SUSTAINABILITY IN US SPECIALTY CROP PRODUCTION

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WI AgriBusiness Classic

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UW Extension
University of Wisconsin-Extension

RENK AGRIBUSINESS INSTITUTE
College of Agricultural & Life Sciences

NPM
Nutrient and Pest Management Program

Presentation Goals

- Present our vison for how a practical agricultural sustainability program can work
- Explain where we are at in trying to make this vision real

USDA SCRI Project Report

- Large USDA grant funding the development of a Practical Agricultural Sustainability Program
- Using processed vegetables as a start
- Combining funding from cranberry, soybeans, etc.
- Working out the process, the implementation details, solving issues
- Group effort with several at UW and other universities and in industry contributing
- Thank you for doing the cost share paperwork!

How we got here

- **Healthy Grown Potato began mid-1990s**

- **National Initiative for Sustainable Agriculture (NISA) began November 2010**

- **FieldRise, LLC in 2015**

Measuring Sustainability using a Practice-Based Approach

- Use a practice-based approach as the foundation for a Practical Agricultural Sustainability Program
  - Direct outcome measurement too costly
  - Model predictions too inaccurate for farm level

Process Steps

1. Work with farmers and regional experts to develop extensive list of sustainable practices
2. Conduct farmer survey, working with an association
3. Analyze data and give individual farmer feedback
4. Farmers and the industry plan and act/implement

Sustainability Measurement Problem

- Have practice adoption profiles for surveyed farmers
- How do we make sense of the data?
- Need to “measure to manage” practice adoption
- Many practices, often 100+
- Most variables are yes/no or integers
- Highly correlated with each other
- Create an index to compare farmers to one another

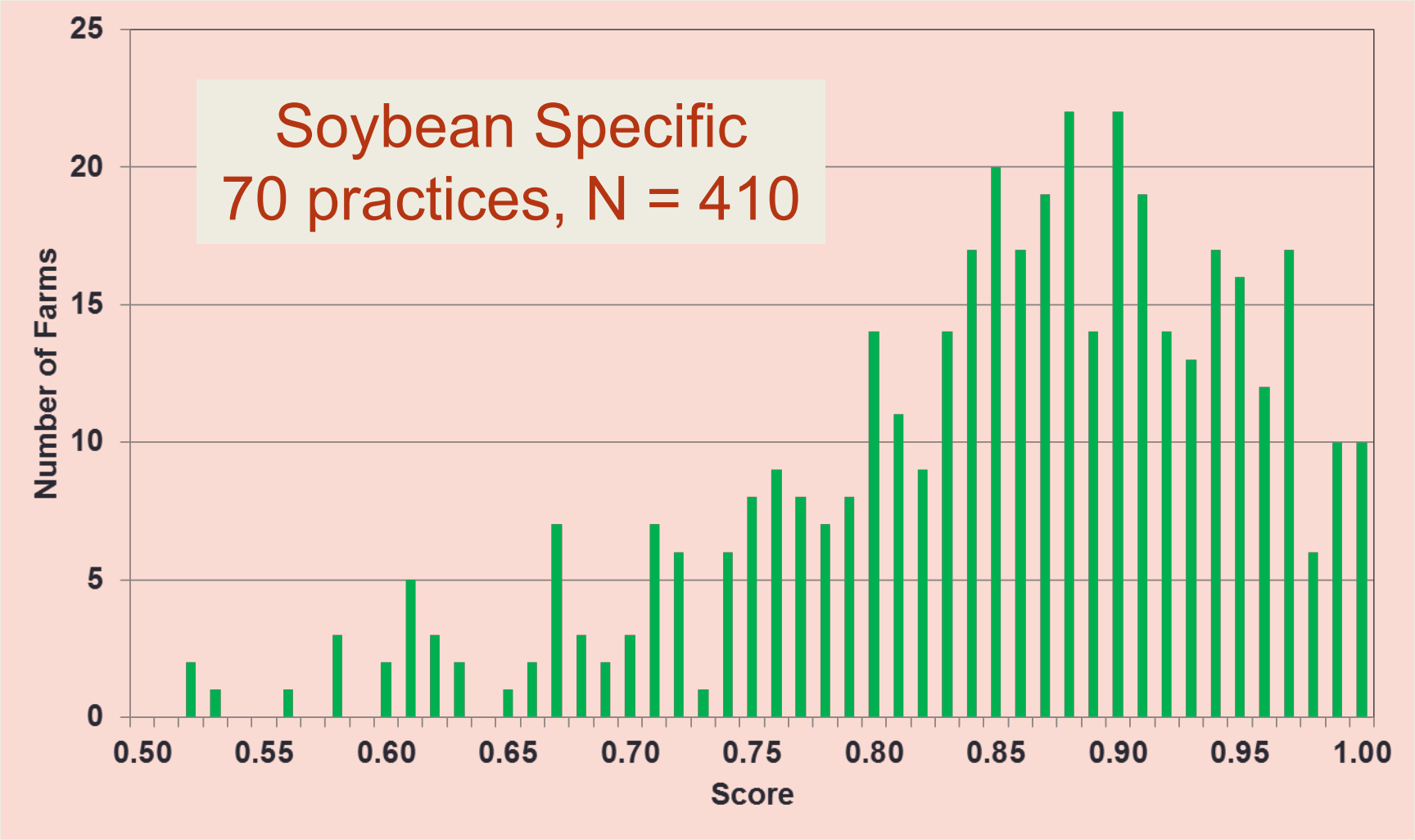
PCA

DEA

Data Envelope Analysis with Principal Components

- First use Principal Component Analysis (PCA) to reduce the number of variables, to remove correlation among variables, and to convert discrete variables to continuous
- Next use Data Envelope Analysis (DEA) to calculate a composite index to measure how intensely each farmer adopts sustainable practices relative to his/her peer group
- Final Output:
  - Score between 0 and 1 for each farmer measuring the intensity of sustainable practice adoption relative to his peers with endogenous weights for each practice
  - Document adoption intensity of farmer population and identify practices to most improve each farmer's score

