

Understanding Farmer Motivation and Attitudes Regarding the Adoption of Specific Soil Best Management Practices

Summary and Recommendations

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SUMMARY

This report summarizes the literature on factors influencing farmer behavior in order to understand how to increase adoption of beneficial management practices (BMPs) for greenhouse gas mitigation, particularly practices related to soil health. The review has three components:

- Factors that affect adoption;
- Farmer segmentation and clustering techniques that can be used to targeting policies and engagement;
- Program review and summary of lessons learned.

The focus is on understanding the process of adoption and behavior change, particularly factors that influence farmers' motivations and attitudes and the role of information and local support.

Factors Affecting Adoption

The Reasoned Action Approach (RAA) was used to organize factors into three categories of belief about the practice that influence: *behavioral beliefs* - beliefs about the economic and environmental efficacy of the practice or behavior; *normative beliefs* – the social and ethical context for the practice; and *capacity beliefs* – the availability of sufficient information, technological, and financial resources to adopt the practice. Background factors are observable socioeconomic or biophysical characteristics of the farm or farmer such as age, gender, farm size, climate, income. The RAA enables grouping of similar factors across studies into determinants of behavior.

- No factor was always significant for predicting adoption of BMPs however in general farm size, age, tenure, experience and access to information, and economic feasibility were positively correlated with adoption.
- Farm size, tenure and debt were consistent predictors of program participation and practice adoption in Ontario. Tenancy interacts with cover crop BMPs because of high up-front investment and length of payback time required. Tenant farming is increasing and is correlated with high land prices in the South and Southwest regions of the province where there are also significant agri-environmental issues.
- Technological and structural barriers include lack of access to specialized equipment and knowledge to implement practices in specific agronomic settings.
- In terms of fit, the farm and food system context is just as important as the on-farm agronomic context. Practices such as cover cropping and crop rotation must conform to current technical, marketing and financing strategies that are designed to optimize cash crop and not multifunctional cropping systems. New programs should frame farms as multifunctional enterprises, to stimulate agronomic and market innovations, and to reinforce norms about the benefits to farmers and society of beneficial practices.

Segmentation Approaches

- Norms about 'good' farming practices interact in complex and subconscious ways to influence behavior. Segmentation approaches that focus on 'farm styles' can be used to target engagement strategies that use existing social and market networks and are consistent with norms, or change norms that hinder practice change.

- The UK adopted a segmentation approach based on 5 farm styles as a framework for targeting practice change strategies. While farm styles did not have a significant effect on carbon mitigation actions in the UK, styles may still be useful for understanding how to motivate different groups, particularly non-adopters.
- Symbolic capital and social networks associated with different farm styles can be used to influence farmer behavior.

Lessons Learned from Other Programs

- Program participation generally increased farmer awareness of environmental issues and BMPs. Most programs were not monitored for impact which can reduce reinforcement of beliefs about the practice.
- Increased efficiency of on-farm outputs and some improvements in soil health, water quality, increased cover vegetation, and reduced fertilizer use have been noted by participants in some programs, showing that evaluation and information sharing amongst stakeholders has focused on the efficacy of practices and farm economic benefits.
- Payments and cost-share initiatives have been effective in some programs. However cost-share payments are not high enough in areas of intense agricultural production or areas where farmers face pressure from urban development. Programs that provide long-term continuous support to farmers increase participation.
- Reasons for program participation in Ontario include: regulatory pre-emption (Environmental Farm Plan); prominence of environmentally sensitive areas on participant lands; and program flexibility. Participation barriers include concerns over time commitments; long waits for funding application approval; complicated record keeping and worries about confidentiality. Competing and inconsistent requirements from different programs made it difficult to minimize duplication of effort, or maximize leverage from available programs.
- Current cost-share arrangements in Ontario likely do not affect participation rates and funding approaches should be reevaluated. In some cases inadequate token funding levels were insufficient to incent adoption. In other cases farmers are accessing funds to support practices they planned to undertaken anyhow. Although the role of economic factors is secondary in terms of motivation, targeting incentives to costly practices which would not be adopted otherwise would improve the probability of practice change.

Key Findings

1. How to segment Ontario Farmers:

- Qualitative studies suggest that farmers have different attitudes and perceptions and internal motivations across styles and, farm types in Ontario. It is not clear that different styles have a significant effect on levels of adoption. Non-adoption in some of the more challenging areas in Southern and SW Ontario may require addressing farmer attitudes and normative beliefs.
- There are complex differences between adopters, potential adopters, and non-adopters. Targeted engagement addressing the motivations and barriers of each of these groups is required. In particular, strategies should focus on demonstrating both environmental and economic efficacy to maintain or increase adoption for weak adopters (those who currently adopt a limit subset of practices); removing barriers for potential adopters (those who are motivated to adopt but are not adopting due to structural or economic barriers); and overcoming motivational barriers for non-adopters.

- A number of significant observable adoption factors for Ontario farmers can be further explored for segmentation. These include: tenure (renters versus owners), large versus small farms, primary versus secondary income sources, and cultural influences, particularly new immigrants, Mennonites, Francophones and First Nations. Perceptions and interpretations of farm norms as well as stewardship and environmental beliefs should be assessed through future research.

2. How to design targeted programs in Ontario

- Motivation is a prerequisite to practice change. Economic, technological, and structural factors are only relevant once a farmer is motivated to change practice. Multiple structural, technological, economic, psychological and social factors contribute to practice barriers and motivations.
- Although adoption and potential adoption of climate mitigation and adaptation practices are correlated with concerns and belief in anthropogenic climate change, this does not imply that education about climate change risk will motivate non-adopters. Framing practice change through the lens of climate risk for non-believers may reinforce non-adoption. Instead farmers are more likely to be motivated by the on-farm environmental and financial benefits of practice change. Messages about adoption of soil health practices should focus on on-farm benefits and highlight the growing use of soil health practices by mainstream producers as part of farmer identity.
- Changing norms and the agricultural market context for unmotivated non-adopters is only possible in the long run. In the short run the greatest opportunities for behavior change are removing policy barriers and demonstrating environmental and economic efficacy for existing and potential adopters.

3. Technology Transfer Approaches

- Use adaptive management with peer to peer experimentation to understand the efficacy of different practices for different farm types. Extension is a learning process and collective development of solutions with farmers should be iterative and experimental – as in the Landcare and Monitor farm examples provided in the report.
- Ontario farmers underscored the need for more extension from neutral agents (such as OMAFRA extension agents) who are familiar with the local community, or are from a farm. Extension agents should provide specialized training for specific regional issues. OSCIA and OMAFRA representatives can also be trained to facilitate the development of grassroots associations and clubs for producers with shared interests.
- Workshops, short seminars, demonstration events, farmer clubs and one-to-one farm visits are more influential than telephone advice and written material. Tailor services to meet the different needs of different types of producers based on farm and farmer characteristics such as type of commodity, experience, age, size of operation, education and culture (PRA 2011).
- Cover crop extension requires written and in person outreach, and must clearly identify benefits; target specific cropping systems, feature local successful farmer, include calculator to estimate costs and benefits of adoption; and link to concerns about nutrient pollution (Carlisle 2016).

