Dairy Stewardship Alliance

Sustainability Indicators for Dairy Farms

University of Vermont - Center for Sustainable Agriculture
Summer 2008

Sustainable indicators resulting from farmer self assessments completed 2005 through 2007.
A joint project with Center for Sustainable Agriculture at the University of Vermont, St. Alban's Cooperative Creamery, Ben & Jerry's Homemade, inc., Vermont Farmers, University of Vermont Extension, Vermont Agency of Agriculture, Food and Markets with funding from USDA - Sustainable Agriculture Research and Education.
June, 2008 Compiled and Edited by A. Matthews, C. Cooper, and N. Purchase

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2 Abstract

Sustainable dairy farming practices enhance the natural environment and herd health while supporting profitability and improving the quality of life for farmers, their families and their communities. The Dairy Stewardship Alliance's research on sustainability indicators is a collaborative effort with the Center for Sustainable Agriculture at the University of Vermont, Ben & Jerry's Inc., the St. Albans Cooperative Creamery, University of Vermont Extension and the VT Agency of Agriculture.

Together, we have been developing and researching a self-assessment for sustainability indicators for dairy farmers which promote a broader use of sustainable agriculture practices.

The Alliance provides direct support for farmers to help them develop a better understanding of their production practices, to explore alternatives and to implement changes to improve the sustainability of their farm operations.

A partnership among a farmers' dairy cooperative, University Extension, and private industry supports dairy farmers as they adopt sustainable practices. The DSA Team provides all farmers with a self-assessment tool and offers feedback to clarify with them the areas where technical assistance is needed, agricultural regulatory assistance and help with the implementation of state and federal accepted practices.

Performance target:

Of 520 farms in the dairy co-op, 10% will participate in the Dairy Stewardship Sustainability Indicators research and 40 farms will implement at least 2 new identified sustainable production practices.

Expected Outcomes:

1. Farmers complete a self assessment of sustainability indicators for ten modules of sustainable dairy practices, receive summary reports and identify additional sustainable practices to implement.

2. During this research, 76% of participating farms improve sustainable farming practices and utilize the self assessment to guide them in meeting Accepted Agricultural Practices (AAPs) and Concentrated Animal Farm Operation (LFO/ MFO) certification requirements.

3. The Dairy Stewardship Alliance and University Extension will identify future areas for technical assistance as identified through the research summary results.

4. The final edited version of the Dairy Stewardship Sustainability Indicators is published and distributed with recommendations for on-going development and application throughout the Northeast Region.

2.1 Needs and Challenges

The Dairy Stewardship Alliance helps farmers to conduct a careful analysis of their production practices as they move toward greater stewardship in the areas of water quality, soil, pest and nutrient management; biodiversity, and animal husbandry. The farms also assess their financial stability, energy efficiency and community interactions.

The Alliance has identified a set of sustainability indicators and begun to work to test and refine the assessment with an original group of 52 farmers who voluntarily agreed to be a part of the research. Prior to a second assessment, these farms each will identify and implement changes. These farms are moving forward to complete the post-test assessment which will indicate areas of change and needs for further technical assistance.

We have now reached the point that we are ready to expand the scope of the self assessment beyond our original partnership, and make it more readily available to ALL Vermont dairy farmers. The Alliance has gained a great deal of interest and momentum. We plan to eventually expand the availability throughout the Northeast.

Originally conceived as a hard copy set of ten modules, the 90 page manual is extremely costly to reproduce and to assess results. If additional funds can be identified, we are ready to move forward to develop an on-line version of the sustainability indicators as an electronic on-line self-assessment that can be completed and submitted electronically.

2.2 Objectives/ Performance targets

2.2.1 Performance Target:

Of 520 farms in the dairy co-op, 52 will participate in the Dairy Stewardship Self Assessment and 40 (76%) of these will each improve at least two identified sustainable production practices in the areas of animal husbandry, biodiversity, community health, energy efficiency, farm financials, nutrient management, organic practices, pest management, soil health management, and water management.

After the first 20 months, the Alliance has identified 57 farms who volunteered to complete the assessment. These farms are all involved at different stages of our process, with 40 actually involved in completing the assessment a second time after having implemented changes to increase stewardship practices on their farms within the final year of the research.

2.3 Accomplishments

2.3.1 Milestones

- The DSA was originally partnering with St. Alban's Co-op and its 520 members. Participation has expanded to farmers from two other regional dairy co-ops; Agri-Mark and Organic Valley. The treasurer of St. Alban's Coop Board of Directors participated in the research. Four farmers now serve on our advisory board. In addition to widely publicized announcements about the results of the sustainability indicators, articles about the farmer exchange of (36 participants) to The Netherlands appeared in dairy and farming trade/industry magazines and regional newspapers.

- Initially, the goal was to identify 10% of the St. Alban's Co-op 520 farms for participation in this research by Extension, USDA Natural Resource Conservation Service, Vermont Pasture Network, University of Vermont Extension, Vermont's Agency of Agriculture and by other farmers.
- As of 12/3/07, 57 farmers have enrolled to complete the assessment, which already exceeds our final goal. The original 12 farms served as a group of advisors who helped to edit the text of the manuals. In late 2008, we will complete the final editing of the manual for sustainability indicators, which will then be tested with a final group of farmers.
- The final goal of this research is to have the Self Assessment for Sustainability Indicators pre- and post-assessments completed by 40 farms for planning and decision making concerning new sustainable practices to implement and to identify technical assistance needs.
- We continue to collect edits for the modules in order to make the modules more farmer friendly and to standardize results. Our target is to have 76% of the farms who complete the assessment move forward to identify sustainable practices that they can implement on their farms and complete the assessment a second time after their changes have been made.
- The Annual report for 2007 which documents the sustainable indicators and changes implemented for all farms is available at www.uvm.edu/sustainableagriculture in their publications section.

2.3.2 Impacts - Dairy Stewardship Alliance

Farmers and advisors involved in the Alliance assessments have made at least 30 educational presentations on the value of this experience to a wide variety of farm and community groups, and many have written numerous articles on the Alliance. (Sample article is attached in Appendix 6.4)

- After the first 20 months of this three year research project, 57 farmers have applied to complete baseline assessments of their Indicators for Sustainability for all modules of their dairy farming practices. 46% of these farms have already received summary reports of their 2nd assessments and identified sustainable practices to implement. During this period, farmers identified sustainable farming practices to improve in the next phase and utilized the self-assessment to guide them in meeting the state required Accepted Animal Practices (AAPs) and Large Farm Operations(LFO)/ Medium Farm Operations(MFO) certification requirements.
- Through farmer input, the Dairy Stewardship Alliance identified biodiversity, energy enhancement, water quality and farm safety as the most immediate areas for needed technical assistance in order to increase their sustainability practices. The modules are being edited into the final edited version of the Sustainability Indicators Self Assessment. Our intent is to presnet our findings and recommendations in a New England Dairy Stewardship Forum to be held in early 2009.
- We continue partnering with Wageningen University and their "Caring Dairy" project in the Netherlands, who are also developing "Sustainability Indicators" for dairy farms, as a sister project with Ben & Jerry's – Holland and CONO Coop, makers of Beemster Cheese.

- Of special interest is that most recently, 12 University of Vermont students within the College of Agriculture and Life Sciences have completed the assessments for their own family farms.

3 Summary

3.1 Background

In 2003, Ben & Jerry's joined forces with the University of Vermont's Center for Sustainable Agriculture and the St. Albans Cooperative Creamery, Inc. to form the Dairy Stewardship Alliance. The Alliance's primary goals were:

- To provide an on-farm self-assessment of sustainability indicators designed to help dairy farmers measure & evaluate the environmental, social and economic aspects of their farm operations
- To provide information about sustainable indicators for dairy farming practices
- To provide a foundation for further research and development of programs promoting sustainability in agriculture

To date the group's efforts have focused on testing and evaluation of the on-farm self-assessment formally known as the Dairy Farm Sustainability Toolkit (or "Toolkit" for short). Originally developed for Ben & Jerry's by graduate students from the Corporate Environmental Management Program at the University of Michigan, the Toolkit is a comprehensive set of 10 Educational Modules, each corresponding to one of ten key indicators for sustainable dairy farming in Vermont, against which farmers can self-assess their farm management practices and performance over time.

