An Integrated Socio-Economic and Bio-Physical Framework for Mitigating GHG Emissions under Agricultural Water Management System: Socio-Economic Component

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Project Meeting
Montreal January 22 2018
Objective of the Socio-Economic Component

• To develop a robust economic and environmental evaluation of selected Beneficial Water Management Systems (BWMS) in Ontario and Quebec
# Sites and Technology

<table>
<thead>
<tr>
<th>Location</th>
<th>Crop</th>
<th>Technology</th>
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<tbody>
<tr>
<td>St. Emmanuel, Quebec</td>
<td>Corn, Soybean</td>
<td>Controlled tile drainage with subirrigation, surface drainage and sub-surface drainage</td>
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<td>Sherrington, Quebec</td>
<td>Onions</td>
<td>Sprinkler irrigation with and without tensiometer for irrigation scheduling</td>
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<td>Harrow, Ontario</td>
<td>Corn-Soybean rotation</td>
<td>Controlled tile drainage with subirrigation, surface drainage and sub-surface drainage</td>
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<td>Holland Marsh, Ontario</td>
<td>Onion-Carrot rotation</td>
<td>Sub-surface drainage</td>
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<td>Ste. Anne-de-Bellevue, Quebec</td>
<td>Soybean-Alfalfa rotation, Pasture</td>
<td>Controlled tile drainage</td>
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Major components

• Industry Assessment
• Economic analysis from societal accounting stance
• Co-Benefits and their role in adoption
• Factors affecting adoption of Beneficial Management Practices
• Policy instruments to enhance adoption
• Multi-disciplinary Model for GHG emissions estimation
FARM LEVEL DATA COLLECTION AND ANALYSIS

ECONOMIC ANALYSIS OF ADOPTION

DISSEMINATION OF RESULTS TO PRODUCERS

MEASURES TO IMPROVE ADOPTION OF IMPROVED AGRICULTURAL WATER MANAGEMENT SYSTEMS.

BIO-PHYSICAL RESEARCH

G.H.G. SIMULATION MODEL IN SPATIAL AND TEMPORAL SCALES

EVALUATION OF BENEFICIAL MANAGEMENT PRACTICES
Industry Assessment

• Current status of the industry for the product under study
• Location of production and climatic conditions
• Regional, national and international markets
• Trends in industry production and structure
• Future of the industry including future structure
Economic Analysis of Technology for a crop and region combination

• Basic tool: Benefit-cost analysis
• Period from installation to productive life of the technology
• Data for three summers: 2018, 2019, and 2020.
• Issue: Technology field level vs. Whole farm analysis
• Criteria for assessment:
  • Net present value of returns
  • Benefit-cost ratio
  • Internal rate of returns
  • Pay-back period
Social Benefit Cost Analysis

• Extended benefit-cost analysis
• Including co-benefits of the technology
• Requires identification and estimation of these co-benefits
• Co-benefits would be monetized using values reported in the literature
• Economic desirability would be assessed from society accounting stance
• Criteria: Benefit-cost ratio, NPV of returns, IRR
Identification and assessment of Co-Benefits

• Based on review of literature and bio-physical research of team members
• Both quantification and monetization
• Monetary value based on literature review
• Major co-benefits related to:
  • Water quality
  • Soil quality
  • GHG Emissions
  • Air quality
  • Other environmental aspects
Factors affecting adoption by producers

• Based on a survey of producers
  • Mail-in, telephone or in-person survey

• Survey for each crop and region
  • Question of frequency

• Topics included:
  • Farm and operator characteristics
  • Perception and attitude
  • Contingent adoption questions
  • Policy measures
Multi-criteria Analysis

- Refers to decision-making using various alternatives and different goals of the decision maker
- Decision-making criteria could also be different
- Some of the goals may be conflicting in nature and may require trade-offs
- Incorporates both qualitative and quantitative information
- Different options area ranked according to the given set of objectives (goals)
<table>
<thead>
<tr>
<th>Multi-Criteria Analysis</th>
<th>Site 1</th>
<th>Site 2</th>
<th>...Site n</th>
<th>Data Sources</th>
<th>Weights Sources</th>
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<td>Financial Criteria - On farm</td>
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<td>Cost of investment ($)</td>
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<td>Interviews with farms, contractors and gov. publications</td>
<td>Farmers (regional survey)</td>
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<td>Net Present Value ($)</td>
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<td>Calculations based on interviews with farmers and from gov. publications</td>
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<td>Improved yields (kg or T)</td>
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Some results from AGGP1