Next Steps

Increasing adoption of soil health practices requires multiple, coordinated approaches involving engaging producers through local level networks; developing targeted extension; and peer to peer learning linked to incentives. We provide 5 specific next steps which build on these three elements.

1. Develop a Farm Segmentation Framework and Test Engagement Strategies
2. Implement Additional Extension to Encourage Farmers to Implement Soil Health Practices Plan
3. Establish EFP as a Clearinghouse for Agri-environmental and Stewardship Programs
4. Develop a Peer-Peer Experimentation Program for Trialing Soil Health BMPs
5. Test the recommendations through implementation of the Ontario Cover Crops Strategy (OMAFRA, 2017)

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1. INTRODUCTION

The purpose of this report is to understanding the process of farmer practice adoption and behavior change in order to target programs to increase adoption of agricultural Best Management Practices (BMPs) for climate change mitigation and adaptation. The scope of the study includes a review of studies that explore 1) factors influencing adoption of soil and nutrient management practices for climate change mitigation; 2) approaches for segmenting farmers into groups for the purposes of targeting programs; and 3) program features and success factors particularly related to use of market segmentation techniques, extension, and technology transfer. Focal issues include the roles of farmers' motivations and attitudes; information and local support; and socio-demographic and economic factors which enhance or impede adoption. A more detailed summary of the studies reviewed is available as an accompanying background report "*Understanding Farmer Motivation and Attitudes Regarding the Adoption of Specific Soil Best Management Practices – A Background Paper*". Key references used in this report include Carlisle (2016); Prokopy et al. (2008); Dwyer et al. (2007); Pike (2008); and PRA (2011).

Findings were organized to address the following three questions:

1. How can Ontario farmers be effectively categorized into different ``like-minded`` groups based on the relative importance of factors that drive their adoption of soil management practices such as: attitudes, risk tolerance, socio economic factors, peer supports, other key drivers and barriers, as well as their general predisposition to adopting soil management practices;
2. How can targeted programs and messaging be designed to enhance adoption of soil BMPs among these different groups of Ontario farmers either directly or through influencers;
3. What technology transfer methods are expected to be most effective now and in the future.

The review focused on the following soil BMPs recognizing that while adoption behavior does tend to be BMP specific many relevant studies on factors affecting adoption are not BMP specific:

- Diverse crop rotations with perennials
- Use of cover crops to extend the months of ground cover with live plants
- Reduced tillage, residue management
- Organic amendments
- Afforestation, buffer strips, windbreaks, wind strips
- Minimizing compaction
- Soil testing
- Nutrient management (4Rs)
- Retirement of fragile lands
- Erosion control

1.1 METHODS

The Reasoned Action Approach (RAA) framework was used to organize results from the practice adoption literature. The RAA incorporates farm traits, farmer demographics, perceived BMP characteristics, social norms, and perceptions of self-efficacy in a single framework which describes the process of decision making. The flexible framework, which incorporates a number of internal and

external motivational factors, is suited for synthesizing empirical information from diverse sources which include a variety of explanatory factors and testable hypotheses.

The RAA organizes determinants of adoption in four overarching categories: behavioral beliefs, normative beliefs, control beliefs, and background variables. Behavioral beliefs refer to the landowner's perception of the *impact* of the BMP in terms of economic and environmental efficacy. Factors related to behavioral beliefs about the practice include profitability, riskiness, complexity, trialability, and ability to control environmental outcomes. Normative beliefs refer psychological and social factors related to the *rightness* of the practice and norms about 'good farming' which can be based on internal beliefs and values as well as external expectations from peers and neighbors. This category includes social network factors that influence attitudes including interactions with family members, farm organizations, and conservation organizations, as well as attitudes towards stewardship, profitability, and the environment. Control beliefs refer to landowner perceptions of their *capacity* to implement the practice and include factors such as skill level, availability of credit, availability of expertise, or access to information, and financial incentives.¹ Finally, background factors are observable socioeconomic or biophysical characteristics of the farm or farmer and include age, gender, farm size, and income.

Factors Affecting Adoption

We used the RAA framework to compile data from the papers reviewed into behavioral, normative, control, and background factors. We reviewed 41 studies, 2 which were qualitative reviews, 2 meta-analyses, and 19 survey/interviews. In terms of geography, 5 studies were from Canada, 27 from the USA (7 were from the Iowa cornbelt), 3 from Australia, 1 from New Zealand, 1 from Thailand, and 1 from Ethiopia. The others were not geography specific. Row crop, corn, and grain were the most common farm types. Management practices included 12 conservation tillage, 9 nutrient management, 6 soil management, 5 alternative crop rotations, and 8 cover crop studies.

Segmentation Analysis

The review of factors affecting adoption highlights the diversity of farm motivations and farming styles that determine adoption behavior. Segmentation focuses on the sub-cultures of farming systems in order to better understand how to target programs to increase uptake. Segmentation is particularly important for voluntary programs which must address attitudes and motivations of individuals, especially the social and psychological barriers to adoption for weak and non-adopters. We reviewed 12 studies of segmentation approaches employed in North America, the United Kingdom, Australia and Asia. Most studies were from North America and Europe and Central Asia (high income countries). Each study classified the farmer population into 3-6 segments (4 segments was most common).

Program Review

A search of agri-environmental stewardship programs across the US, Canada, Australia and Europe was conducted to better understand how different elements of environmental programs can be used to create behaviour change amongst farmers. The review focused on program design elements such as cost sharing and compliance; elements which targeted different groups of farmers; and knowledge and technology transfer (KTT) approaches that worked best for different groups.

¹ Note control factors can also include perceived ability to influence the environmental outcome, however for the purpose of this report we have included this belief with behavioral beliefs in order to focus on capacity issues related to programming and support under control beliefs.

We targeted our analysis to programs in Canada, the US and Australia because of similarity in farming systems and attitudes towards government. We excluded programs for which there was no evaluation. In total 15 programs were evaluated. These included cost share programs (2), social advisory clubs (2), farm plan programs (5) and one payment for ecosystem services program. Most program reviews did not look specifically at how program design elements other than cost share and extension affected participation.

In the next section of the report we highlight results from the literature review. We then provide a summary of findings from Ontario studies. We summarize key findings and conclude with recommendations and next steps for engaging farmers to increase adoption of BMPs for climate change mitigation and adaption in Ontario.

2. LITERATURE REVIEW SUMMARY

2.1 SUMMARY OF FACTORS AFFECTING ADOPTION

No factor is always significant for adoption, though there are overarching patterns. Farm size, age, access to information, and profitability are all correlated with adoption, as are attitudes towards for stewardship. Factors affecting actual adoption and likelihood to adopt are not always the same; in fact some studies find little correlation between factors that affect actual versus potential adoption (Niles et al. 2016). Some of the apparently contradictory evidence in some studies could reflect differences in how adoption behavior is defined in the study. Below we summarize a few key points highlighted in the literature. More information is available in the Background Report.