3.2 Purpose

The purposes of this initiative to:

- **Provide an on-farm assessment tool for sustainability indicators for dairy farms**
- **Educate and communicate information on sustainable dairy farming practices**
- **Create a foundation for ongoing work in sustainable agriculture.**

The Dairy Stewardship Alliance's creation of a self-assessment tool helps the farm to assess farm management strategies which include environmental, social and economic goals.

4 Methodology

4.1 Strategy

The self-assessment tool has 10 modules encompassing social, environmental and economic indicators:

ANIMAL HUSBANDRY
NUTRIENT MANAGEMENT
BIODIVERSITY
ORGANIC (included only for informational purposes)
COMMUNITY HEALTH
PEST MANAGEMENT
ENERGY
HEALTH
FARM FINANCIALS
WATER MANAGEMENT

After completing the first assessment, participating farmers each receive a report with detailed charts showing how they scored in each of the different topic areas of the modules. Their first chart shows their individual farm results and the second one presents the overall averages for all farms for each module area. In this way the farmer can see how they've scored in relation to all the other farms completing the self assessment. (See Appendix 6.1)

The scoring is done based on a 'red', 'yellow' and 'green' color coding, in a sort of "traffic light" system where 'green' indicates that sustainable practices are being used. 'Yellow', indicates that some level of sustainable practices are being used, however additional attention could be added to improve them. Finally, a 'red' score shows areas within an evaluation which are in need of improvements to be corrected in order to be more sustainable overall. The organic module is included for informational purposes and there are no specific questions for this area.

Table 4-1 Scoring System for Module Total Scores

Module	Green			Yellow		Red	
	Maximum	High	Low	High	Low	High	Low
Animal Husbandry	41	41	35	34	25	24	9
Biodiversity	26	26	21	20	16	16	6
Community Health	28	28	23	22	19	18	12
Energy	20	20	16	15	13	12	6
Farm Financials	33	33	28	27	20	19	6
Nutrient Management	25	25	21	20	16	15	7
Pest Management	30	30	26	25	18	17	5
Soil Health	24	24	21	20	15	14	6
Water Management	32	32	27	26	20	19	7

4.1 Modules and Topics

Animal Husbandry	
1	Herd Nutrition
2	Overall Health
3	Health Incoming/Outgoing Animals
4	Milk Quality
5	Lactations
6	Housing/Handling Areas
7	Stalls
8	Pasturing
9	Milk Equipment
10	Calf Raising Conditions

Module Topics (Continued)

Biodiversity	
1	Genetic Diversity of Crops
2	Natural Area Conservation
3	Management of Riparian Areas
4	Pasture Management
5	Crop Field Management
6	Adjacent Area Management
7	GMO's
Community Health	
1	Community Relations
2	Documented Labor
3	Child Labor
4	Base Wage
5	Worker Sanitation
6	General Safety
Farm Financials	
1	Current Ratio
2	Equity of Asset Ratio
3	Rate of Return on Farm Assets
4	Term Debt& Capital Ratio
5	Operating Expense Ratio
6	Farm Income
7	Work/Life Balance
8	Attitude To Adopt New Practices
Nutrient Management	
1	Nutrient Management & Records
2	Manure Rates
3	Commercial Fertilizer Rates
4	Manure & Phosphorus Application
5	Nitrogen Fertilizer Application
6	Fertilizer Equipment
7	Phosphorus Supplements
Pest Management	
1	Pest ID
2	Pesticide Selection
3	Timing of Application
4	Weather Conditions
5	Record Keeping
6	Fly Management
7	Weed Management
Soil Health	
1	Soil Organic Matter
2	Use of Cover Crops and Vegetative Areas
3	Crop Rotation
4	Tillage Practices
5	Soil Conservation/Erosion Prevention
6	Soil Quality Monitoring

4.2 Database Methodology

4.2.1 Scalability and Inferential Integrity

Initially, all data was entered into an EXCEL spreadsheet. Reproducing the reports for farmers, and accessing information details proved to be difficult and time consuming. During 2007 all data collected from the Dairy Stewardship Alliance has been migrated into Microsoft Access 2007. This system established a structured data base structure that provided relationships and inferential integrity between different tables (see figure 4.1). This system ensures scalability while maintaining flexibility in the development to meet future growth and complexity requirements.

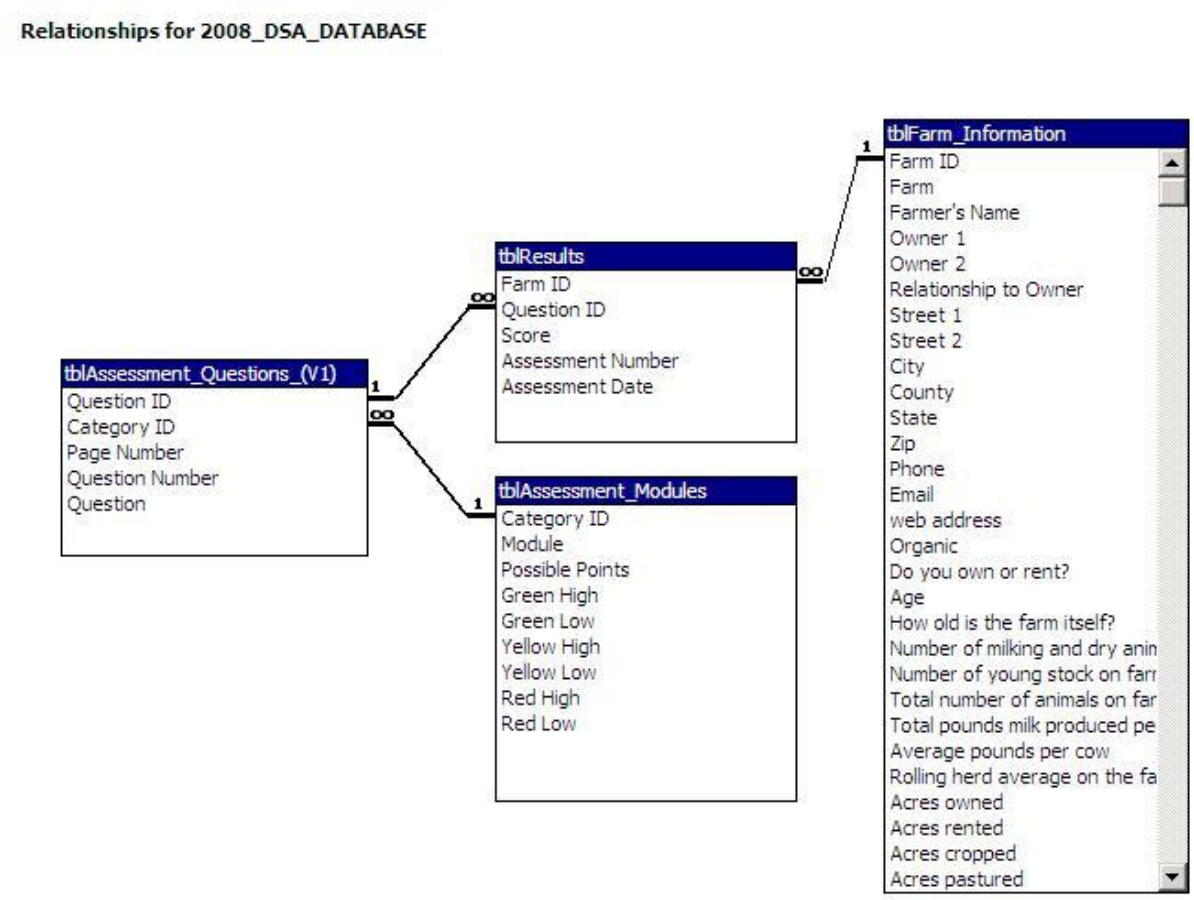


Figure 4-1 Inferential Integrity in the DSA Database

Prior to 2007 all of the data existed in Microsoft Excel. While Excel provides strong presentation and shorter development time, benefits of migration to Microsoft Access include increased performance as the data storage of Access is faster than Excel. In addition data extraction is streamlined through Access reports, integration with Microsoft Excel, or third-party applications such as Crystal Reports. Finally, the migration to Access will give the researchers the ability to upscale to SQL Server for web based data entry, collection and reports.

