Enhancing Farming System Environmental & Economic Performance in the Pleasant Valley Watershed

New Farming Systems Approach: Balancing Environmental Gains with Improved Farm Profitability

Our new triple bottom line—environment, society, profitability—conservation approach is designed to improve water quality, environmental performance, and economic performance. Traditional conservation practices are still important, but we are now taking conservation to the next level by fine-tuning these traditional practices, adding new and evolving technologies, and optimizing the management of whole farming systems.

Process

In order to be successful at implementing a triple bottom line, whole farming systems approach, we must follow new management protocols:

1. Inventory current farming system, farmer objectives and constraints.
2. Estimate current soil and phosphorus losses using Snap-Plus software, and identify problem areas for remediation.
3. Identify a team of key farm system consultants.
4. Identify potential farm management options to improve economic and environmental performance.
5. Evaluate environmental impacts of identified alternatives using Snap-Plus.
7. Determine best economic/environmental alternatives with optimization model.
8. Use dynamic feedback decision process with producers to verify feasibility of best options.

Key Players
Many more professionals are necessary to ensure that the implemented practices improve both environmental performance and profitability. These professionals represent all areas of the farm’s management and all areas of the conservation service staff. All of the following collaborators take an active role in making profitable and productive environmental decisions:

- Farmers.
- Natural Resource Conservation Service district conservationists.
- County conservation staff.
- University of Wisconsin Extension local agents and specialists in:
  - Dairy/livestock: rations, breeding, etc.
  - Soil, nutrient, and water management.
  - Agronomy: rotations, tillage, varieties, etc.
  - Farm management: economic/environmental.
- Certified Crop Advisers and agronomists.
- Other private farm consultants.

Complimentary Farming System Practices:
Combined these new and traditional management practices can affect more than crop production and may provide opportunities to improve the whole farming system:

- No-till/strip-till/minimum tillage.
- Seeding with a companion crop.
- Grass with alfalfa versus pure alfalfa hay/silage.
- Increasing hay acres relative to corn silage acres in rotation.
- Shortened rotations.
- Manure management (storage, application) options.
- Manure separation technologies.
- Cover crops: forage or green manure.
- Precision agriculture.
- On-farm research: replicated/ randomized treatments and control at site/management specific field scale.
A full inventory of the Pleasant Valley watershed was completed to identify farm fields which had proportionately higher levels of soil and phosphorous runoff losses. These fields were then targeted for management changes to reduce soil and phosphorus losses. Several representative farms containing these higher losses were selected as case studies for intensive whole farm systems analysis.

Snap-Plus simulation results indicate that incremental changes to the cropping system can generate large improvements in environmental performance, as shown in the table below. Farming systems changes in the Optimal rotation reduce soil and phosphorus losses by 87% and 71%, respectively.

The Optimal rotation:
- Adds a winter rye forage/cover crop after the no-till corn crops.
- Changes the 2nd year corn silage to corn grain for more crop residue.
- Drops one year from the alfalfa/grass hay portion of the rotation to offset the loss of the 2nd year corn silage, hence shortening the rotation from 7 to 6 years.

These cropping systems changes have economic and management effects across the whole farming system. It is important to recognize that these proposed changes to the farming system need to be consistent with the farmer’s objectives, constraints and preferences if they are to be adopted. In other words are they feasible in for their farming system, and do they improve or reduce farm profitability?

<table>
<thead>
<tr>
<th>Changing the Original 7-year Rotation: 3 years fall chisel-plowed corn silage, fall chisel-plowed pure alfalfa seeding and 3 years established alfalfa to:</th>
<th>Soil Loss</th>
<th>Runoff Phosphorus Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till corn silage</td>
<td>-51%</td>
<td>-43%</td>
</tr>
<tr>
<td>No-till corn silage, add grass to alfalfa hay seeding</td>
<td>-72%</td>
<td>-57%</td>
</tr>
<tr>
<td>Optimal Rotation</td>
<td>-87%</td>
<td>-71%</td>
</tr>
</tbody>
</table>

1 Soil loss was calculated for a particular field in Snap-Plus using the RUSLE2 erosion model. Calculated soil loss reductions with these management changes will vary by field soil and slope.

2 Phosphorus Loss was calculated in Snap-Plus using the Wisconsin P Index. Calculated runoff phosphorus loss reductions with these management changes will vary by soil, slope and soil test phosphorus concentrations.