Behavioral Beliefs

Concerns about soil productivity, financial efficacy and water quality are the most important reasons for choosing soil management practices (e.g. Andrews et al. 2013) and highlight the need for messaging and extension to focus on beliefs about practice efficacy. Practice efficacy depends on beliefs about environmental risks and control over environmental outcomes at both the farm and watershed or larger scale. For example, farmers may strongly believe in water quality risk and the response efficacy of the practice at the field scale, but still believe they have limited control over nutrient loads due to uncontrollable external factors such as weather (Wilson 2014). For these groups of farmers it will be necessary to demonstrate how individual and collective adoption of practices can lead to positive environmental outcomes.

Normative Beliefs

There is mixed evidence on the correlation between the adoption of climate change adaptation and mitigation practices, and beliefs and attitudes towards climate change and the environment. Some studies find no correlation (e.g. Niles et al. 2016; Barnes and Toma 2012; Arbuckle et al. 2013) and others find positive correlation (Baumgart-Getz et al. 2012; Wilson, 2014). Education about climate change risks will not change the minds of non-adopters or those not-likely to adopt. Issue framing is important for encouraging adoption. Issue frames influence attitudes by highlighting certain beliefs and minimizing others (Andrews et al. 2013). Acceptance of frames depends on perceived credibility of the source and the farmer's own beliefs and values. Framing the benefits of climate adaptation and mitigation practice adoption through the lens of climate change to climate change deniers is conflict reinforcing and will not change behavior. On the other hand, framing the benefits of the practice through the lens of benefits for downstream communities or for on farm benefits is positively reinforcing for the practice change (Andrews 2013).

Control Beliefs

For soil health practices, knowledge barriers to adoption include lack of information about benefits of practices and how to measure them; lack of understanding of how to optimize cover cropping and crop rotation with cash cropping, and lack of regionally specific information on cover crop variety selection (Carlisle 2016). Access to capital and appropriate machinery are also barriers, particularly for smaller farmers. Increasing soil health practices requires a combination of education, research, policy, measures to overcome equipment barriers, and efforts to address the farm and food system socio-economic context (Carlisle 2016).

2.2 SUMMARY OF RESULTS FROM THE SEGMENTATION ANALYSIS

The review of factors affecting adoption highlights the diversity of farm motivations and farming styles that determine adoption behavior. The purpose of segmentation is to recognize the diversity of farmers, and to examine external, biophysical, and socio-economic factors that influence behaviors and constraints, as well as motivations and perceptions of different practices. Segmentation focuses on the sub-cultures of farming systems in order to better understand how to target programs to increase uptake (Dwyer et al. 2007). Segmentation is particularly important for voluntary programs which must address attitudes and motivations of individuals, particularly to understand social and psychological barriers to adoption for weak and non-adopters.

The literature distinguishes between factors that predict adoption and factors that are linked to pathways for influencing motivations and behavior. Much less is understood about the latter than the former. Behavior change is grounded in psychological, social, and economic factors. In particular while favorable external conditions may be necessary for behavior change they are not sufficient. Farmers must first be motivated to change. While external barriers such as finance can be addressed by changing the financial rewards of different behaviors, internal barriers must be addressed through communication and engagement strategies that influence attitudes and norms through the social context of farming (Pike 2008). Thus societal norms are an important factor in understanding how to engage farmers and construct messages that are socially acceptable.

The concept of “Farming style” originated in the Netherlands, and is a way of combining social, economic, ecological and technological practices that underpin farm decisions into different farming subcultures. Easy to measure external factors, such as age, farm size, and farm type, can be used to define farming styles. However internal perceptions and attitudes as well as social factors are just as important. These are more difficult to measure and often require in-depth qualitative approaches to understand the diverse range of motivations that drive behaviors in different farm styles.

The concept of “habitus” refers to the attitudes and values that underpin farming decisions (Bourdieu 1985; Juhasz 2014). These attitudes develop over time as successful strategies for interacting in the farm system until eventually they become sub-conscious. The attitudes are formed in response to structural elements of farming, such as market and production technologies, as well as social structures. Importantly, social dynamics create opportunities for practices and attitudes and values to change over time. Identifying the social and structural context in which attitudes and values exist helps identify opportunities to intervene (e.g. Pike 2008).

The key to understanding “habitus” is to recognize that attitudes and beliefs represent “symbolic capital”. For example, the way a field looks, how productive the land is, how entrepreneurial and risk taking the farmer is, are forms of symbolic capital associated with sub-cultures of what it means to be a “good farmer”. Symbolic capital leverages social and economic rewards for the farmer within different social networks. The hypothesis is that understanding and acting on symbolic attitudes and beliefs can change agri-environmental motivations and behaviors. Segmentation studies in Europe have attempted to categorize farms according to primary farming motivations and values, and then link these motivations to value orientations that could be leveraged to develop key messages or engage different groups. Some examples are provided below (e.g. Dwyer et al. 2007).

A similar suite of farm attributes and farmer characteristics have been used to define different farm styles in the literature. The most common variables were related to environmental practices, wealth or

available resources, information networks, and farm-as-a-business versus custodial and production orientations where animal health and yield were motivators. Cluster names reported for 11 studies were:

1. Conservationist, Traditionist, Improvident, Risk-averse
2. Pragmatists, custodians, modern family businesses, challenged enterprises, lifestyle choice
3. Value orientation - instrumental, expressive, intrinsic or social values
4. Dual Interest Theory-low stewardship, moderate to high farm as-business attitudes, high stewardship, low business, high stewardship, high business, very high stewardship, very low business
5. Large commercial producer market segments: balance, price, convenience and performance
6. Conventional, alternative, status
7. Pro-environmental/conservationist, productivist, optimism, pessimism, traditional, technological practices
8. Concerned but unengaged, multiple objective, production oriented, disconnected and conservative, well-connected and progressive
9. Traditional, Supplementary, Business-oriented, Non-operator
10. Custodians, Lifestyle choice, Pragmatist, Modern family business, challenged enterprises
11. Resisters, apathists, multifunctionists

The Defra Model

The UK experience is noteworthy as the Department of Environment, Food and Rural Affairs (Defra) tried to institutionalize farm segmentation within its policy process. The Defra farmer segmentation model and its application to climate change are explained in more detail below (Figure 1)