4.2.2 Transparency of Analytical Processes

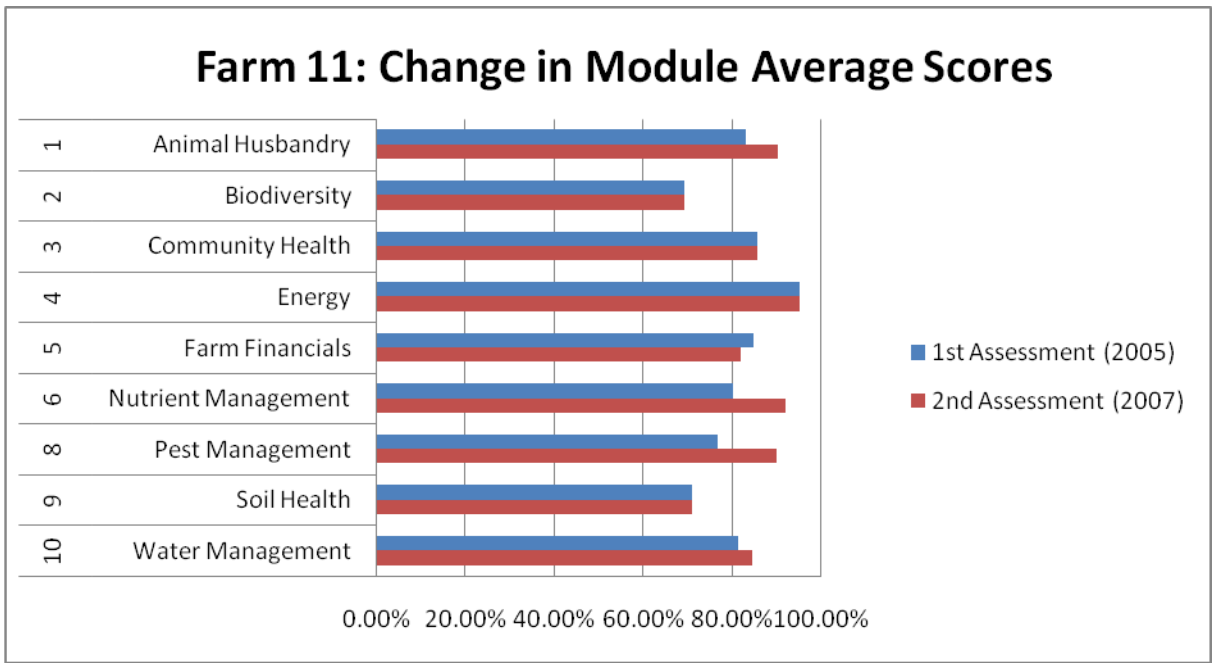
Users can audit the database to see named ranges, formulas, and macros that are creating the interlocking system of calculations, linked cells, and formatted summaries that work together as an intricate system to create a final analysis. This ensures there are no hidden steps in the analysis.

4.2.3 Separation of Data and Presentation

ACCESS separates the analytical data into components: tables, queries, and reports. These components are less sensitive to changes and create an environment where changes to the database can easily be implemented and custom analysis can be created at request without destroying previous analyses.

5 Findings/Results

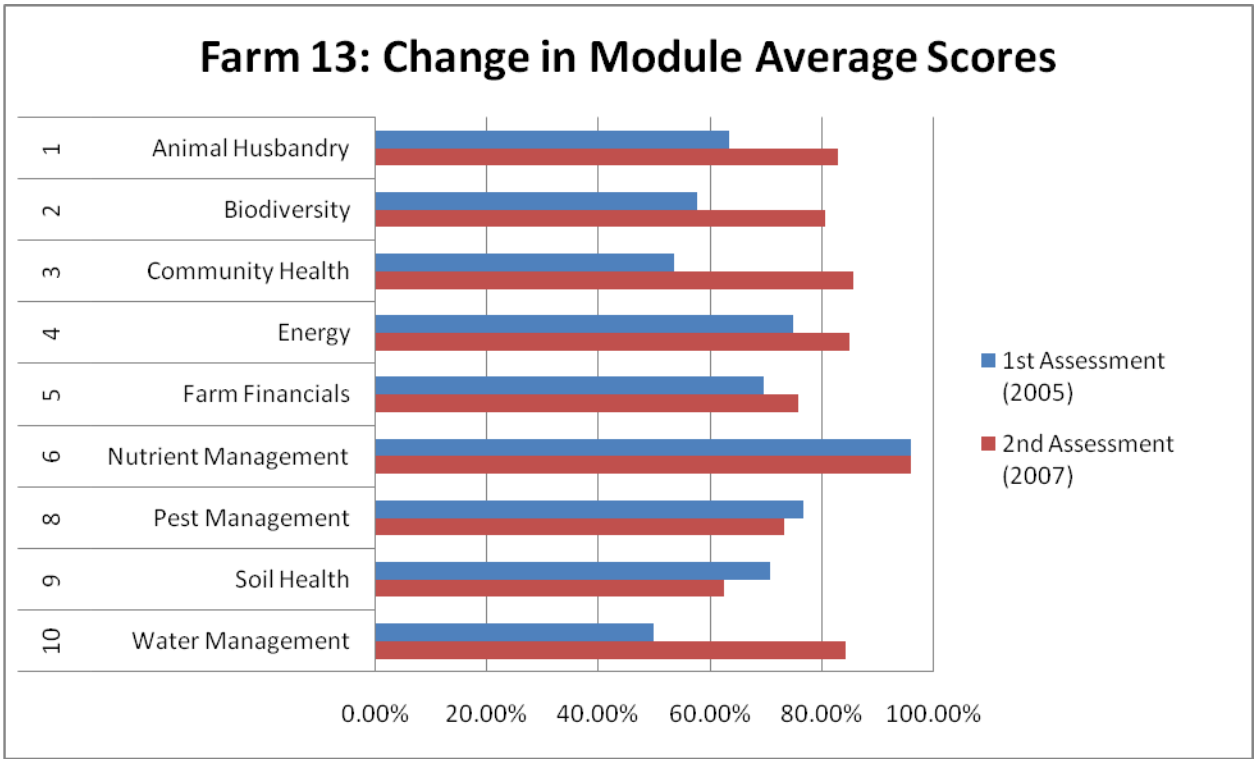
5.1 Farm 11 Charts and Summary



Example of the Comparison of Results from Farm 11

Farm 11 shows marked improvement between the first and second assessments in key areas, and has remained constant in others. Areas of improvement include animal husbandry, as well as nutrient , pest, and water management. Significant strides were made in nutrient and pest management. This shows a focus on trying to improve crop management. While making improvements in several areas, the farm was able to maintain the same level of sustainability in other areas, indicating that the new management practices that employed have smoothly integrated into the whole farm practices and are not so labor intensive that they detract from other areas of the farm. Farm financials was the one area in which this farm scored a lower percentile on the second assessment as compared to the first. There are many possible reasons for this including the drastic drop in milk prices in 2006. Financial indicators are affected by farm management and by the variable economy, and farmers can expect it to fluctuate more than some of the other modules.