Histogram of Scores

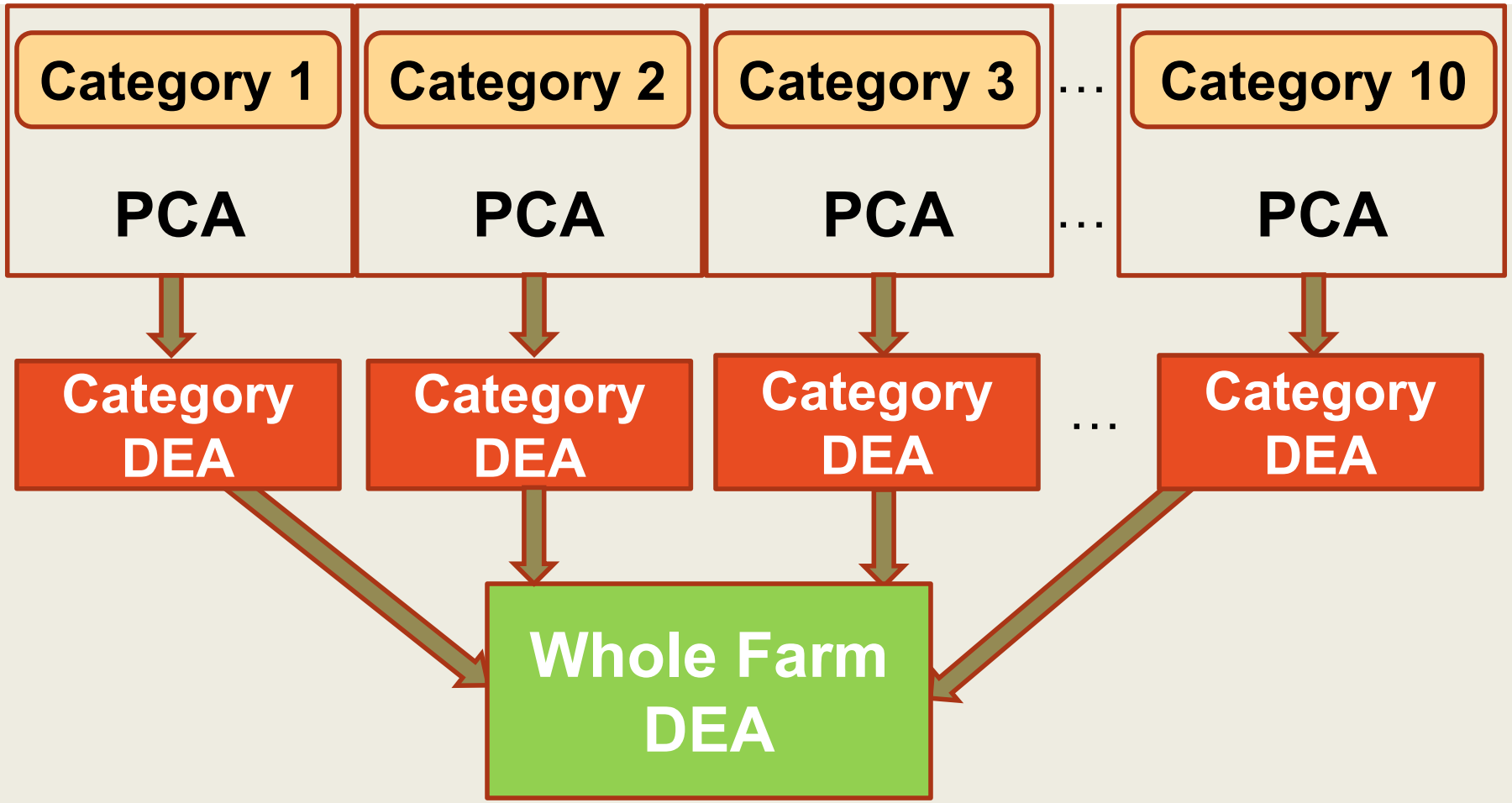


What have we gotten done?