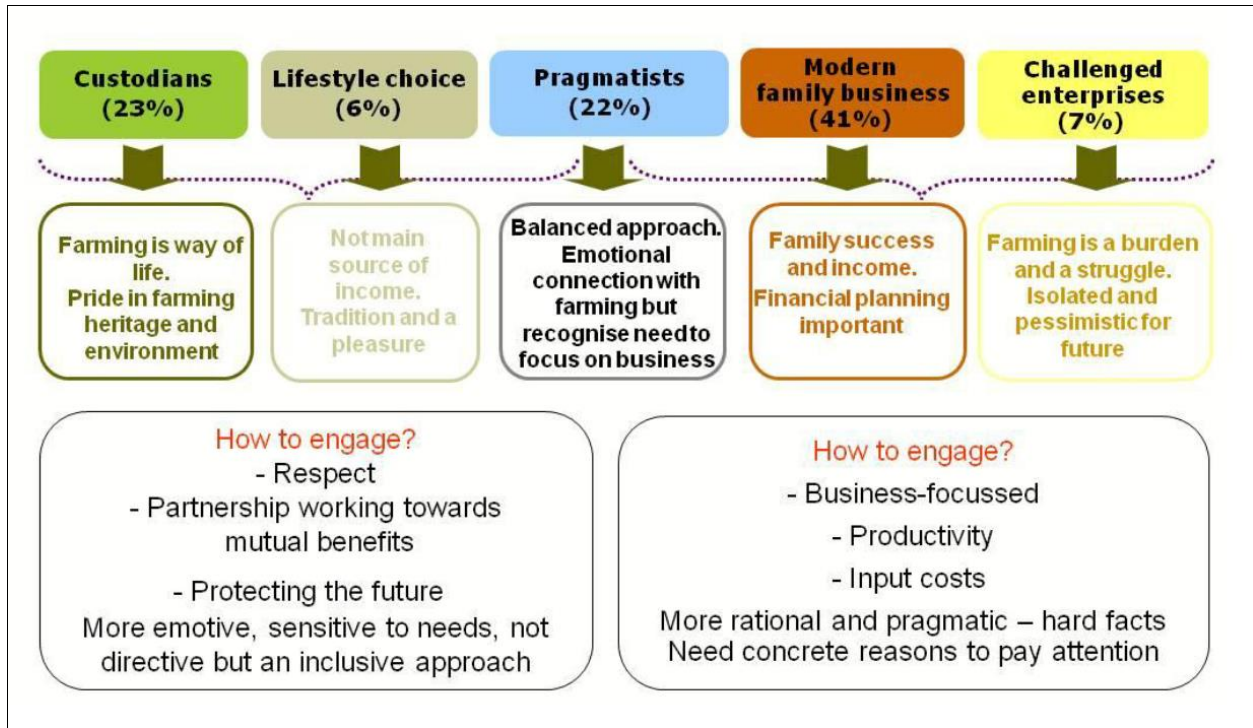


Figure 1 the Defra Farm Segmentation Model (Pike 2008)

In the mid-2000s, Defra commissioned studies (see Dwyer et al. 2007; Pike 2008) to quantify and characterise the diversity within English farming. The studies reviewed international academic literature categorising farmers and measuring attitudes and farming objectives, interviewed experts, and surveyed farms. The Defra farm segmentation model (Pike 2008) is based on a survey of 750 farmers using 17 objective and value questions. Farmers were clustered in 5 types: custodians; lifestyle choice; pragmatists; modern family business; challenged enterprises (see Figure 1). An important finding is that segments were similar when profiled by size, region and farm type and only differed when attitudes were included. Only a small number of attitudinal statements was needed to assign respondents to segments.

Custodians and lifestyle choice are more likely to respond to emotive messages that emphasize inclusion, partnership, and mutual benefits. These are the groups that are targeted in Alberta's 'partnership approaches'. Key messages include: protecting the future, partnership approach, not directive. Modern family business and Challenged Enterprise types are more focused on the bottom-line while Pragmatists are mainstream, traditional, family farms and are a mixture of the other types. The typology was used to identify strategies to target each "type" (see Table 1 below).

The DEFRA segmentation model was tested for adoption of climate change BMPs (Barnes et al. 2010). The aim of the study was to identify the most relevant farm types, sizes, behavioral segments, attitudes and motivations for uptake of low carbon opportunities. However the results showed no correlation between practice adoption and farm type. Barnes et al. (2010) found diversity in perceptions of the importance of climate change, but generally a poor level of understanding in relation to farming. Most farmers did not view climate change as an important consideration in their business. This result was consistent for farm size and segmentation type even when the uptake of mitigation methods was high. Barriers to uptake were financial, educational, management, administrative, and structural. The

conclusion was that large farms should be targeted irrespective of farm types – Dairy, Cereals, General Cropping and Mixed – due to their size-related and sector-specific abatement potential.

2.3 SUMMARY OF ELEMENTS AND LESSONS FROM OTHER PROGRAMS

Program Elements

Eligibility: All programs reviewed were voluntary. Most programs, aside from social advisory clubs, were merit based, that is, participants needed to complete specific guidelines to be eligible. Many programs required a certified farm plan to be eligible for participation. One program (the USDA Conservation Security Program), paid for past practices (BMPs already implemented). None of the programs were first-come-first-serve. The majority of programs also had an educational component. One program (Landcare Australia) was open to the general public. All others were only open to rural-landholders.

Financial Incentives: Programs used a variety of financial incentives including: reduced crop insurance costs (e.g. Campbell 2014); a waiver of civil fines and penalties during future pollution events in Michigan’s Agricultural Environmental Assurance Program (MAEAP 2017); and financial payments for future or past BMP implementation.

Enrollment: Enrollment was funneled through a local coordinator/consultant for six of the reviewed programs. The two programs, Clubs conseils en agroenvironnement (Tamini 2011) and Landcare (Landcare Australia 2017), with a social networking focus did not require an application for participation.

KTТ Approaches: Programs varied greatly in their use of and presence on social media. Most programs involved partnerships with local groups and had a meeting component, even if just for initial recruitment. SmartCane BMP (Canegrowers 2017) created its own smartphone app to assist farmers in the accreditation process

Messengers and Delivery Agents: While most programs were at least, in part, government funded, local program coordinators with extension/agrology experience were the primary messengers. Sometimes these advisors were fellow farmers. In some programs, political tensions can strongly impact the trust between participants and local program coordinators (e.g. MAEAP 2017). Collaboration with all stakeholders (including farmers) during the program development phase, such as in the Northern Everglades Payment for Ecosystem Services Program (Shabman et al. 2013) was shown to increase trust in program participation. In some cases, miscommunication between levels of government has resulted in misinformation to participants, which can act as a deterrent for participation as in the USDA Conservation Reserve Program (Stubbs 2014). In terms of building trust, programs that focus on social networking, which relies heavily on local knowledge exchange, have created an atmosphere of trust among participants.

Lessons Learned

- Program participation generally increased farmer awareness of environmental issues and BMPs. However the true environmental impact of these programs is very difficult to evaluate and has rarely been measured, despite the fact that improved environmental health is a main goal for every program.
- Increased efficiency of on-farm outputs and some improvements in soil health, water quality, increased cover vegetation, and reduced fertilizer use have been noted by participants, showing that evaluation and information sharing amongst stakeholders has focused on the efficacy of practices and farm economic benefits, which is consistent with what farmers say they are interested in understanding.

- Some program models such as the Nova Scotia Environmental Farm Plan (Atari et al. 2009; Yirdoe et al. 2010) provide long-term continuous support to farmers which is positively associated with participation.
- The programs deemed most successful by reviewers had an educational/workshop component

Financial Payments

- Payment programs, particularly geography-specific cost-share initiatives, have been praised for effectiveness in some programs. The Northern Everglades Payment or Ecosystem Services program is a relatively new model that has found some success (Shabman & Lynch 2013; Shabman et al. 2013). Payment criteria, such as payment caps, limit the extent to which larger farms can participate (e.g. payment caps disproportionately affect larger farms) and so should be carefully analyzed to avoid unintended consequences.
- Cost-share payments are not high enough in areas of intense agricultural production or areas where farmers face pressure from urban development. Land-rental payments that are calculated by acreage disproportionately benefit farmers with larger land-holdings and fail to properly place value in ecological goods and services. Some suggest payments should be based on the environmental value of the BMP and not on acreage. Paying farmers for BMPs already implemented, as in the Conservation Security Program (Soil and Water Conservation Society and Environmental Defense, 2007) was not effective.