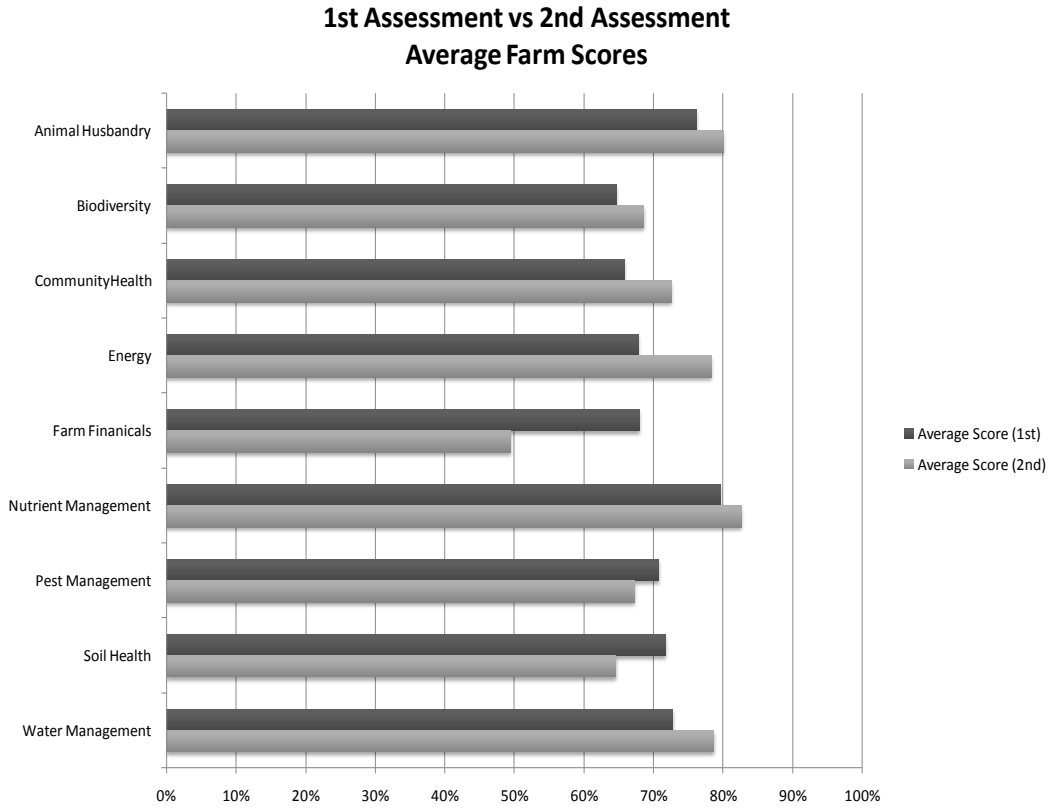
5.2 Farm 13 Charts and Summary



Comparison of Results from Farm 13

Farm 13 really focused and made great progress in many of the areas including scoring 34% higher in water management, 32% higher in community health, and 23% higher in biodiversity. This intense honing of management practices in certain areas took a small toll on other aspects on the farm with both soil health and pest management going down by 3.3% and 8.3% respectively. This may mean that the new practices adopted by the farm are too time consuming, or that implementing them at first proved to be a challenge so that other areas of the farm were not as closely managed as usual. However, the two modules that did go down did not go down that much, so hopefully farm 13 will become more adept at executing a more sustainable management plan. Eventually, they will be able to bring up the other modules to the original level of sustainability, if not higher. Another possibility is that the questions in those modules were unclear so the farmer systematically marked the farm down when unsure which answer category the farms practices fell under.

5.3 1st and 2nd Assessments Charts and Summary



Sustainability Indicators - Comparison of Results for Overall Farm Averages

The overall change for all the farms between the first and second assessment was positive. Energy management went up 9.6% and community health went up 8.4%. However there were some modules that went down. Soil health and pest management both went down by about 3%. Altogether the modules showed 41.8% points of improvement and 5.6% points of regressing, for a net change of 36.2% improvement.

Note: Since we are at a mid-point is this research, the chart above has a different number of farms completing the 1st and 2nd assessment. The final report, due out in 2009, will have adjusted for these differences.

Sustainability Indicators - Comparison of Results for Overall Farm Averages

Interpretation of Results

In the second assessments, on average, farmers scored lower on both the soil health and pest management modules than they had in assessment one. After reviewing the results, there are some trends that can be seen. These trends could be due to certain circumstances affecting farms, primarily the weather, which is unpredictable and tends to affect large numbers of farms in one area. Our experience after interviewing involved farmers, indicated that the lower scores could also be due to problems with the phrasing of the questions in the soil and pest management modules, which are being edited for the final version.

For example, a confinement operation, not growing their own crops, may not respond accurately to the questions in these sections, because some of the questions did not seem applicable to their farm. Or, an organic farm, not using chemical pesticides, may score themselves lower in the pest module, based on their interpretation of the questions. This implies that there was something confusing or different about the question. This trend can be seen in question four of pest management. Not all of the decrease in the total score can be attributed to questioning error, because we see some questions where some farms will score higher, some will score lower, and others will say the same. It is true that the farms who scored lower may have been confused as to what the question was asking; and thus scored themselves lower than they should have.

During the first assessment people from the Dairy Stewardship Alliance were there to help the farmers navigate the questions, and often made personal visits. For the second assessment, without this help, the farmers may not have been sure what answers best fit their farm because of the overall wording. This means that the assessment, or particular modules in the assessment might be poorly phrased and some farms may have found them confusing.

Overall, the farms that participated were able to implement new sustainable measures in certain areas without neglecting other parts of the farm. This is very important because this assessment is only pertinent if it can help farmers not only identify parts of their farms that could become more sustainable but also suggest solutions that are able to be integrated into their overall management. Individual farms seem to be implementing a focused approach to tackling improved sustainability. Whatever area needs the most work, or whatever changes seem the most feasible are made by the participating farm, while the rest of the farm is managed in a similar way as before. This seems to be a very effective and doable method because farmers are able to make significant steps toward sustainability without completely overhauling their farms or becoming burnt out. If farms focus on two or three modules a year then they will be able to make changes at a reasonable pace. Eventually, they can make a full circle and implement additional improvements in the areas of the farms that they tackled first. This makes implementing changes toward sustainability a systematic and successful ongoing process.

6 Appendix

6.1 1st Assessment Report

July 14th, 2006

DAIRY FARM SUSTAINABILITY:

Sustainability Indicators: AN ON-FARM ASSESSMENT TOOL

Dear **name goes here**,

We thank you for your participation in the Dairy Stewardship Alliance's on-farm self assessment. Your input about sustainable farming practices will help guide further programs to promote sustainable agriculture. We appreciate your effort!

We are providing you with a detailed analysis of your individual farm's results and a comparison with overall performance of the other farms involved in your group. You will find a table that reflects your color-coded total scores of each module. The average scores for other farms are provided in similar color coded charts. We hope that this information will assist you in an ongoing process to evaluate the sustainability of your farm as it relates to social, environmental and economic aspects of farming. We'll be back in touch to assist you in completing the toolkit again to compare your scores to the baseline after you've made at least two identified changes to your farming practices.

As you identify areas for making changes in your operation please consult the back section of each module in the toolkit manual for a list of potential resources for assistance. In addition, keep an eye out for upcoming discussion groups and evening sessions on various educational topics to assist you in understanding possible on farm improvements.

We all want to thank you for your time, effort and interest in the project.

Sincerely,

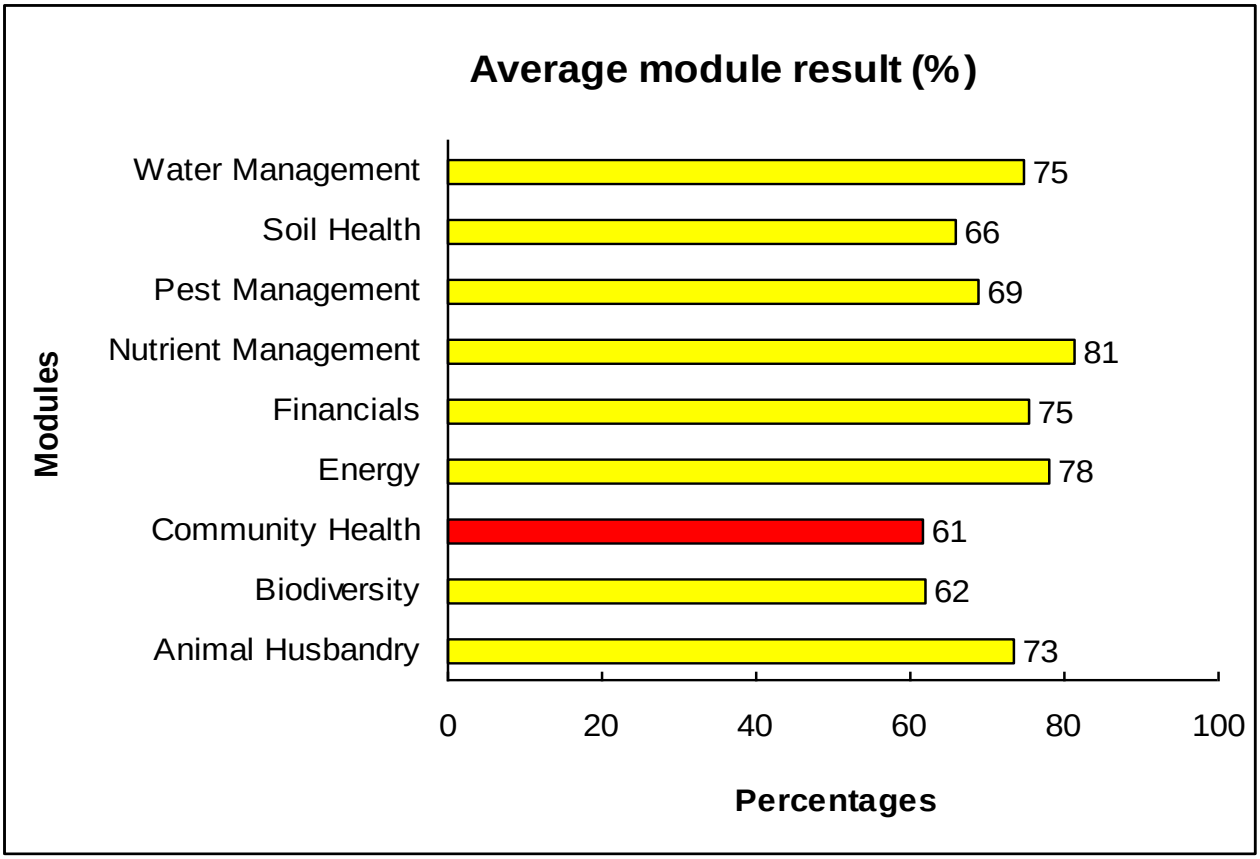
Allen Matthews, UVM Center for Sustainable Agriculture