- Analysis methods refined and published
- Several assessments completed
- Ecosystem restoration handbook
- Consumer survey
- Field research (not presented by me)
- **Our struggle: Supply Chain Engagement**

Analysis Methods Refined and Published

- Measuring Farm Sustainability using Data Envelope Analysis with Principal Components: The Case of Wisconsin Cranberry (JEM 2015)
- Assessing Sustainability and Improvements in U.S. Midwestern Soybean Production Systems Using a PCA-DEA Approach (RAFS 2015)
- Quantifying Adoption Intensity for Weed Resistance Management Practices and Its Determinants among U.S. Soybean, Corn, and Cotton Farmers (JARE 2016)
- Conceptual Framework & Empirical Results for a Practical Agricultural Sustainability Program in the United States (Conference Paper, Netherlands 2015)
- Endogenizing Sustainability in U.S. Corn Production: A Cost Function Analysis (Conference Paper, Boston 2016)



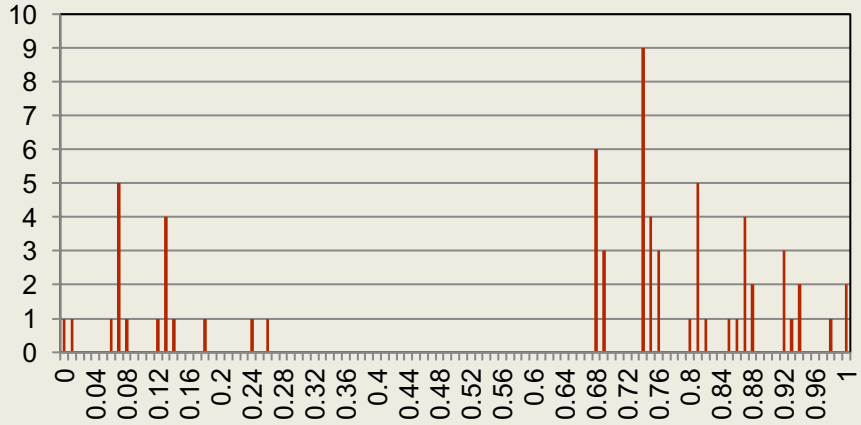
- To deal with PCA computational intensity: group practices into categories (nutrients, pests, energy, human resources, etc.)
- Calculate category DEA score, then do DEA on these scores to get the grand DEA score

Several Assessments Completed

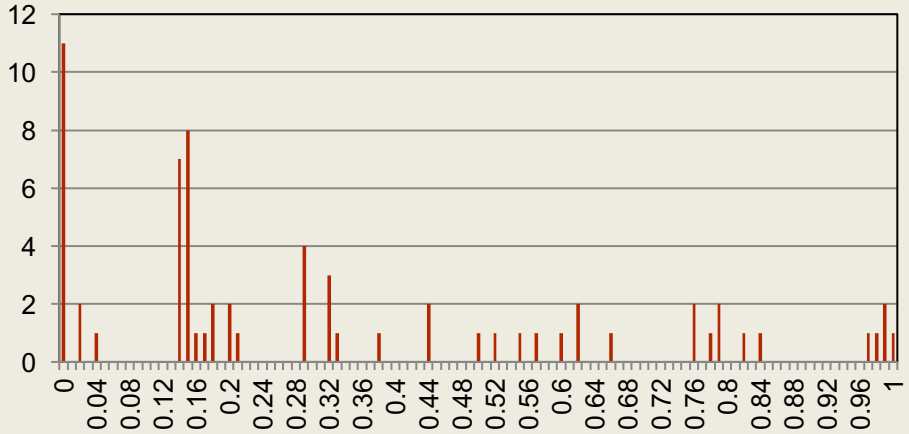
- Survey and full DEA-PCA Analysis
  - Sweet Corn and Green Beans in Midwest and New York
  - Cranberry: 1st Wisconsin, 2nd survey US and Canada
  - Soybean: mostly IL and WI
  - Potato and irrigation practices in Wisconsin
  - Mint in the US and Canada
- OUTPUT: Summary reports and journal articles
- 1,400 Farmers & 1.35 million acres and counting