• Perception re. environmental improvement
• Barriers to adoption
• Change in policy that might encourage producers to adopt
Farmers Opinions Regarding Environmental Issues

- Reducing water use in agriculture is important.
  - Strongly disagree: 30
  - Disagree: 51
  - Neutral: 13
  - Agree: 6

- Reducing greenhouse gas emissions coming from agriculture is important.
  - Strongly disagree: 20
  - Disagree: 50
  - Neutral: 24
  - Agree: 6

- Cost-share programs supporting the adoption of improved agricultural practices and technologies represent good use of public money.
  - Strongly disagree: 33
  - Disagree: 53
  - Neutral: 11
  - Agree: 3

- Making best use of scarce resources is important to you.
  - Strongly disagree: 37
  - Disagree: 53
  - Neutral: 9
  - Agree: 1

- Society should share the costs of minimizing agriculture’s impacts on the environment.
  - Strongly disagree: 21
  - Disagree: 41
  - Neutral: 33
  - Agree: 4

- Farmers should be the ones supporting the costs associated with environmental damages as a result of their farming.
  - Strongly disagree: 29
  - Disagree: 34
  - Neutral: 27
  - Agree: 9

- Farmers should be responsible for minimizing environmental damages coming from their farms.
  - Strongly disagree: 27
  - Disagree: 60
  - Neutral: 7
  - Agree: 4
Perceived Barriers to BMPs Adoption

Characteristics of BMPs

- Market stability (i.e. assurance of contracts)
  - Very important: 3
  - Important: 23
  - Neutral: 31
  - Somewhat important: 36
  - Not at all important: 7

- Steep learning curve
  - Very important: 9
  - Important: 10
  - Neutral: 51
  - Somewhat important: 19
  - Not at all important: 11

- Low profit margins
  - Very important: 6
  - Important: 24
  - Neutral: 33
  - Somewhat important: 30
  - Not at all important: 7

- Low prices
  - Very important: 9
  - Important: 19
  - Neutral: 38
  - Somewhat important: 30
  - Not at all important: 9

- Risk of investment
  - Very important: 4
  - Important: 37
  - Neutral: 30
  - Somewhat important: 30
  - Not at all important: 4

- Available investment capital
  - Very important: 10
  - Important: 10
  - Neutral: 30
  - Somewhat important: 4
  - Not at all important: 4

- Initial cost of the system
  - Very important: 9
  - Important: 30
  - Neutral: 41
  - Somewhat important: 29
  - Not at all important: 21

Percentages
Policy changes

Policy changes importance in influencing adoption, n=24

Factors

- Increased water use costs
- Tax credits for the purchase of the improved water management system
- Increased governmental technical assistance and/or information.
- Increase in the share supported by the government for the improved water management system

Respondents

4=agree
5=strongly agree
Adoption of improved water management systems

In a nutshell:

• Farmers with more experience are less likely to adopt an improved water management systems – they rely more on heuristics or rule of thumbs in their decision-making, which in turn bias their decision

• Farmers with a positive perception of the BMP are more likely to adopt. If farmers think that the proposed BMP is better than the practice they have, and if they think the new BMP is profitable, they are more likely to adopt it. Results suggests that perception of the BMP as a better alternative, is one of the best predictors of adoption

• Larger farms are more likely to adopt, however, our results indicate that the effect of this variable is very small

• Farms with a larger percentage of sales coming from tomato, cranberry and onion production respectively, are more likely to adopt
Policy and Recommendations

- Case for public policy
  - Social net benefits > Private net benefits
  - Climate change policy
- Identification of better Agricultural Water Management Systems
- Removing barriers
- Incentives / Penalty to producers