Andrea Asch, Ben & Jerry's Homemade, Inc

Diane Bothfield, VT Agency of Agriculture

Tom Gates, St. Albans Co-op

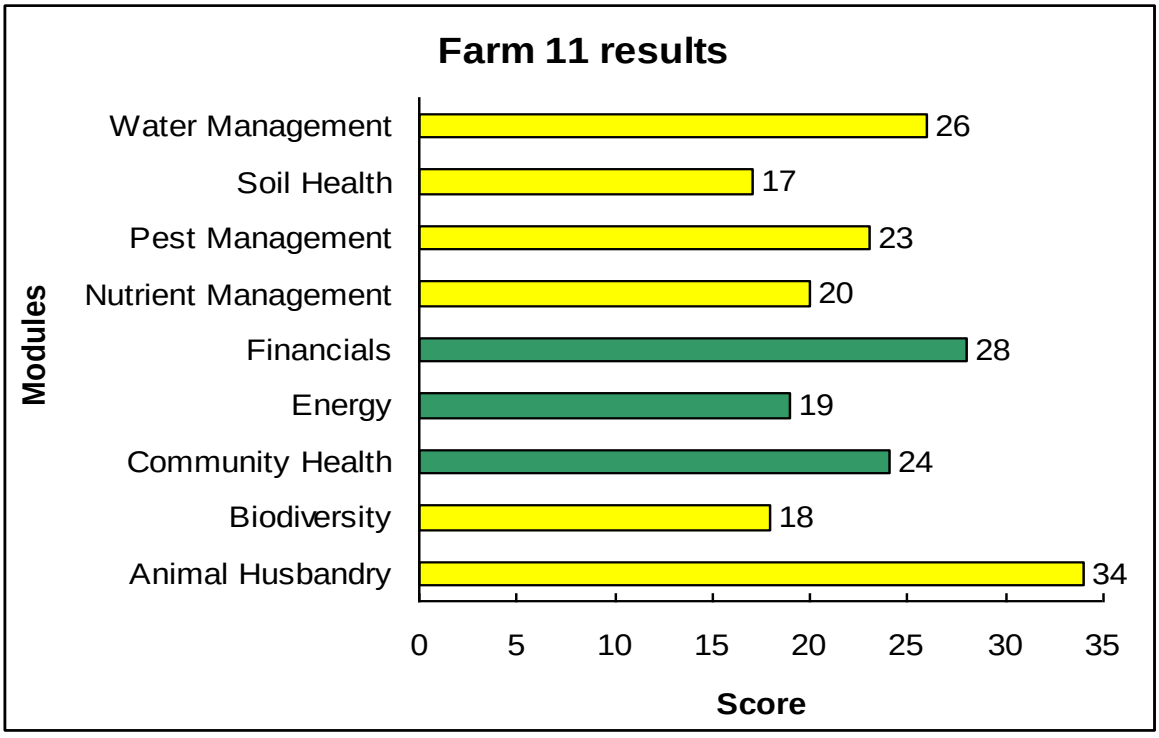
Colleen Leonard, UVM Extension



Overall average scores of each module for all farms represented in percentages

Because of the different number of questions in each module, it provides a clearer comparison when we view the scores for each module by percentage.

For example, the Nutrient Management module, with an average of 81% was the module with the highest overall average score across all farms. However, it is still in the "Yellow" range. To be in the "green Range" the average scores would need to be at least 84% overall.



Participating farmers each receive reports with detailed charts showing how they scored in each of the different topic areas of the modules. The first chart shows their individual farm results and the second one presents the overall-farms average for each topic area. In this way the farmer can see how they've scored in relation to all the other farms completing the self assessment.

6.2 2nd Assessment Report

November 30th, 2007

DAIRY FARM SUSTAINABILITY:

Sustainability Indicators: AN ON-FARM ASSESSMENT TOOL

Dear «Famers_Name»,

We thank you for your participation in the Dairy Stewardship Alliance's on-farm self assessment. Your input about sustainable farming practices will help guide further programs to promote sustainable agriculture. We appreciate your effort!

We are providing you with a detailed analysis in which the tables reflect the color-coded total scores of each module. The first analysis in the report is focused on the average performance of all the farms that have completed their second assessment. This analysis includes a comparison to all the farms having only completed their first assessment. The second analysis is of your farm's second assessment results. This analysis includes a comparison of your second assessment result as it relates to your first assessment results.

We hope this information will assist you in your ongoing process to evaluate the social, environmental, and economic sustainability of your farming operation.

As you identify areas for making changes in your operation please consult the back section of each module in the toolkit manual for a list of potential resources for assistance. In addition, keep an eye out for upcoming discussion groups and evening sessions on various educational topics to assist you in understanding possible on farm improvements.

We all want to thank you for your time, effort and interest in the project.

Sincerely,

Allen Matthews, UVM Center for Sustainable Agriculture

Andrea Asch, Ben & Jerry's Homemade, Inc.

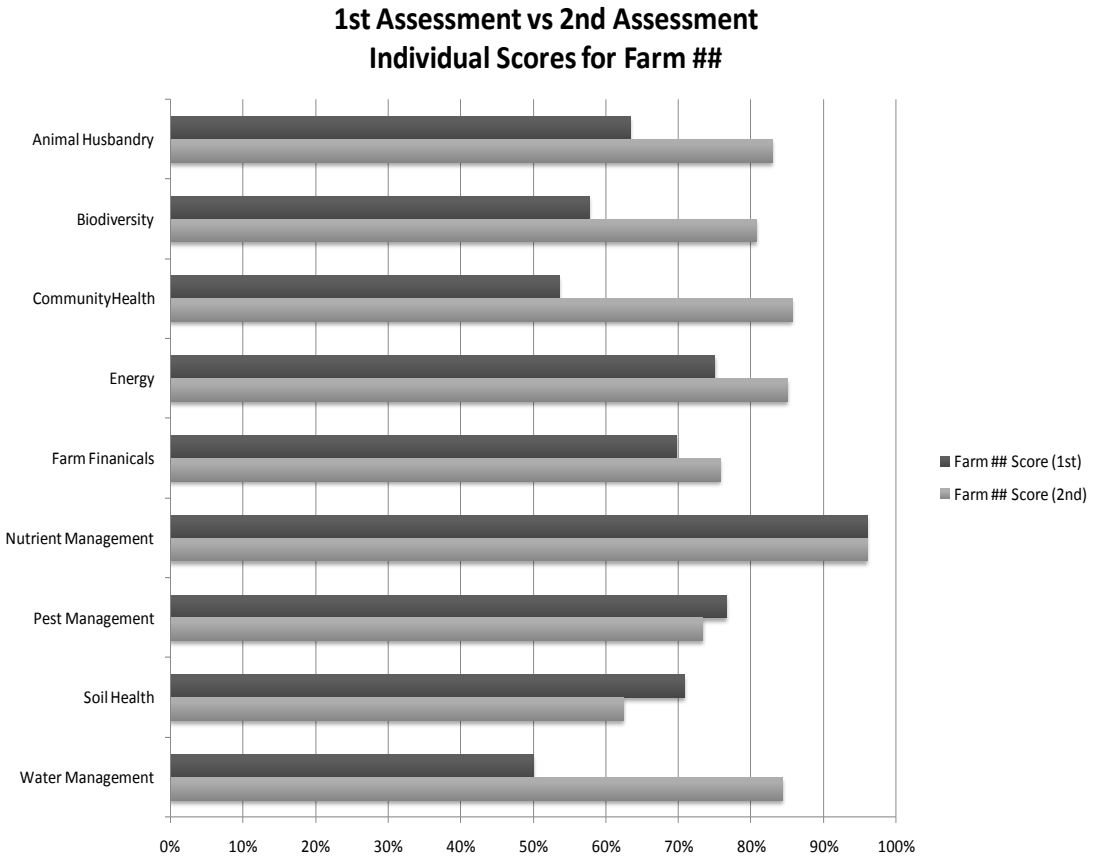
Diane Bothfield, VT Agency of Agriculture