3 Optimal Rotation: No-till corn silage to winter rye for forage-corn grain-no-till corn silage followed by winter rye, alfalfa-grass seeded into winter rye in following spring, 2 years established alfalfa-grass hay (6-year rotation).

Farming System Issues:
As farmers implement these new practices, management changes may be needed in several of the farm’s enterprises. This may create new types of management issues such as:
- Additional management requirements for new enterprises such as cover crops.
- Additional labor and machinery requirements for planting and harvest under new farming system.
- Changes to dairy and livestock rations.
- Changes in annual forage and grain production.
- Questions on varieties and seeding mixtures, harvest timing, and labor/machinery availability associated with these new crop enterprises.

We are now using a whole farm approach to management which address both economic and environmental performance. This complicates decision-making, but is generally how farmers handle decisions for the multiple enterprises on their farms.
Economic and Environmental, Cost Benefit Analysis: Identify potential “win/win” alternatives.

Adding grass to alfalfa hay is one way to decrease soil loss potential in a rotation. Working with UW-Extension agronomist/forage specialist Dan Undersander and dairy nutrition specialist Randy Shaver provides state-of-the-art research to address the whole farm management issues with this change. Results in the table below show that it can create a “win/win” situation for farm profitability and environmental performance.

- Milk production, composition, and quality can be maintained at a reduced feed cost.
- Purchased feed cost reductions range from 4.0% to 11.1% varying with ration proportions.

The ration that provides the most profitability for each farm will depend on the forage yield of each system. As yields rise for a particular crop, the economic benefit may trend toward that crop. Changes to annual total forage production and composition will need to be considered, to make sure the adopted farming system will have enough forage quantity/quality to meet livestock needs. The availability of labor, machinery, storage, and management also needs consideration to ensure the change to the farming system is realistic and profitable.

### Lactating dairy cow diet simulations: varying proportions of corn and hay crop silage with mixtures of alfalfa and grass silage.

<table>
<thead>
<tr>
<th>Corn Silage to Hay Crop Silage Ratio</th>
<th>Alfalfa Silage to Grass Silage Ratio</th>
<th>Purchased Feed Cost ($/cow/d)</th>
<th>% Change Relative to Corresponding 75:25 Hay Crop Silage Ration</th>
</tr>
</thead>
<tbody>
<tr>
<td>25:75</td>
<td>100:0</td>
<td>$2.79</td>
<td>-11.1%</td>
</tr>
<tr>
<td></td>
<td>50:50</td>
<td>$2.95</td>
<td>-7.1%</td>
</tr>
<tr>
<td></td>
<td>0:100</td>
<td>$3.11</td>
<td>-4.0%</td>
</tr>
<tr>
<td>50:50</td>
<td>100:0</td>
<td>$2.94</td>
<td>-7.4%</td>
</tr>
<tr>
<td></td>
<td>50:50</td>
<td>$2.94</td>
<td>-7.4%</td>
</tr>
<tr>
<td></td>
<td>0:100</td>
<td>$3.04</td>
<td>-7.1%</td>
</tr>
<tr>
<td>75:25</td>
<td>100:0</td>
<td>$3.21</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>50:50</td>
<td>$3.25</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>0:100</td>
<td>$3.32</td>
<td>--</td>
</tr>
</tbody>
</table>

1. Proportions of forage DM from corn silage or hay crop silage. Assumed corn silage composition of 8.5% CP & 45% NDF (DM basis) & 60% ivNDFD (% of NDF).
2. Proportions of hay crop silage DM from alfalfa silage or grass silage. Assumed 100%-alfalfa silage composition of 21% CP, 40% NDF, & 1.5% Ca (DM basis) & 50% ivNDFD (% of NDF). Assumed 100%-grass silage composition of 16% CP, 55% NDF, and 0.60% Ca (DM basis) & 60% ivNDFD (% of NDF).
3. Dry matter intake (DMI); assumed that the greater ivNDFD assigned corn silage & grass silage relative to alfalfa silage allowed for similar DMI with increasing diet NDF from forage and total NDF concentrations. Gray shading indicates that DMI, and hence estimated allowable milk yields, may be reduced by feeding 26% NDF from forage diets; research is needed with these types of diets.

The Whole Farming System Economic and Environmental Optimization approach identifies a range of new farming system options and shows their likely economic and environmental impacts across the whole farming system. An active dialogue with the farm management as to their objectives, constraints, and preferences is very important to make sure the options picked will be manageable on their farming operation.

### Contacts:

If you have questions about this new approach to improving environmental and economic performance please feel free to contact us:

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