result in moderate changes in RFV.

Subsequent cuttings result in a premium over first-cutting hay for SS bales in both years. Third-cutting hay had the highest premiums of $9.32/\text{ton}$ and $10.79/\text{ton}$ in 2000–01 and 2001–02, respectively. An interesting result was fourth-cutting hay had a lower marginal value than third-cutting hay. This may be due to the fact that fourth-cutting hay is often leafier than third-cutting hay making it more difficult to balance fiber content of dairy rations. A certain amount of stem material is needed in the ration to maintain an adequate fiber level.

The marginal values for all bale types were calculated. The parameter estimate for MS bales was not statistically significant. The marginal values of LR, LS, and MR bales indicated these types of bales were discounted relative to SS bales. From a hay producer’s perspective, price premiums could be garnered from SS or MS bales. The potential development of supply of SS and MS bales of hay is quite great. Many smaller dairy farms exiting the dairy industry have the bale equipment necessary to make SS and MS bales.

LR and MR bales were discounted more than LS bales. This may have more to do with the shape of the bale rather than the size. Fewer tons of round bales can be loaded on a transport because they cannot be stacked as tightly as square bales.

Price flexibility shows the percentage change in price given a percentage change in a continuous characteristic from its mean. The price flexibility for RFV was 0.12, indicating that a 1% increase in RFV would raise price by 0.12%. While this impact may seem small, a 1% increase in RFV from the mean of 146 is only a 1.6-point increase to 147.6. A 1% change in moisture has a relatively small impact on price, $-0.015%$.

The price flexibility for discrete variables is the percentage change in price due to the presence of a characteristic relative to its absence. Price flexibilities for subsequent cuttings were relatively small with second cutting at 0.04% and third cutting at 0.01%. RFV had a greater impact on price than the subjective quality measures of cutting.

Bale type and size has a greater impact on hay price than does quality. LR and MR bales reduced the hay price by 0.16% and LS bales lowered the price by 0.14%. From a seller’s perspective, LR and MR bales and LS bales negatively
impact price to a greater degree than quality positively impacts it, indicating that attention needs to be paid to how hay is packaged. An acceptable nutritive bundle could be available in large bales at a lower price.

Conclusions

Structural change in the dairy industry has encouraged the emergence of a market for dairy-quality hay. Farmers who exited the dairy industry may be in a position to produce quality hay for a growing market. Dairy farmers who purchase hay are interested in a high-quality product packaged to fit their feeding systems. A hedonic pricing model was used to assess the implicit prices of various hay quality and bale characteristics.

The results provide several lessons to hay sellers. First, the implicit value of RFV indicates that even relatively small improvements in RFV can significantly impact hay price. Given that subsequent cuttings had positive marginal values, hay producers might attempt to ensile first cuttings and make hay from subsequent cutting to capture premiums associated with later cuttings. From a practical standpoint, it could be a risk management strategy as the timing of first cutting is more critical and the probability of rain is higher, especially in the Upper Midwest.

Internet hay auctions can benefit from this research as well. Currently, internet hay auctions provide a mechanism for buyers and sellers to connect and complete a transaction. A minimal amount of information is given regarding the quality of hay being offered for sale on internet hay auction sites. Given the premiums associated with cuttings and RFV, sellers would benefit from including cutting information. The inclusion of the objective quality measure of RFV could result in price premiums.

Endnotes

1 There were seven observations of small round bales sold in the data set. The model was run with the small round bales included, and neither the fit of the model nor the parameter estimates changed significantly. R^2 with round bales included in the model was 0.58.
2 The a linear model was estimated with similar results to the semi-log model.

References