Tom Gates, St. Albans Co-op

Colleen Leonard, UVM Extension

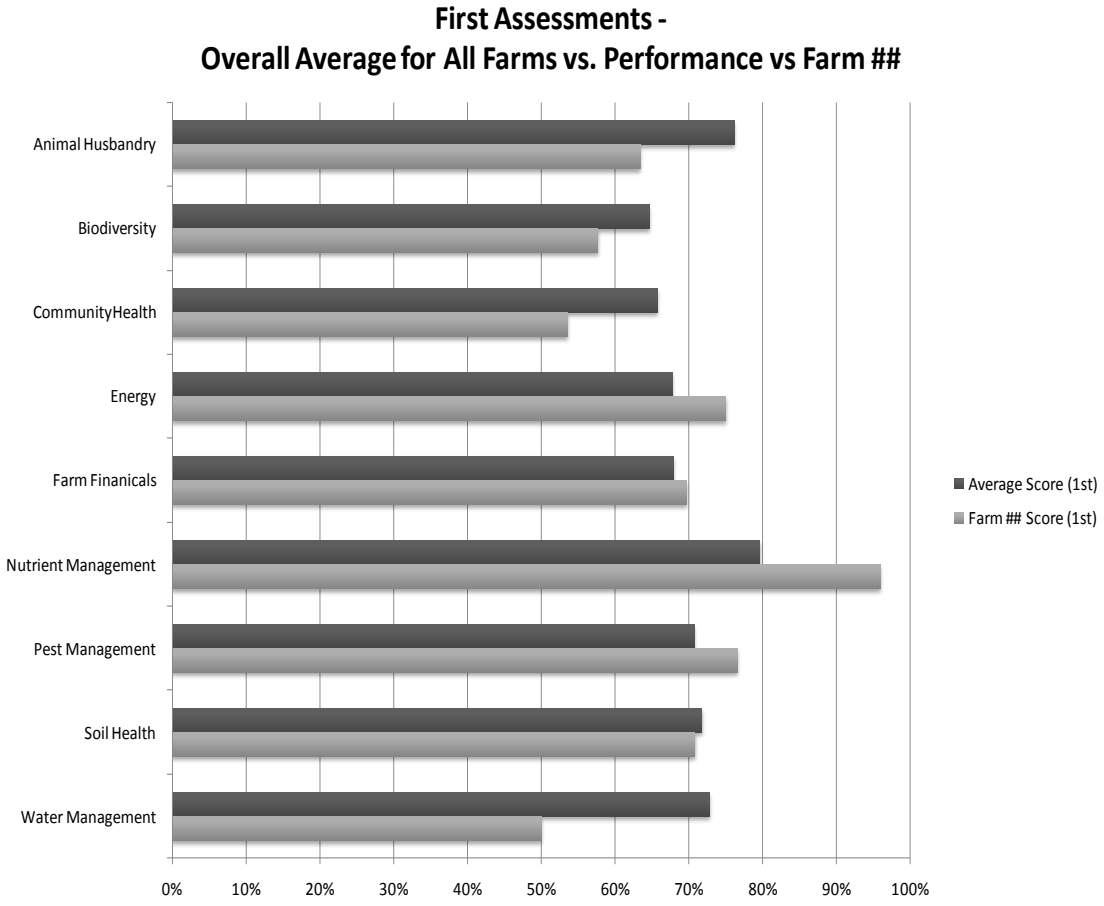
Sample of Results:

Each farm receives a report that compares their sustainability indicator scores between the first and second assessments. Farmer Graph 2.1 allows the farm to compare their own individual scores between the two assessments. Farmer Graph 2.2 and Farmer graph 2.3 will allow the farmer to compare their individual scores to the overall averages of all participating farms.



Farmer Graph 2.1

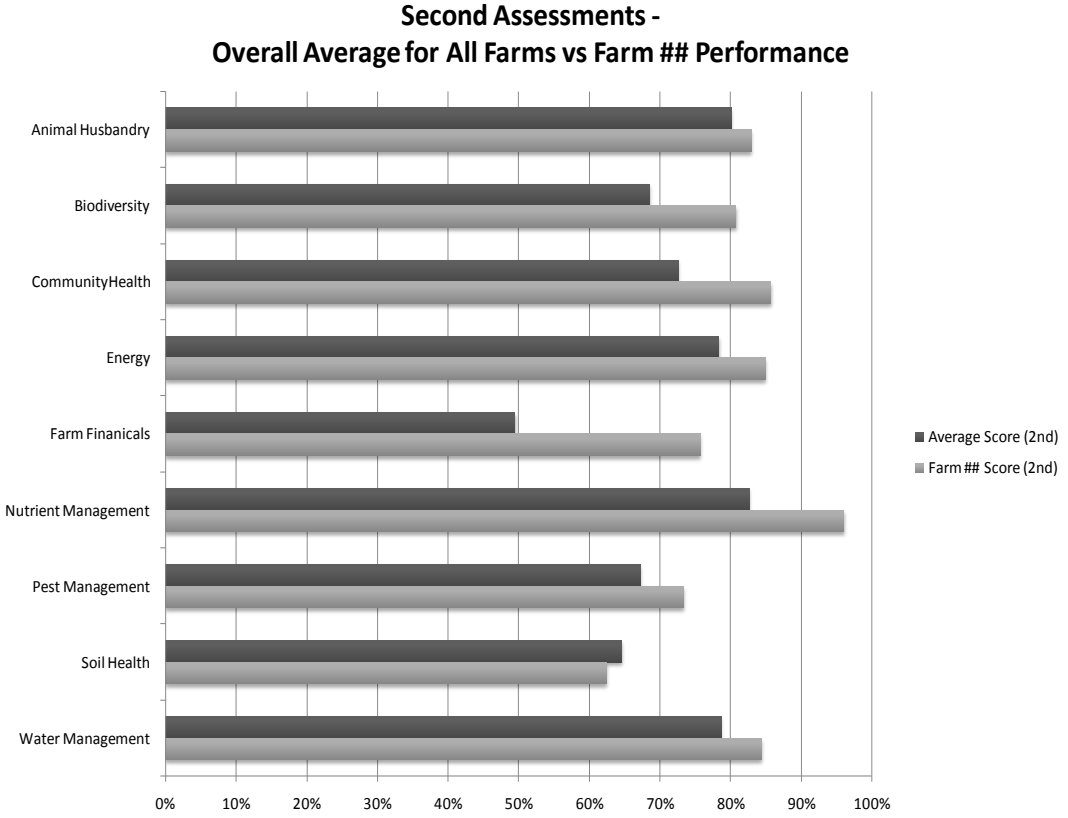
Farmer Graph 2.1 allows the farm to compare their own individual scores between the two assessments, and to recognize where the stewardship practices implemented have increased their sustainability indicators in the various modules. By identifying areas where Farm ## scored the lowest in the first assessment, the farm operation was able to identify modules where they might make improvements in their stewardship practices. In addition to the graph above, each farm receives a narrative report recognizing the indicators where they have made improvement, and identifying areas for continued changes in stewardship practices in order to increase their scores on Sustainability Indicator self assessments in the future.



Farmer Graph 2.2

This graph represents the overall average indicator scores from all farms participating in the research and compares them to the individual scores from individual Farm ##. For example, in the On-farm Energy, Farm Financials, Nutrient Management and Pest Mnagement indicators Farm ## scored well above the average score for all other farms involved. However, Farm ## scored lower than the overall average for sustainability indicators for Animal Husbandry, Biodiversity, Community Health, and Water Management.

It is in the areas where farm ## scored lower than the overall averages for all farms that they have the most opportunity to identify changes is stewardship practices in order to increase their scores on the follow-up Sustainability Indicator self assessment.