Histograms of Midwest Green Bean Scores for Select Categories

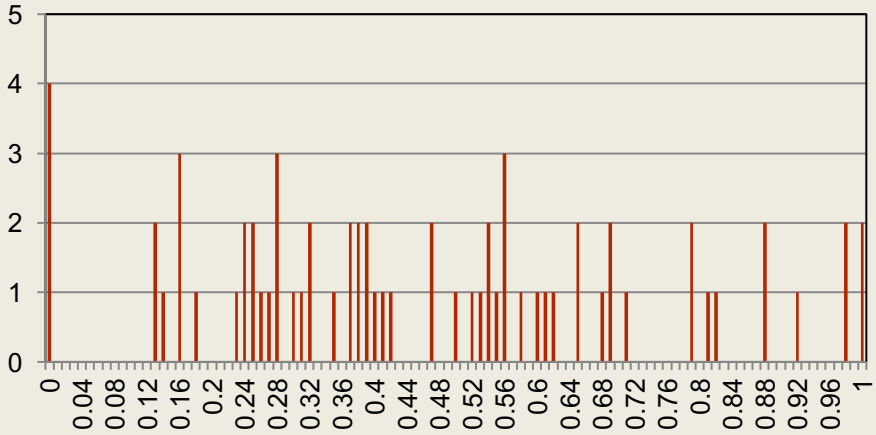
Disease Management



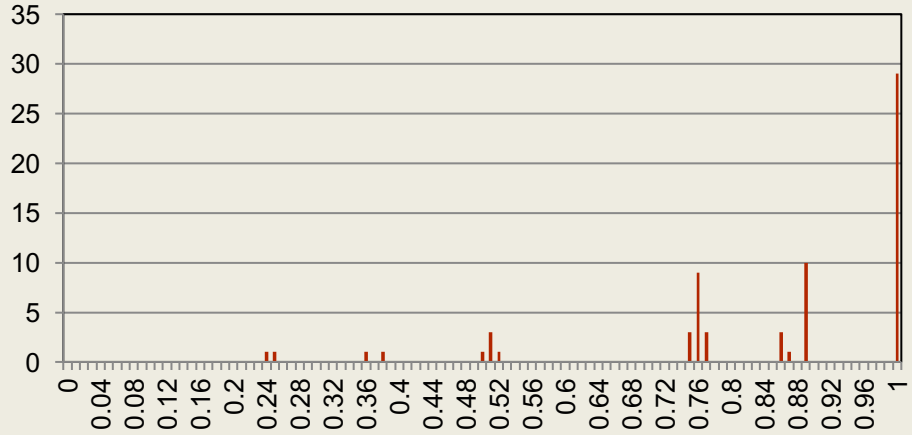
Ecosystem Restoration



Insect Management



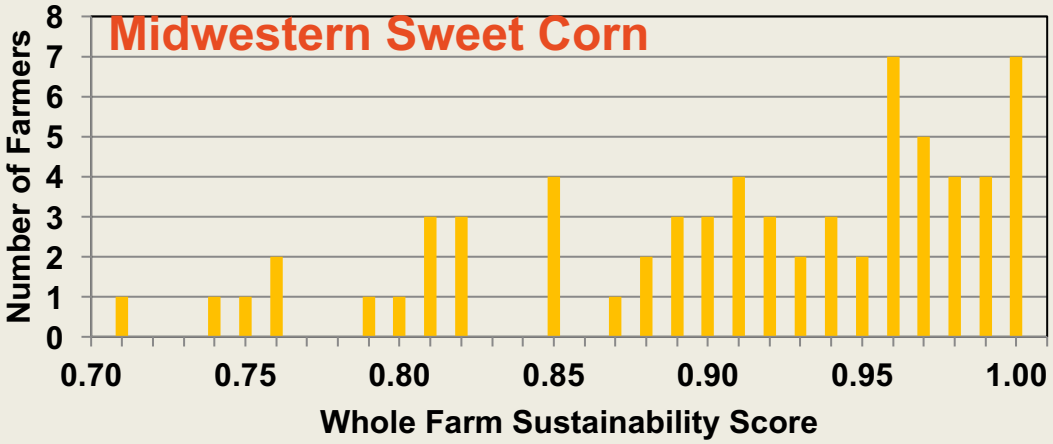
Nutrient Management

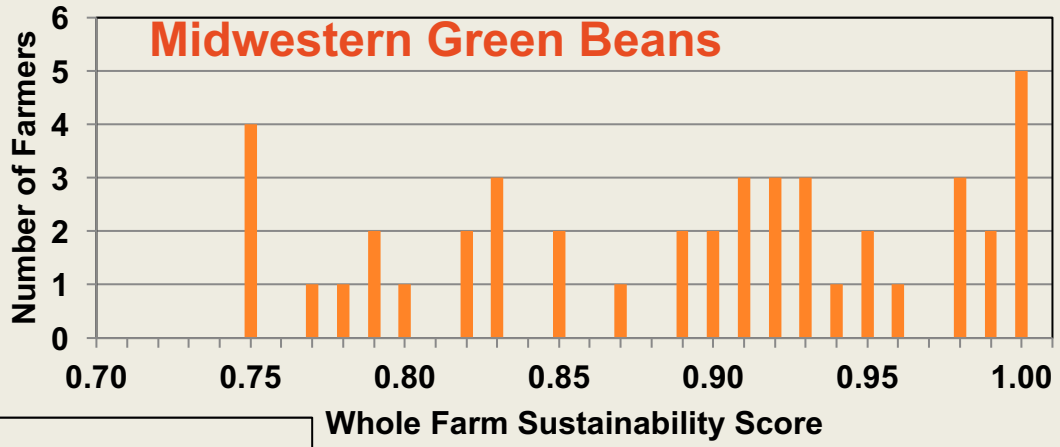


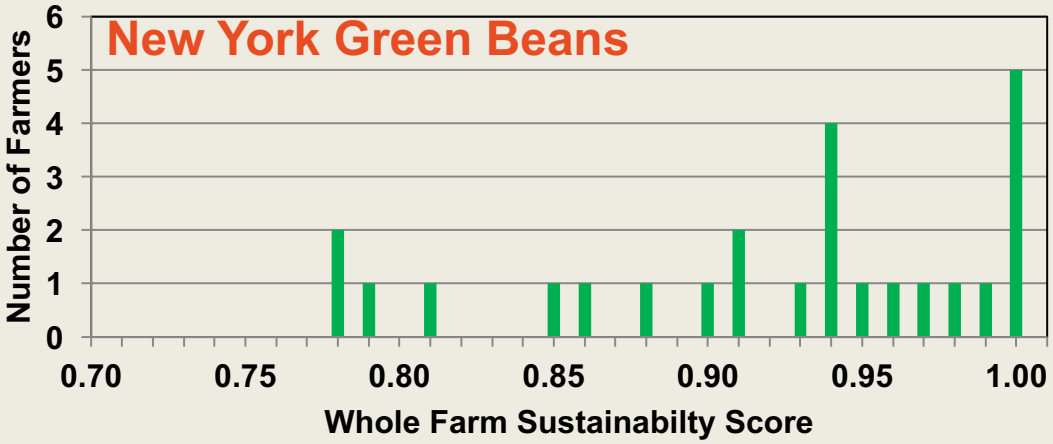
Average Category Scores by Crop and Region