Compliance

- Programs without financial incentives had few performance standards or repercussions for non-compliance. Some programs lack on-the-ground staff to ensure project commitments are being fulfilled properly such as the USDA EQIP program (USDA, 2017)

Motivation for Program Participation

- The top reasons cited for program participation include: regulatory pre-emption; prominence of environmentally sensitive areas on participant lands; program flexibility with opt out and contract renegotiation opportunities; public perceptions and relations; how information was disseminated (PRA 2011; McCallum 2003; Jahusz 2014).

Barriers to Participation

- Participation barriers include concerns over time commitments for implementation; long waits for funding application approval; complicated record keeping needed for some accreditation programs; poor economic justification and perception of improper government support; worries about confidentiality (PRA 2011).

Value of Social Capital

- Social capital can have a large impact on program success. In particular, the dispersal of trusted knowledge through community networks (involving local extension officers, advisors and farmers) has had a positive impact on environmental stewardship. For example, participation in a local agro-environmental club has had a statistically significant positive impact on BMP implementation in Quebec (Tamini 2011).
- Programs should not be 'one-size-fits-all'. Programs have been more successful when they cater to differ farm types.

- Programs are successful when they include farmer input about actions such as ALUS (Campbell 2014)

The following examples of successful engagement and extension approaches are taken from Dwyer et al. (2007)

The National Landcare Programme, Australia

Purpose: form community Landcare groups based on watersheds or neighborhoods to address local soil erosion and salinity problems in a cooperative partnership manner

Components: experimental and demonstration projects, Education, farm and catchment planning, tree planting, demonstrations and trials of new practices

Lessons: factors for success include: group need assistance, leadership, priority setting and catchment planning, and member recruitment and retention; drawback - led by small core of dedicated individuals who need admin support to avoid burnout. Independence of the groups is a problem for achieving outcomes.

The Water Quality Program and Environmental Quality Incentive Program (United States)

Purpose: The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers to plan and implement conservation practices that improve soil, water, plant, animal, air and related natural resources on agricultural land and non-industrial private forestland. EQIP may also help producers meet Federal, State, Tribal, and local environmental regulations

Components: Demonstration Projects, Hydraulic Unit Area Projects, Water Quality Special Projects, Water Quality Incentive Projects, Priority Components Research, and Management Systems Evaluation Areas.

Lessons: The program showed the value of targeting areas in need of improvement and convincing farmers that a problem exists; accompanying environmental improvements with financial benefits enhances the likelihood of success; co-ordination of education, technical assistance, financial assistance, interaction with local stakeholders and ongoing performance evaluation were found to be crucial elements of success. Education only was ineffective; providing farmers with evidence of change (following their actions) improved adoption. Voluntary programs are enhanced if backed by firm but flexible regulation.

Monitor farms, New Zealand

Purpose: A network of farmers and monitoring sites to demonstrate how nutrient management solutions can work on a commercial farm and assist producers in decisions to reduce nitrate leaching

Components: Local community groups select a facilitator and Monitor farm which is relevant and applicable to the local region, a business plan is then developed and implemented along with associated monitoring plans for 3-4 years. The Monitor farmers are assisted through the process by a community group which comprises local agribusiness people including vets, consultants, farmers, scientists, financiers and processors. Shared learning is focussed on farm viability and competitiveness not environmental management, and there is evidence of benefits and increased production.

Lessons: The commercial success of Monitor farms approach is attributed to the fact that knowledge is generated entirely within the group following objectives set by the farmers themselves ensuring the knowledge is relevant to the local farming population. Industry involvement ensures transfer of the knowledge across the industry.

Figure 2 Three Examples of Successful Technology Transfer Approaches

3. ANALYSIS OF ONTARIO FARMERS

This section addresses the specific context and applicability of the findings above to Ontario farms. Census Farm Operator Data (Statistics Canada 2017) shows that oilseed and grain farms are the most common operation, followed by other crops. Of field crops, soy, corn and winter wheat make up the largest three crops. The average farm size (249 acres) is increasing. Over half of farm acres are soy and corn. Ontario has the second lowest rate of decline of farm operators in Canada (next to Quebec) and women make up almost 30% of farm operators. The number of farmers in the lowest and highest age categories both increased, with operators older than 55 representing 55% of operators, and those under 35 years representing 9% of operators. Compared to 2011, average operator age increased by about 1 year to 55.3 years. In addition, fewer farmers worked off the farm (46.3%).

In Ontario participation in agri-environmental programs is primarily voluntary (exceptions include the Nutrient Management Act), regionally flexible, reliant on self-regulation, and decoupled from other programs (McCallum 2003). The decentralized approach allows significant flexibility and locally and regionally responsive programming. Ontario's experience can be contrasted with the UK and Europe where there is greater focus on regulatory and top down carrot-stick approaches, and the US where there is greater emphasis on cross compliance between environmental stewardship and other income support programs. The voluntary decentralized approach in Ontario is similar to the Australian experience however Australia has experienced greater severity of environmental problems which creates a different urgency and motivation for change.

Ontario's main vehicle for delivering agri-environmental programming is the province-wide Environmental Farm Plan (EFP) which is delivered by the arms-length Ontario Soil and Crop Improvement Association (OSCIA). OSCIA is a farm-based organization which is accountable to the government for outcomes. The regional Rural Water Quality Programs are also province wide and significant. They are largely funded by the province and municipalities and delivered by Conservation Authorities (CAs) which are local public sector organizations governed by municipalities. In addition to these large programs there are numerous smaller stewardship and land management programs such as the Land Stewardship and Habitat Restoration Program administered by Ontario Ministry of Natural Resources and Forestry, and the Farmland Health Checkup (Nebel et al. 2017). However EFP and RWQP are the most studied.

3.1 ONTARIO PROGRAMS

Environmental Farm Plan

The EFP provides workshops and guidance to farmers to assess their operations for environmental risks and develop self-defined action plans to reduce risks. Workshops are held throughout the province. EFPs are linked to cost-share financial incentives through the Canada-Ontario Farm Stewardship Program. The workshop takes one day and the typical farmer spends approximately 6 hours of their own time to fill out an EFP. The participation rate is high with 41% of farmers in 2011 having completed an EFP within the previous three years. Ontario farmers have on average completed 65% of identified actions (Statistics Canada 2011). Soil management is one the most commonly completed actions (PRA 2011).

The EFP has increased awareness and led to behavioural changes by farmers (McCallum 2003; PRA 2011) although the depth of behavior change has been questioned with some evidence that farmers participate in order to obtain matching funding for projects they were already planning and that farmers

omit information due to worries about identifying risks and the potential for liability (Smithers and Furman 2003, PRA 2011). A 2010 survey of participants in EFP commissioned by the Ontario Federation of Agriculture found that 62% of respondents went to the EFP workshop with a clear environmental project in mind, and almost half of the respondents (45%) reported changing their priorities for environmental projects because of what they learned in the workshop. Respondents indicated that the workshops increased their awareness and knowledge of agri-environmental issues and concerns, motivated them to take action, and helped them prioritize projects. Furthermore, producers paid for the majority of the actions.