Farmer Graph 2.3

After certain changes were made in his stewardship practices, this graph represents the results of the second self assessment. The farmer can compare overall average indicator scores from all farms participating in the research to Farm ##'s individual. For example, Farm ## drastically increased the sustainability indicator scores in Animal Husbandry, Biodiversity, and Community Health, and Water Management. All these areas were scored lower than the total average for all farms in Farm ##'s first assessment. His indicator scores remained higher than the average for On-farm energy, Farm Financials, Nutrient Management and Pest Management modules.

After 20 months, having made significant changes, Farm ## was recognized as having made the greatest improvement in stewardship practices. Their resulting scores in overall sustainability indicators increase their opportunity to identify changes is stewardship practices which may increase their scores on follow-up Sustainability Indicator self assessment.

Appendix 6.3: Sample Sustainability Indicator Module:

Nutrient Management Module

DESCRIPTION

Nutrients are needed to sustain healthy animals and crops but overuse or mismanagement of nutrients, in particular nitrogen and phosphorus, can lead to nutrient pollution of ground or surface waters. Purchased feed and fertilizer are by far the largest sources of nutrient imports onto a farm, accounting for 89.5% of imported nitrogen and 96% of imported phosphorus.[i] Reliance on these external nutrient sources is becoming problematic in that 59-81% of imported nitrogen and phosphorus remain on a dairy farm over one year.[ii] This results in a build-up of nutrients in the soil and an increased chance that nutrients will be transported to water sources, resulting in environmental harm to surface and ground water.

While dairy farms are certainly not the only source of this pollution, contributions from farmland can be significant and participation from the dairy farmer community is therefore essential to improving overall water quality. In Vermont, Lake Champlain, a critical water resource, is experiencing a serious decline in water quality, in part due to sediment and nutrients from agricultural runoff from barnyards, manured and fertilized fields and cropland erosion. Also, many drinking water wells have been found to have nitrate-nitrogen levels exceeding the Vermont public health standard.[iii]

Adopting best practices for nutrient management is important to maintaining ground water that is safe for drinking and surface waters that can support healthy aquatic ecosystems, function as industrial and commercial water supplies, and provide recreational enjoyment. This module is devoted to controlling direct nutrient use on farms, specifically with respect to nutrient applications to fields. Recommendations regarding nutrient management plans, use of fertilizer and manure, and use of dietary phosphorus supplements are intended as an introduction to best management practices to improve farm performance and environmental health. Actual changes to nutrient management should be made in cooperation with experts, such as UVM extension representatives, feed or fertilizer specialists, or other consultants. Controlling water pollution from other nutrient sources, such as manure or silage, is addressed in the Water Management Module.

INCENTIVES FOR CHANGE

- **Cost savings.** Appropriate nutrient management can reduce unnecessary feed and fertilizer purchases, improving crop production efficiency and farm profitability. The Vermont Dairy Farm Sustainability Project found that, by reducing phosphate fertilizer application by 40% (average reduction over a 3 year period), farms could reduce total fertilizer expenditures by an average of $2800/farm or $27/acre, while maintaining farm yields.[iv] One farm decreased phosphate fertilizer use by 8.3 tons/year for savings of $4200/year.[v]

- **Improved on-farm water quality.** Minimizing impact on surface and ground water is beneficial to the extent that these water resources become inputs on the farm. Maintaining healthy drinking water can reduce the chance for illness, and associated costs, from contaminated water.

- **Regulatory environment and funding.** The EPA recently passed water quality legislation requiring that farms with large 'concentrated animal feeding operations' (CAFO) obtain a permit for operation. However, in order to get a permit, a farmer must first develop and implement a comprehensive nutrient management plan. While Vermont's current limit of "large" CAFO operations is 675 milking cows, there is discussion of reducing this number to 200. Additionally, regulation of phosphorus in Vermont requires that farmers take action to reduce the amount of phosphorus coming onto the farm.[vi] As this and other water quality legislation becomes more stringent, dairy farms will increasingly need to demonstrate nutrient management best practices.

SAMPLE: NUTRIENT MANAGEMENT ASSESSMENT QUESTIONS

For all questions, please choose the categories that best identify your current management practices. Use the Summary sheet on the last page of this module to evaluate overall performance.

- **NUTRIENT MANAGEMENT & RECORD KEEPING**:
  1. No nutrient management plan exists for the farm. Nutrient use is driven by compliance with applicable state or local regulations governing nutrient use.
  2. Nutrient management plan is based on some soil testing and recommendations of the University of Vermont or another credible source. Recommended nutrient application rates are exceeded by 5-25% as 'insurance' for a good yield level.
  3. In addition to #2, the plan is based on soil tests ever 1-3 years and recommended application rates not exceeded by more than 10%. Detailed nutrient records are kept (soil test results, crop yields, nutrient application rates and timing, etc.).
  4. In addition to #3, recommended application rates are never exceeded. Additionally, detailed records are used to guide and improve the nutrient management plan on an annual basis.

Record keeping can help farmers further understand, monitor, and therefore improve, farm performance. It also demonstrates good management and can provide valuable data if management practices are ever challenged. While a bit of effort needs to be invested up front, implementation and maintenance of a nutrient management and record-keeping plan will ultimately save both time (e.g. records are readily available when needed for taxes or other purposes) and money in the long term. A nutrient management plan, developed in conjunction with the UVM Extension service, consultant or other expert resource, covers multiple nutrient flows on farms, including use of manure, fertilizer, and feed and supplements. Some best practices associated with nutrient management plans are captured in the questions in this module.

- **MANURE APPLICATION RATE:**
  1. Application rates are unknown or manure is applied until all manure is used up (without regard to nutrient requirements of field or crop).
  2. Application rates are determined by crop-specific phosphorus needs (per UVM or other published standards) and realistic yield goals (goals are within 10% of 5-year average yield).
  3. In addition to #2, application rates are loosely determined by soil nutrient need according to soil tests performed every 3-5 years. To prevent over-application, most excess manure is applied to neighboring fields or otherwise properly disposed of.
  4. In addition to #3, rates are determined by strictly following application recommendations from soil tests conducted every 1-3 years and application reflects manure nutrient content, as determined by laboratory analysis. To prevent over-application, all excess manure is applied to neighboring fields or otherwise properly disposed of.

Manure is a valuable source of nitrogen, phosphorus and potassium for crop production but it is important that the use of manure on fields focuses on crop utilization of manure nutrients rather than manure waste disposal. Over-application of manure can result in build up of nutrients in the soil and increased potential that nutrients will be leached through the soil to groundwater or transported to surface waters via runoff. The amount of manure applied should therefore be closely matched to the needs of each field. Any excess manure remaining after application should be applied to neighboring fields or otherwise properly disposed of. As a benchmark for the amount of land that will be needed for your farm, best practice requires .5 to 1.0 animal units (AU) per acre of cropland that is environmentally, economically, and agronomically suitable for the application of manure.[vii] One AU is equivalent to 1,000 pounds so a 1,400-pound dairy cow would be 1.4 AU's.[viii]

To more closely match manure application rates to soil and crop needs, the farmer should base application rates on the following:

- Soil Testing*:* Soil testing, conducted at least every 3 years, is a great way to determine soil nutrient content and other characteristics that affect crop uptake of nutrients. UVM offers soil test kits that provide information on soil pH, available phosphorus, aluminum (which affects plant uptake of phosphorus) and other nutrients, and soil fertility recommendations. Soil testing is a non-time-intensive, non-costly way to better understand and manage on-farm nutrients.
- Manure Nutrient Content: The percentage of nutrients in manure will vary, depending on such factors as type of cow, composition of feed, additions of other substances to manure, and collection and storage methods. Because of the wide potential variation in nutrient content, a manure nutrient analysis, which can be done at UVM, is highly recommended as the best means of determining exact nutrient content for precision crop nutrient applications. If such an analysis is not possible, using published averages for manure nutrient levels is the next best alternative.
- Type of Crop and Crop Yield: Different crops and yield levels will result in varying crop nutrient needs. Manure use should be based on nutrient need of the crop being grown, together with realistic yield goals (within 10% of average yields from the last 5 years). Ideally, nutrient content should be matched with crop need and soil nutrient content per the results of soil testing. However, using general published standards is the next best alternative.