Category	Midwest Sweet Corn	Midwest Green Bean	NY Green Bean
Community	0.930	0.733	0.611
Disease Management	0.610	0.663	0.823
Ecosystem Restoration	0.330	0.291	0.438
Business Management	0.870	0.869	0.887
Farm Operations	0.761	0.731	0.782
Insect Management	0.456	0.555	0.822
Nutrient Management	0.840	0.836	-----
Production Management	0.882	0.887	0.911
Soil & Water Management	0.792	0.709	0.904
Weed Management	0.753	0.828	0.725
Whole Farm	0.905	0.887	0.945

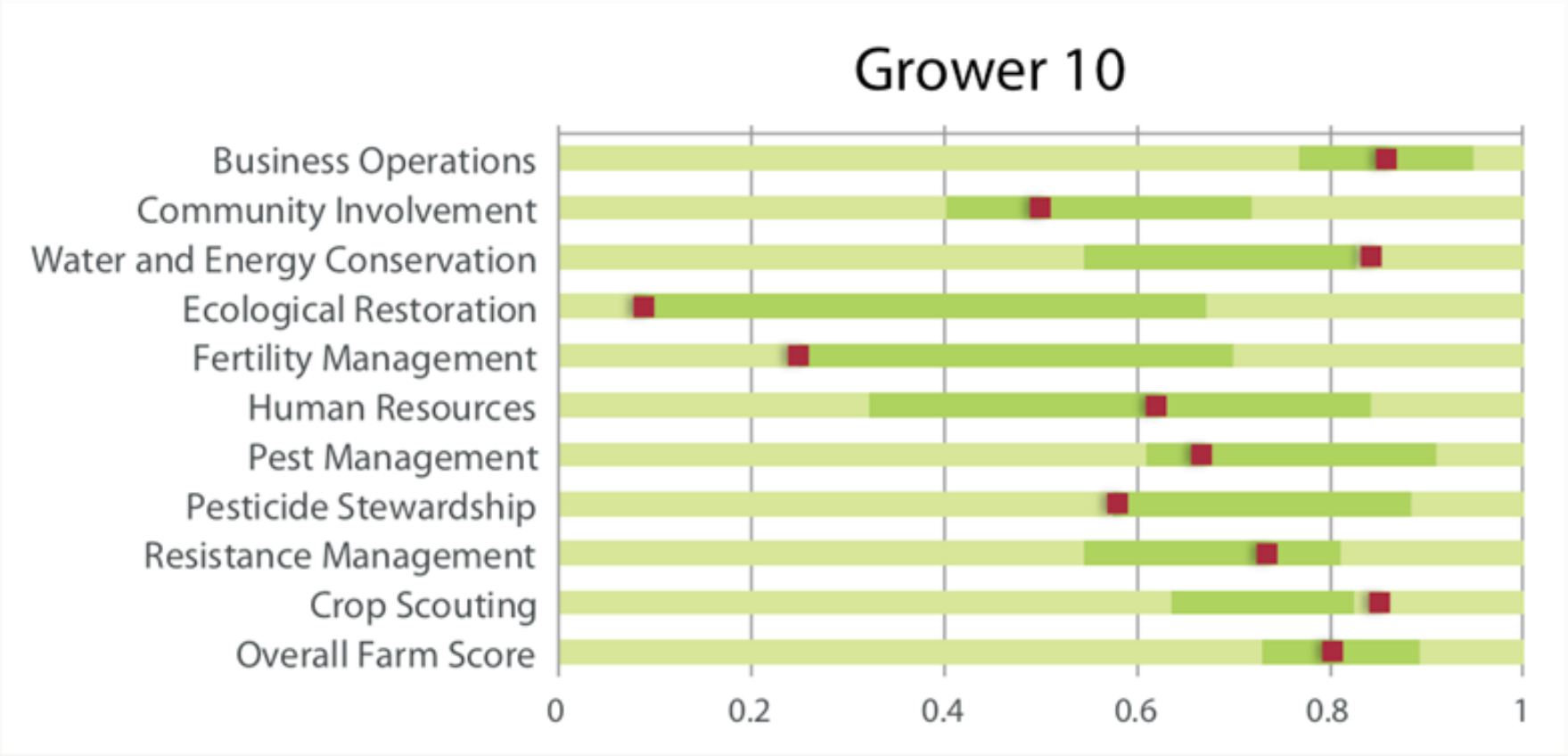
Histograms of Whole Farm Scores







Individualized Grower Reports



- **Darker green band = middle 50% of farmers = “Average”**
- **Red square the farmer’s score**