Factors Contributing to EFP Success:

Features of EFP that work are the educational workshops, confidentiality, and opportunities to interact with other farmers (PRA 2011). Success was driven by agency representatives working directly with farmers and perceptions of the program as ‘farmer driven, owned and operated’ (McCallum 2003). OSCIA was seen as a good delivery agent because it is arm’s length from government however there was also the negative perception that it was “rather loose-knit and reliant on volunteers”. Farmer perceptions of EFP program value included financial incentives, communication quality, and planning and outreach effectiveness (Juhasz 2014). The 2010 survey found that virtually all producers (94%) attended an EFP workshop so they could access cost-share funding (PRA 2011), however interviews with farmers indicated that the educational value of the EFP is greater than its financial value and that the incentives were insufficient to cover costs. Thus it is fair to conclude that the motivations for practice change were not primarily to receive payments. Other motivations for participation include avoiding future regulation.

Factors Contributing to EFP Barriers

Barriers to EFP participation include: worries about confidentiality, liability and litigation (though these have decreased over time (PRA 2011)); lack of awareness, knowledge or understanding of the program; inadequate financial incentives; and lack of longevity of program (i.e. the concern that the program and funding would not continue over time); lack of follow up; and finally community acceptance of EFP representatives, and lack of trust of government authority (McCallum 2003, PRA 2011, Juhasz 2014). Conditions attached to programs, transactions costs, and doubts about the financial benefits from participation are barriers (McCallum 2003)

Rural Water Quality Program

The Rural Water Quality program is delivered by CAs and tailored to municipalities, locally flexible with cost sharing arrangements. CAs are perceived to have an important role in agri-environmental programming but are also perceived as lacking capacity to develop grant proposals as well as the personnel to deliver programs (McCallum 2003). CAs draw funding from numerous programs and partnerships, and also receive funds through municipal tax base. The Grand River and Upper Thames watershed’s programs are frequently studied. McCallum (2003) found low participation rates in RWQ programs due to insufficient funding. There is also variable access to RWQ programs across the province due to variations in municipal funding and eligibility constraints. In particular, watersheds with low populations had low tax bases, limiting funds. Generally insufficient monitoring is seen as a long term risk due to the RWQ program with increased public demands for accountability and transparency. The Ontario government is currently reviewing the Conservation Authority Act, and the Niagra Conservation Authority is facing legal challenges related to lack of financial transparency.

Lessons Learned from CWP and EFP

There were a number of common perceived barriers by farmers gleaned from interviews and focus groups. These include insufficient payments to make participation worthwhile, mistrust of government, lack of time and perceived paperwork. Participants were motivated by cost saving rather than environmental stewardship, and farmers missed direct extension from OMAFRA staff who were seen as neutral. Focus groups also indicated some regionally differentiated perspectives. In particular, social license concerns were more prevalent in the North, versus South. Another barrier identified in focus groups was whether practices would be compatible with future regulations, such as expectations under the Nutrient Management Act. Some concerns were raised over loss of control over land management decisions and the influence of environmentalists on farm decision making. In general farmers expressed lack of awareness and knowledge of how to access funding programs. The complexity and multiplicity of programs was confusing and direct benefits to farmers were not clear. Local flexibility was perceived as unfair, and interestingly environmental payment programs were viewed as unrealistic in regions where the environment was more intact (McCallum 2003). Structural and organizational challenges include insufficient time and financial commitments by programmers leading to indifference in the farming population (McCallum, 2003; Agnew & Filson, 2011, p.118 as in Juhasz 2014).

3.2 REVIEW OF FACTORS AFFECTING PROGRAM PARTICIPATION IN ONTARIO

Though somewhat dated, a study by McCallum (2003) found from a sample of farmers surveyed at trade shows that 8.9% were unaware of the existence of any agri-environmental programs while 42.3% of farmers who were aware of programs had never participated. This suggests the scope of opportunity to focus on non-adopters. Most of the program reviews and research on factors affecting program participation in Ontario focus on background socio-economic factors. Exceptions are studies by Jurhasz (2014), PRA (2011) and McCallum (2003) which conducted interviews and focus groups to explore motivation and engagement factors. Participation factors that have been identified for Ontario are summarized below. The studies by Jurhasz and McCallum focus on dairy farmers and some of their findings may not apply to the crop sector because supply management and the Nutrient Management Act contribute to a different financial and regulatory context. Segmentation would help identify the generalizability of their results.

Behavioral Beliefs

Environmental and Financial Efficacy: Most farmers would participate in programs if the advantage to them was clear. Most farmers feel they are already good and innovative environmental actors and would need to be convinced that they are not doing enough (McCallum 2003)

Personal Benefit: Nebel et al. (2017) found the most highly rated motivation to participate in a wetland enhancement program was 'more information on how the decline in wetland area affects them personally'

Health Benefits: Jahusz (2014) found farmers motivated by health impacts on farm and animals

Normative Beliefs

Environmental Concern: McCallum (2003) found the most frequent motivation to participate was environmental concern (34.0%), followed by economics (23.7%), stewardship (21.1%), education (13.4%), and finally persuasion by others (4.0%).

Ethical Attitude: In empirical studies *ethical attitudes* have been shown to have both positive (Nadella et al. 2014) and insignificant (Brick 2013) effects on conservation behavior. Nebel et al. (2017) found ethics was a significant factor for land conservation and that environmental attitude was the strongest predictor of pro-environmental behavior

Social Networks and Trust: Juhasz (2014) found no statistically significant relationship between social sources of information about agri-environmental programs and degree of program participation. Juhasz (2014) also found farmers learned about programs through a wide variety and multiple sources. Mistrust by farmers of agencies and their personnel was reported in McCallum (2003), PRA (2011) and Jurhasz (2014). Juhasz (2014) found a positive relationship between program satisfaction and willingness to promote programs to others. Similarly PRA (2011) found the majority of individuals who participated in the EFP were willing to recommend it to others. However McCallum (2003) found the perception by some farmers that participants might be viewed as status seekers, and others did not want to advertise that they were participating in programs.

Proximity: Juhasz (2014) found no statistically significant relationship between participation of a farmer's immediate neighbor own participation. Friends, industry and farm organization contacts were more important. In terms of "isolation" Juhasz (2014) also found no significant relationship between the strength of their social relationships and degree of program participation. Dairy farmers saw themselves as independent/individualistic and worried about the "group think" of networks, as well as potential corporate agendas of some farmers and advisors pushing "pharma" or fertilizer. On the other hand, PRA (2011) found that farmers use their social networks to access information.

Control Beliefs

Control Beliefs concern the farmer's perceptions about her/his capacity to adopt the practice. These factors depend on knowledge, information, technological, and financial capacity.

Knowledge/Skill: Several studies noted the importance of *extension* and the need to understand how to implement practices (McCallum 2003, PRA 2011, Jauhsz 2014) and complained about cutbacks to OMAFRA extension staff who were perceived as knowledgeable and neutral.

