Agricultural greenhouse gas emission (GHG) contributes 8.1% of the total U.S. emissions (EPA, 2014)

Dairy industry contributes 4% to the global GHG emissions (FAO, 2010)

Livestock enteric fermentation and manure methane emission accounted for 34.4% of total anthropogenic CH$_4$ emission (EPA, 2014)
A major goal for dairy cattle farming is to reduce GHG emissions meanwhile increase or keep the farm profit.

Animal performance influences the GHG in dairy farms, including productions and replacement decisions (Crosson, 2011).
Mitigation strategies could affect differently on different farm types (Dutreuil et al., 2014)

- Reducing GHG emission could maintain the profit
- Estimate the environmental and economic effects of milk production and herd structure on a typical Wisconsin dairy farm
- Integrated farm system model (IFSM, version 4.0, USDA, 2013)

- Applied to crop growth, feed storage, machinery usage, and herd management to simulate integrated whole farm performance

- 25-yr daily weather data used in crop growth, tillage, harvest, feed storage, and manure handling modules

- Each year calculated separately, no carry-over effect
Farm located in Dane County, WI

100 milking cows, no replacement heifers on farm

100 ha rented cropland, 43 ha of alfalfa, and 57 ha of corn

Economics parameters

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk price</td>
<td>$ 0.40 per kg</td>
</tr>
<tr>
<td>Slaughter price</td>
<td>$1.21 per kg</td>
</tr>
<tr>
<td>Replacement heifer price</td>
<td>$1500 per cow</td>
</tr>
<tr>
<td>Calf price</td>
<td>$ 150 per calf</td>
</tr>
</tbody>
</table>
- Target milk production

- The model optimized the feed allocation to push the actual milk production to approach the target milk production

- Change from 9,979 to 11,743 kg per cow per year by 279 kg interval
- First lactation cow percent

- Proportion of cows in first lactation

- Representing the culling and replacement decisions

- Change from 15% to 45% by 5% interval
- Farm produced feed
- Energy corrected milk production (4.0% fat, 3.3% protein)
- Net return on management
  - Cost and revenue
- Equivalent CO₂
<table>
<thead>
<tr>
<th>Feed category</th>
<th>Mean ± SD, ton DM</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-quality hay</td>
<td>48 ± 31</td>
</tr>
<tr>
<td>Low-quality hay</td>
<td>16 ± 26</td>
</tr>
<tr>
<td>High-quality silage</td>
<td>273 ± 48</td>
</tr>
<tr>
<td>Grain crop silage</td>
<td>269 ± 2</td>
</tr>
<tr>
<td>High-moisture grain</td>
<td>191 ± 64</td>
</tr>
<tr>
<td>Dry grain</td>
<td>11 ± 24</td>
</tr>
<tr>
<td>Forage</td>
<td>223 ± 65</td>
</tr>
</tbody>
</table>
Energy-corrected milk production (kg, per cow per year)

Target milk production (kg, per cow per year)

- 15%
- 20%
- 25%
- 30%
- 35%
- 40%
- 45%
Equivalent CO₂ emissions (kg eq CO₂ per kg ECM)

Target milk production (kg, per cow per year)

- 25%
- 20%
- 15%
- 30%
- 35%
- 40%
- 45%
- Production levels and culling decisions could impact on the farm profit and greenhouse gas emissions

- High production and less culling could increase the farm profit meanwhile decrease the greenhouse gas emissions

- Greenhouse gas mitigation strategies could increase the profit at same time
Questions?
Effect of target milk production and first lactation cow percent interact on net return on greenhouse gas emission
Effect of target milk production and first lactation cow percent interact on net return on management.
Energy corrected milk production vs. Target milk production

- Energy corrected milk production: 9,000 kg per cow per year
- Target milk production: 9,200 kg per cow per year

- 15%: 10,206 kg per cow per year
- 20%: 10,433 kg per cow per year
- 25%: 10,659 kg per cow per year
- 30%: 10,886 kg per cow per year
- 35%: 11,113 kg per cow per year
- 40%: 11,340 kg per cow per year
- 45%: 11,567 kg per cow per year

Target milk production (kg per cow per year):
- 9,979 kg
- 10,206 kg
- 10,433 kg
- 10,659 kg
- 10,886 kg
- 11,113 kg
- 11,340 kg
- 11,567 kg
- 11,793 kg