Individual Grower Scorecard: Recommended Practices

Midwestern Green Beans

Community	Provide local community leadership Gather input from local stakeholders
Disease Management	Evaluate root health at harvest during the previous growing season Avoid planting vegetable crops in fields adjacent to field planted to potatoes in previous year
Ecosystem Restoration	Develop a sustainability mission statement for operation that contains information on my sustainable farming/operations philosophy Attend ecological, conservation or restoration education or training events
Economics	Purchase federal crop insurance for my major crops annually Develop a risk management and disaster plan for operation
Farm Operations and Sustainability	Use weather data for scheduling green bean planting and harvest dates Develop pest management plans to lower the risk for resistance development
Insect Management	Scout green beans for insect pests weekly throughout the growing season Use seed treatments for early potato leafhopper and seed corn maggot control
Nutrient Management	Apply nitrogen in multiple applications according to university recommendations with additional justified by foliar or petiole nitrate samples and/or varietal needs Apply calcium, magnesium and sulfur based on soil test results
Production Management	Plant potatoes and/or carrots in rotation with green beans Plant crops when soils are at 85% field moisture capacity
Soil and Water Management	Select crop varieties with shorter growing season Plant a new windbreak
Weed Management	Plan herbicides across the rotation to vary mode of action and prevent or delay herbicide resistance Plan crop rotations to include those with multiple tools to control weeds problematic in green beans during the present growing season
Practices to keep doing	Plan herbicides across the rotation to vary mode of action and prevent or delay herbicide resistance Plan crop rotations to include those with multiple tools to control weeds problematic in green beans during the present growing season Buy production inputs from a local (e.g. state) source Apply potassium based on soil test results

What did we Learn?

- Most farmers for most crops are doing a good job on the traditional BMPs
  - Agronomics: nutrients, pest management, scouting, water/irrigation, and soil management, etc.
  - Business management: finances, insurance, plans, etc.
- Each industry has specific areas of low & high scores
- Common low scoring areas for many crops
  - Ecosystem restoration/wildlife habitat = management of non-cropped lands
  - Community involvement/engagement/leadership
  - Human resources

Ecosystem Restoration Handbook

- **Alison Duff**
- **Deana Knuteson**
- **Mimi Broeske**

- **Extremely practical guide for Wisconsin farmers**

Ecosystem Restoration Handbook

STEP 1: FARM ASSESSMENT

- ☐ Map the farm and conduct a rough inventory of its non-cropped areas
- ☐ Determine whether any existing plant communities are ecological remnants and if they contain species of conservation concern
- ☐ Ask an ecologist to assess the quality of any remnants and discuss how their condition should affect the management priorities of the sites
- ☐ Locate non-cropland areas that are adjacent or near protected lands or large tracts of habitat on nearby-properties

STEP 2: GOAL-SETTING

- ☐ Determine a conservation vision for the land, consider which benefits and what land uses are important
- ☐ Review other local or regional conservation projects and determine which areas are important to the farm and surrounding community
- ☐ Communicate with ecologist to understand how and why they prioritize particular sites for restoration

STEP 3: SITE SELECTION AND PLANNING

- ☐ Create a priority list of management units and select sites feasible for conservation
- ☐ Prioritize sites and determine which to begin managing now and where management will done in the future
- ☐ Develop a restoration plan for each management unit, including assessment of the site's current conditions, the restoration target and the steps required to get there over time

STEP 4: IMPLEMENTATION AND MONITORING

- ☐ Determine the farm's capacity to complete restoration work and whether target outcomes are achievable
- ☐ Determine who would complete the work
- ☐ Finalize what equipment or training is needed and if desired, look for outside funding or other support resources to off-set the costs of ecological restoration
- ☐ Ensure that the implementation plan includes all of the information needed to accomplish the annual work recommended in the site management plan
- ☐ Include a list of annual management actions with clear directions specifying when, how and where the work should be completed
- ☐ Monitor progress to assess the success of restoration programs (walking 2x per year or use monitoring equipment) and note changes in key species within the landscape

Activity/Comments	Timing/Season
Year 1	
☐ Complete a prescribed burn to control woody vegetation	March-May
☐ Consult with ecologist for a site assessment; create an invasive species "watch list"	June-August
☐ Control invasive plants (as appropriate to species)	Growing season
Year 2	
☐ Complete a prescribed burn to control woody vegetation	March-May
☐ Control invasive plants (as appropriate to species)	Growing season
Years 3-4	
☐ Control invasive plants (as appropriate to species)	Growing season
Year 5+	
☐ Complete a prescribed burn every 3-6 years (may need to burn more frequently to control weeds and brush)	Spring/Fall
☐ Monitor and control problem weeds, note weeds on "watch list"	Throughout season
☐ Consider interseeding understory of site to boost native plant diversity	After burn

- **Copies available: Deana Knuteson <dknuteson@wisc.edu>**

What's new?

- **<u>Integrating Outcomes into the DEA-PCA Analysis</u>**
  - Cost function using USDA corn data to estimate the average cost impact to increase sustainability score
  - Carbon footprint: kg of CO2-equivalent in GHG emissions per pound of mint produced

Endogenizing Sustainability in U.S. Corn Production: A Cost Function Analysis

Fengxia Dong and Paul Mitchell, Department of Agricultural and Applied Economics, University of Wisconsin-Madison

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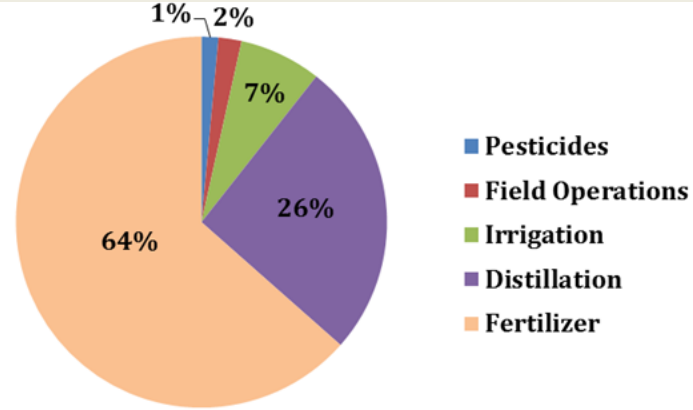