>COMMERCIAL FERTILIZER APPLICATION RATE:

1. Application is based on historical practice; specific application rate is unknown.
2. Rates are determined by crop-specific nutrient needs (per University or other published standards) and realistic yield goals (goals are within 10% of 5-year average yield).
3. In addition to #2, application rates are loosely determined by soil nutrient need according to soil tests performed every 3-5 years and manure nutrient credits and legume nitrogen credits (per University guidelines published standards) are reflected in application rates.
4. In addition to #2 (not #3), rates are determined by strictly following application recommendations from soil tests (conducted every 1-3 years) and by annual Pre-Sidedress Nitrate Tests. Every effort is made to use only on-farm nutrient sources (manure, compost, cover crops, etc.).
5.

Given that manure is an excellent and abundant source of crop nutrients, every effort should be made to effectively utilize manure (or other on-farm, organic nutrient sources) to satisfy crop nutrient need. However, and when inorganic commercial fertilizer is needed to supplement manure nutrients, precisely matching it to crop need will minimize fertilizer costs and nutrient build-up in soils. As discussed in the "Manure Application Rate" section, soil testing and closely following corresponding nutrient recommendations is a best management practice. These nutrient recommendations should take into account crop type and yield (as discussed above).

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- [1] Klausner. 1993. Quoted in Weber, Greg. "Vermont Dairy Farm Sustainability Project, Inc. (VDFSP) DRAFT Summary." Provided by Greg Weber, formerly of VDFSP, via e-mail in June 2003.
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6.4 Newsletter Articles

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Our Report From The Netherlands

By Beth Choiniere

For a family that rarely leaves the farm, this was a trip of a lifetime. Our family recently spent a week in Holland as part of the Dairy Stewardship Alliance (DSA). The DSA is a collaborative effort of Ben & Jerry's, the St. Albans Cooperative Creamery, the University of Vermont's Center for Sustainable Agriculture and Vermont's Agency of Agriculture. The purpose of our trip was to reconnect and compare farming methods with the Dutch farm family we hosted in the Fall of 2006.

All farmers had to complete a Self-Assessment Toolkit before being accepted in to the DSA. The Toolkit was an in-depth evaluation of our farm which covered 10 focus areas including: animal husbandry, biodiversity, community health, energy, farm financials, nutrient management, organic information, pest management, soil health, and water management.

After completing the toolkit we had to identify 2 areas of interest and possible improvement on our farm. According to Andrea Ash, of Ben & Jerry's, Program Director of the DSA, the goal of the program is to provide all farmers information to understand, document and implement sustainable dairy farming practices. "This is core to our social mission," said Asch of the project. "This is one of the ways that Ben and Jerry's can give back to the community," she continued. "There is a perception of Unilever as a big behemoth that doesn't care about community." said Asch of the parent company to Ben & Jerry's, "That is simply not the case."

Our trip began in the amazing city of Amsterdam. We spent the first days of our trip in Amsterdam and enjoyed touring the city with our group of fellow Vermont farmers. The two main attractions that caught our attention were the canals and the multitude of bicycles.

The canals serve as a network of waterways brilliantly designed to maintain the water level within the city, which is 20 feet below sea level. The system of canals was very complex, yet simple at the same time. While serving to keep the water level constant, the canals serve equally well to keep cattle corralled on their own pasture, thus eliminating the need for fencing.

As we love to bike in our free time, we were fascinated by the number of bike riders in Amsterdam and in the surrounding villages. Bicycles serve as the main source of transportation within the country. In Amsterdam, hiking is more convenient due to the large population and the limited number of car permits issued each year. The waiting period to obtain a car permit is typically five years. The villages in Holland are small and therefore hiking to the grocery store and to school is the norm. Unlike Vermont, Holland is extremely flat thus making a trip to the market a little more encouraging.

After spending two days in Amsterdam, the farmer in us was feeling a little restless. We were ready to head to our host family's farm. On Tuesday, we loaded onto a bus and headed out to the country. Within five minutes, we were surrounded by cows, goats, horses, windmills, and plentiful green pastures. We couldn't believe the countryside had been so close all this time.

But before reaching our host family, we visited two farms that were operated by the local University. We learned that the University plays a large role in helping farmers deal with upgrades in agricultural regulations. One barn we were in had" four different types of floors. The University continuously searches for the best barn flooring material. Farmers reap the rewards of the government-funded research and grants for technology upgrades.

One of the farms we visited that day was a conventional farm and the other farm was organic. Although the farms were fundamentally different, the farms were similar in that both herds were on pasture, both herds were milked by robots, the barn styles were similar, and automation was prevalent on both farms. Both farm types allowed for antibiotic use (although much more limited on the organic farm). The organic farmer is paid only slightly more for his organic milk. This is the reason why there are so few organic farms in Holland. Chemical fertilizer is not allowed on an organic farm.

After a day of touring farms, we finally reunited with our host family at a nearby restaurant for a dinner meeting. After the meeting, we finally headed to our host's home. Antoon and Angelique Stockman's farm was approximately two hours outside of Amsterdam, in the town of Noordsleen. Once arriving on the farm, the relationship we started last October rekindled very quickly, and it felt like old friends getting together. Now on their turf, Antoon felt very comfortable putting us to work. Matt and I each picked out a pair of coveralls and barn boots and headed out to the barn which was separated from the house with only one sliding wooden door. Antoon was very excited to show us his new double 12 parallel parlor, which was very new and modern considering he milks 90 cows. Equipment upgrades were a common sight throughout our tour of Holland. We believe the farmers are preparing for the predicted loss of the European Union's quota system in the next 2 years.

Antoon's barn is like the others, it was a free stall barn with the cows standing on a slotted floor with the manure pit direct¬ly underneath. This system seemed to be most practical. This set up satisfies the regulation that mandates a roof over all manure pits. Antoon had a lot of field work to do which was lucky for us because we got to see how it was done.

Due to Holland's place below sea level, and the limited amount of land, the Dutch are diligent about clean water issues. Holland has strict manure dispersal restrictions. The government regulates farm practices closely. Farmers are told when and how much manure they can spread. Dutch rules require farmers with an abundance of manure to truck it away to another farmer needing more, or to a digester to dispose of it.

Dutch farmers must follow other strict standards. Manure must be injected into the soil, not spread upon it. All manure pits must be covered to prevent gases from escaping. Equipment must be designed to do multiple tasks at one time to reduce traffic on the land, and cover crops are required to avoid runoff from open soil.

The Dutch farmers are very organized. They have a cooperative that is called upon when it is time to harvest crops. Antoon called to make an appointment and then someone showed up to do the work. The uniform standards and similar equipment must make it easier for hired labor to fill in for any given farmer.

Erosion was a hot topic of conversation on this trip. I learned that to the Dutch, erosion is when water and nutrients leach into the water table through the ground which is 3 feet below the surface. Holland's top soil is mainly peat moss, from the reclaimed soil, or pure sand. Both of these soils allow bad management to be detrimental to water quality.

Erosion in Vermont is caused mainly by surface runoff which results in sediment loading and nutrient loading in our rivers and lakes. Our challenges might be different but the concern is the same.

We gained a lot of knowledge from the farm connection, but we were significantly moved by another aspect of our trip. Antoon and Angelique were kind enough to bring us sightseeing around Noordsleen. The most significant stop for us was a visit the Westerbork Concentration Camp.

Amazingly, the site was just 40 minutes from their home. The barbed wire fences, the lookout towers, and the house the guards lived in remain intact. The rest of the buildings have been torn down, and the train rails have been ripped from the ground. Still, the atmosphere at the camp is chilling. Westerbork is the concentration camp where Anne Franke was taken after she and her family were found in hiding in Amsterdam. Anne Franke was a Jewish girl who wrote a diary while in hiding with her family in Amsterdam during the German occupation of Holland in World War II. Anne Franke was made famous when her diary detailing her time in hiding was published. We went back to Amsterdam the following day, and were able to take a tour of the warehouse where Anne and her family lived for their two years in hiding. The warehouse is now a museum in downtown Amsterdam.

We are very grateful to Ben & Jerry's and the other groups for giving our family the opportunity to participate in this program. Our family truly enjoyed our visit to Holland. The Dutch culture was an inspiration to all of us. All the people we met were great. We observed that family time is a priority and farming techniques are from common basic principles that work for farm and nature. Their farming practices also proved to be innovative with their dikes, canals, windmills and robotic milkers.

Our farming strategies at times did seem a little different from the Dutch farmers, yet be assured that we do have sustainability in common.

Beth, Hannah, Guy and Matt Choiniere