Financial Capacity: participation was positively and significantly associated with farm income (Dupont 2010, Nebel et al. 2017) and the size of grant and percent of cost share (Dupont 2010). Brick (2013) and Nebel et al. (2017) found insignificant correlations for debt load. However Juhasz (2014) reported that one of the most prominent issues for farmers was indebtedness and the need to finance operating costs to adopt BMPs or complete projects. Jahusz (2014) also differences between older and younger farmer attitudes towards debt which could reflect life cycle effects. A survey of farmers by Ipsos-Reid (2006) found cost of adoption to be one the main reasons cited for not using a specific BMP (33%) and (84%) felt it was important for the government to provide some sort of financial assistance for BMP adoption, a finding also reported by Filson (2009). support/financial incentives for those asked to participate in programs, 29% felt that there needs to be more funding with the EFP, and 26% felt that there needs to be more EFP education and training. PRA (2011) found that 23% of the EFP survey respondents lacked finances to implement identified actions.

Background Factors

Background factors include socio-economic and demographic variables that relate to the farming enterprise including biophysical factors, farm size and gross receipts, farm type, level of off-farm income, tenure, education, debt levels, and family and intergenerational factors.

Farm Size: Farms most likely to be implementing BMPs are the larger farms (Filson 2009, McCallum 2003, PRA 2011, Brick 2013, Juhasz 2014) with greater gross farm sales (Filson 2009). EFP participants have higher revenues and larger farms than the Ontario average, however new participants tend to be smaller (PRA 2011). McCallum (2003) reported an inverse relationship between net returns and adoption for dairy farms, possibly because adoption is correlated with larger farms which are concentrated in the North. Low participation rates occurred in regions of high net returns and that had the highest environmental risk in terms of habitat and biodiversity loss, and non-point source pollution (McCallum 2003)

Off-farm income: Both low levels of off farm income and high levels of off-farm income contributed to lower participation rates – possibly illustrating the correlation of high off-farm income with part time farming, and low levels of off-farm income with more economically marginal farms or more traditional farms (PRA 2011). McCallum (2003) found significant differences between Primary (farming is the primary source of income) and Secondary (farming is the secondary source of income) with secondary farmers less motivated by environment and stewardship and more motivated by financial factors. Primary farmers were also more aware and more active in programs (McCallum 2003). Nebel et al (2017) found that willingness to set aside land was more likely for landowners who do not rely on farm income, while enrollment in a stewardship program was less likely.

Tenure: Nadella et al. (2014) report a steady rise of farmland under tenancy with tenants operating approximately 40% of Canadian farmland. They found tenure influences the adoption of BMPs which require site specific investments with long term benefits. Tenure had no effect on the adoption of conservation till which has short term benefits, but tenants were less likely to plant cover crops than owners. Filson (2009) found that land ownership had a slightly negative effect on adoption, however that study was not structured to examine tenure specifically.

Socio-demographic factors: Practices were not correlated with age (Nebel et al. 2017, PRA 2011, Brick 2013, Filson 2009, Juhasz 2014) or sex (Juhasz 2014) but increased with the number of years farming (PRA 2011, Brick 2013); Education was insignificant (Filson 2009, Juhasz 2014) or negatively correlated with adoption (PRA 2011). Brick (2013) found a positive correlation between conservation actions and length of farm ownership, speculating that length of ownership was associated with pride in the property. On the other hand, Juhasz (2014) found newer farm owners tend to be more inclined to participate than long time farmers and suggested that participation is higher with recent migrants since “newcomers” have greater willingness to impress and fit in with local environmental standards and practices and may not yet have developed as strong informal networks resistant to change.

Internet use: Internet use had mixed results with Dupont (2010) finding a positive correlation and Juhasz (2014) no correlation between internet use frequency and degree of program participation.

Agronomic factors: - Nadell et al. (2014) found that conservation till was more likely on larger plots of land, and on land planted to soybeans and less likely on land planted to corn (possibly due to residues associated with corn crops). Cover crops were less likely in fields grown to soybeans, and more likely in fields growing winter wheat. Nebel et al. (2017) found the area of land set aside for conservation was positively related to land type.

Region: Regional differences were largely found to be insignificant (Nebel et al. 2017, Juhasz 2014, McCallum 2003, PRA 2011).

4. KEY FINDINGS

4.1 HOW TO SEGMENT ONTARIO FARMERS

- Carlisle (2016) recommends targeted outreach to particular groups, including increased outreach to renters and off-farm landowners, peer-to-peer conservation networks among women, and tailored communication strategies that address the difference between small and large farmers and adopter and non-adopter audiences. Ontario evidence on factors affecting adoption also supports targeting these specific groups (women tend to have smaller farms). Except for these categories there is little consistent information on other observable background factors that contribute to participation that could be used to segment the market. Unobservable internal factors that contribute to differences between adopters, weak adopters, and non-adopters may be more important than observable factors
- There is some disagreement about whether farm styles are a useful construct – and whether farmers would recognize themselves in the farm styles. The UK (Defra) has gone the furthest of any jurisdictions assessed in employing farm-style models to develop targeted strategies for different agricultural subsectors in the delivery of their programs. Defra identified farm 5 styles but found no difference in the impact of styles on adoption of practices until attitudinal factors were included. This highlights the importance of styles in framing messages and targeting the motivations of weak and non-adopters.
- In the most comprehensive Ontario analysis of social factors (Jahusz 2014), there appeared to be little quantitative evidence of impacts from social network variables varying by different regions or farm types.
- Communities that had high participation rates appeared to have cultural cohesion – for example, Mennonite and First Nation communities in the Grand River watershed, or Francophone farmers in Eastern Ontario. Other segments that appeared worthy of targeting are new farmers from primarily European backgrounds who have had prior exposure to agri-environmental programming under the European Directives. Cultural backgrounds may be an important segmentation variable to target, especially when there are visible cultural networks for minorities.
- The most consistent factor affecting participation in Ontario is the size of the farm, suggesting that there may be styles associated with farm size that could be developed through future research. There appears to be a dichotomy between large intensively managed farms with full time employees and small family operated farms that have greater financial risk in Ontario. It is not clear whether large farms or small farms are facing the greatest environmental challenges (Filson 2009).
- Environics Research Group (2003) also found that “stewardship” meant different things to different farmers (for 67 percent of Ontario farmers, stewardship meant “keeping the land economically in production” while some 33 percent of farmers felt it meant “voluntarily conserving the natural environment”) suggesting the dichotomy between economy and stewardship could another segment
- Practice segmentation distinguishing between ‘structural’ practices (buffer strips, grassed waterways, tree-shrub establishment, wildlife habitat management), and ‘operational’ practices (nutrient management, manure lagoons, tillage practice, conservation crops) (Juhasz 2014)

- Belief segmentation - those who attributed climate change to natural causes, were uncertain about whether it is occurring, or did not believe that it is occurring were less concerned, less supportive of adaptation, and much less likely to support government and individual mitigative action suggesting that outreach with farmers should account for these attitude differences (Arbuckle et al. 2013).