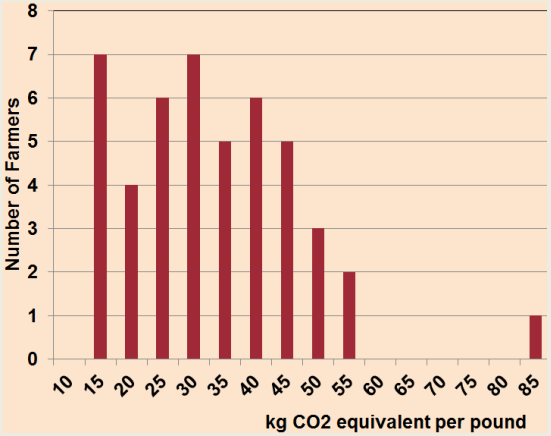

Consumer Survey

- Dr. Chengyan Yue, U of MN, Applied Econ & Hort
- What consumers want for a sustainability program: Focus on Program Characteristics
  - Not whether the farmer uses IPM, soil testing, no till, community involvement, etc. …
  - Not the farmer practices, but the program
- Plenty of research looks at consumer willingness to pay for "green" production practices
  - Generally find little value or willingness to pay

Conjoint Analysis

- Give consumers two hypothetical cans of sweet corn, each with a random mix of prices and of the five program characteristics, and then ask them to choose which can of sweet corn they prefer
  - Do this with several pairs and for 10,000 consumers and we can estimate which characteristics they value
- Program Characteristics examined
  - Farmer Engagement
  - Role of Science
  - Consumer Access to Sustainable Products
  - How Sustainability is Measured
  - Communication with the Supply Chain

What do Consumers Care About?

- Price dominates willingness to pay, as expected
- Measurement of Sustainability
  - Farmers in program must demonstrate use of sustainable practices
  - Measures of on-farm practices are used to measure sustainability
- Role of Science
  - Program communicates scientific information to farmers
  - Program funds science to increase the sustainability of farmer practices
- Farmers' active participation
  - Farmers advise program managers on program requirements and activities
  - Farmers learn what is required to meet consumer demands
- Communication
  - Do **not** create sustainability materials to distribute to consumers

Where are we now?

- We can refine the analysis methods, write journal papers, do field research to improve practices, show that we have created a program that consumers want, …
- Our struggle: **Supply Chain Engagement**
- We can get farmers: 1,400 Farmers & 1.35 million acres
- **How do we get companies to accept our program???**
- This has been Healthy Grown's and NISA's struggle and now FieldRise's:
- **It takes expertise and time that we do not have!**
- We are not marketers or business people
- We do not have the time to travel around marketing this program or to do the networking needed

Summary and Conclusion

- A Practical Agricultural Sustainability Program
  - Analysis methods refined and published
  - Several assessments completed
  - Ecosystem restoration handbook ready for distribution
  - Consumer survey analysis written
  - Field research (not presented by me)

- **Our struggle: Supply Chain Engagement**

Questions?
Comments?

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Example Whole Farm Questions

1B Which of the following practices are used to limit compaction on your farm?
(Check all that apply)

- ☐ Correct tire inflation and/or tracks (reduce psi as much as is practical)
- ☐ Control traffic patterns
- ☐ Add a deep tap rooted crop to your rotation (e.g., alfalfa)
- ☐ Avoid equipment traffic on wet soils
- ☐ Not applicable

Scouting and Record Keeping Section

3A Which of the following describe why you scout?
(Check as many that apply)

- ☐ To determine when levels of a pest in a field reach or exceed treatment thresholds
- ☐ To reduce the amount of pesticides you use in order to minimize environmental impact
- ☐ To check on the effectiveness of a pest control measure already implemented
- ☐ In response to a local or recent pest report you heard or read about
- ☐ Not applicable

