INTRODUCTION

Dairy expansion presents many complex problems to which the answers are not easily found. Inclusion of a Dairy Expansion Decision Support System (DE-DSS) is essential to minimize risk exposure throughout an expansion phase. The DE-DSS is a Markov chain simulation model designed to forecast herd structure and production at a future point in time. When coupled with economic figures, the DE-DSS becomes a robust risk management tool configured specifically for on-farm applications. Forecasts provide vital information needed to properly design facilities/housing, monitor cash flows, and successfully conduct what if analyses under a wide variety of herd management and economic conditions.

OBJECTIVES

- Develop a user-friendly stochastic decision support system tool for risk management in dairy production and expansion.
- Address dairy producer information needs during periods of growth.

MATERIALS AND METHODS

- Four herd growth strategies were evaluated in which the total number of cows grew from 150 to ~300 over a period of 31 months to simulate an expansion phase.
- Outputs for key herd parameters were tracked for a total 54 months (2008 to 2012) to evaluate long-term scenario performance.
- Outputs were generated using a Markov chain simulation model created in Microsoft Excel®.
- Economic considerations were generated from 2003-2008 mean market price levels for culling, milk production, feed intake, and labor requirements. Additional analysis was conducted using +/- 10% of mean price levels to simulate price fluctuation.
- Comparison of Income over Variable Cost (IOVC) between scenarios was conducted using Present Value equation with 5% discount rate.

RESULTS

- Of the scenarios evaluated, the optimal heifer purchasing strategy appears to include purchase of all heifers at the beginning of the expansion phase.
- Regardless of price levels, Scenario #3 provided the highest Income over Variable Expenses.
- The DE-DSS can be readily applied to dairy production settings and empower producers with greater information to aid in complex decision making.

CONCLUSIONS

Table 1. Economic assumptions used in support of DE-DSS evaluation.

<table>
<thead>
<tr>
<th>Segment</th>
<th>Description</th>
<th>Mean Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culling</td>
<td>Cow Cull Rate</td>
<td>38.3%</td>
</tr>
<tr>
<td></td>
<td>Young Stock Cull Rate</td>
<td>12.0%</td>
</tr>
<tr>
<td>Milk</td>
<td>Production Level</td>
<td>76.02 lbs/cow/day</td>
</tr>
<tr>
<td>Feed</td>
<td>Avg. Dry Matter Intake</td>
<td>54.3 lbs/cow/day</td>
</tr>
<tr>
<td></td>
<td>Replicas</td>
<td>9 mo Pregnant at Arrival</td>
</tr>
<tr>
<td>Labor</td>
<td>Full-Time Equivalent</td>
<td>2,860 hrs</td>
</tr>
</tbody>
</table>

Table 2. Movement of animals through the herd structure forecast model. For example, the cell labeled “9,4” denotes all cows that are 8 months in milk and 4 months pregnant.

Table 3. Replacement heifer purchasing schedule and total number of replacements purchased for each scenario evaluated with the DE-DSS.

Key Equations

I.  \[ C_{i,p} = C_r \left( 1 + \frac{r}{100} \right)^{t-i} \]

II. Milk Income = \[ \sum_{i=1}^{12} C_{i,p} \left( \text{Milk Production} \times \text{Milk Price} \right) \]

III. Total Income = \[ \sum_{i=1}^{12} \left( \text{Milk Income} + \text{Voluntary Cull Income} \right) \]

IV. Total Cost = \[ \sum_{i=1}^{12} \left( \text{Dry Cost} + \text{Feed Cost} + \text{Labor Cost} \right) \]

Net Present Value = \[ \sum_{i=1}^{12} \left( \frac{\text{Total Income} - \text{Total Cost}}{(1 + r)^t} \right) \]

Where j = month, r = discount rate, t = number of periods

Figure 1. Snapshot of herd structure for each scenario at end of month 54.

Figure 2. Income over Variable Expenses for each scenario.

Figure 3. Comparison of Income over Variable Expenses at High, Low, and Medium price levels.

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<table>
<thead>
<tr>
<th>Scenario</th>
<th>Purchasing Months</th>
<th>Total Replacements Purchased</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,8,13,18,23,27</td>
<td>108</td>
</tr>
<tr>
<td>2</td>
<td>1,2,29,30</td>
<td>87</td>
</tr>
<tr>
<td>3</td>
<td>1,2</td>
<td>98</td>
</tr>
<tr>
<td>4</td>
<td>29,30</td>
<td>77</td>
</tr>
</tbody>
</table>

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