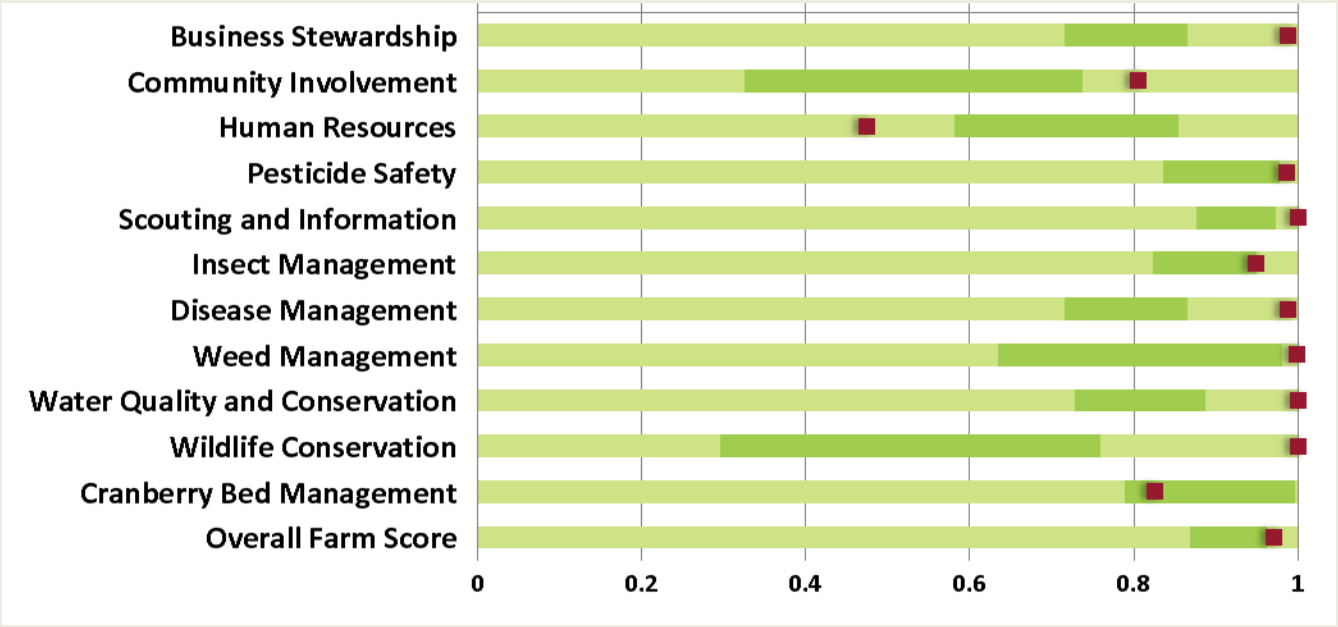
Example Green Bean Questions

7A Which of the following herbicide treatments are used to manage weeds in your green bean fields?
(Check all that apply)

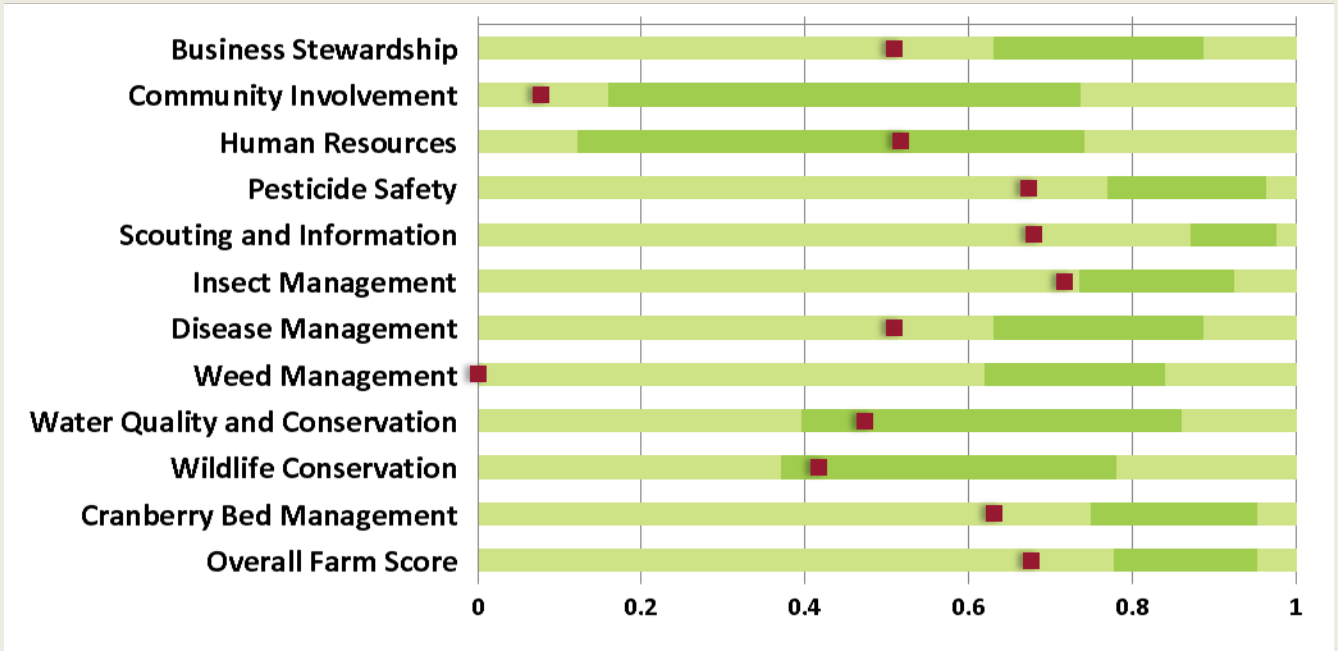
- ☐ Pre-plant incorporated herbicides
- ☐ Pre-emergence herbicides
- ☐ Always 1 post-emergence application
- ☐ Generally 1-2 post-emergence applications
- ☐ Always 2 post-emergence applications
- ☐ Generally 2 or more post-emergence applications
- ☐ No herbicides applied

8A Which of the following are used to manage green bean insect pests?
(Check all that apply)

- ☐ Avoid green manure plow-down within 14 days of planting to avoid threat of maggot damage
- ☐ Plan rotations to limit overwintering and/or previous years' insect pest concerns
- ☐ Not applicable



Above Average Grower



Below Average Grower