4.2 HOW TO DESIGN TARGETED PROGRAMS

- The UK farm style approach targets different engagement strategies with different farm styles by linking sources of information to styles, and identifying different types of symbolic capital when tailoring messages. Ontario does not have this information but could test such a model through surveys and market research (see below under recommendations). With respect to climate mitigation strategies in the UK, farm styles did not have a significant impact on the adoption of GHG mitigation practices (Barnes et al. 2011). In fact the UK experience found no conclusive evidence about how policy can be differentiated between sectors/types or segments, likely due to the large variation within segments. Thus policies that are broad based and sensitive to a range of situations would promote wider uptake (Barnes et al. 2010): “though “not helpful to policy makers, it is consistent with the high degree of heterogeneity within the industry” (p. 35). Table 1 shows how different farming styles could be linked to engagement opportunities (adapted from Dwyer et al. 2007).
- Recognize that different factors influence decisions at different levels of social organization (Dwyer et al. 2007) and create a map of influence for different farm segments:

Farm level influences: household and farm business dynamics (intergenerational issues, cross-generation and family decision making, debt, technology etc.)

Community level influences: specialist and commercial networks, local farm organizations, local business networks, and informal clubs; also churches, social clubs.

Societal influences – consumers, regulators, retailers, public and social license, government

Table 1 Farming Styles and Engagement Opportunities

Label	Style	Symbolic Capital	Information Channels	Recommended Approach
Older/Traditional	Poor knowledge of impacts Use traditional technologies Low economic capacity May rely on off-farm income		Family and other farmers Social networks	Peer-peer learning Local organizations with farmers from the community
Older/Innovative	Early adopters and experimenters	Passion for farming Soil health Animal Care	Agricultural trade fairs, trade journals, and peer groups	Demonstration farms and peer-peer experimentation Discussion groups focused on their passion
Young innovators	Young family farmers Weak ties to traditional farming	Change and restructure Positive attitude towards nature conservation	Consumer groups and conservation authorities	Willing to engage in advisory groups
Agro-business	Large Low margins High intensity Policy aware	Professional attitude Growth Optimization Use of technology	Agronomic advisory systems Commercial consultants	Industry channels Business breakfasts Short seminars
Reclusive	Involuntary farmers Farm marginal	Low motivation	Family members Vets, commercial feed or fertiliser representatives	One-one advice from trusted local source Raise awareness with family
Part-time	Lifestyle choice Unaware of policies		Not engaged	Needs help identifying information Provide direct assistance

Given the lack of significant results on segmentation the remaining insights are more general and can be employed for all farm types.

- Climate change practices should be encouraged as part of a suite of good practice measures emphasizing co-benefits for water, soil health, and on-farm benefits, de-emphasizing climate change. Given the strong focus on economic returns and the need to demonstrate cost-effectiveness, this should provide a key focus of any messaging.
- Concerns were raised that the three main Ontario farm organizations (OFA, CFFO and NFU) “fight against each other” and that they are not viewed as ‘farmers’. Smaller local groups that address particular problems are seen to deliver more objective advice. Social networks are useful for reaching out to producers who are not otherwise active in farming organizations. Peer information is more important than information from the media or government. The success in engaging Mennonites, First Nations, and francophone farmers suggests that working through cultural social networks is a good practice.

- While it is believed (e.g. Dwyer et al. 2007) that farmers learn from their neighbors, preliminary analysis in Ontario suggests that weaker networks are more important for spawning new ideas, that extension is desired and often required, and that business networks are critical for targeting growth oriented and entrepreneurial non-participants, while isolated non-participants should be approached via trusted consultants or through education of family members (Jahusz 2014).
- Target communication to farmer characteristics and the stage the farmer is at in the decision-making process. Messages should target as wide a range of people as possible using a variety of approaches and a combination of different mechanisms. Mass media such as simple leafleting and the farming press can be used to increase awareness but a one-one approach or practical demonstration is required to link awareness to action. Table 2 below, modified from Dwyer et al. (2007) shows how to engage farmers using different communication mechanisms.

Table 2 Summary of How to Engage Using Different Communication Mechanisms

Mechanism	Strengths/Opportunities/Threats
Mass Media (farm press, leaflets)	<ul style="list-style-type: none"> • chief vehicle for creating farmer awareness
One-One Advice (on-farm visits with credible advisor)	<ul style="list-style-type: none"> • Tailored to specific farm situation and tech transfer • Commercial Consultants who establish regular one-one visits could be credible sources for disseminating environmental information
Demonstration Farms	<ul style="list-style-type: none"> • Provide evidence of suitability of new technology and promote opportunities for farmer networking • Tend to Attract Larger Commercial Farmers • Must be widely marketed
Discussion Groups	<ul style="list-style-type: none"> • Interchange of ideas and experiences • Facilitate action based research approaches to group learning and empowerment • Tailor to character of group members • Tend to attract progressive farmers
Information Technology and Decision Support Systems	<ul style="list-style-type: none"> • Use to facilitate participatory and action based research discussions • Criticized for unrealistic expectations, poor design, lack of transparency and relevance
Structured Learning (training material)	<ul style="list-style-type: none"> • Training materials for farm practices • Suitable to farmers predisposed to conservation • Least important

Messages and Framing

- Do not focus on climate change message for mitigation. Many of the best management practices (BMPs) that are most appropriate for reducing vulnerability also good for other environmental outcomes and should be marketed as a package.
- Efficacy of practice change is linked to collective action, therefore it is important to work through groups, as the perceived efficacy of action is likely to increase if all are working towards understanding the practice (as in the Landcare and Monitor Farm examples). Collective bottom up approaches allow farmers to develop solutions from within their own knowledge. The literature

suggests practice research and extension should address: reduction of time and labor costs, improvements in soil health, improvements in water quality, improvements in animal health, improvements in family quality of life, and increased profitability.

- Farmers repeatedly indicated not understanding the financial or environmental efficacy of the practice as key barriers to participation (this includes the belief that they are already doing all they can and need to do to reduce GHGs). Thus the most important and necessary messages have to convey information to the farmer about environmental and financial benefits of adopting additional BMPs. In many cases these may be unknown because the practices are not widely adopted, or because the financial barriers prevent trialability (Pannell et al. 2008).
- Messages should encourage “central route-processing” (Dwyer et al. 2007), i.e. they should encourage people to think through the problem and be personally relevant (including use of personal pronouns in promotional materials).
- Messages need to show salience of the issue – that the problem is serious and affects the farmer, that recommendations will solve the problem and that farmers are able to implement recommendations (Dwyer et al. 2007). Messages for practice change should be specific and prescriptive rather than general, and arguments should be forceful, and opposing arguments should be convincingly refuted. Overstating risk will reduce effectiveness. Failed messages can harden attitudes.
- Use multiple sources of influence including consultant and commercial networks, local farm organizations, local business networks, and informal clubs; also churches, social clubs.
- “surprise” sources can increase persuasiveness. Outreach efforts should include and peer-to-peer insight, and engage the agribusiness networks that provide farmers with inputs and technical assistance (Carlisle, 2016).
- Messages related to practice change should be delivered by extensionists who come from farming communities or have a farm background. Extensionists should be trained in both latest evidence based practices, as well as in listening and facilitation (Jahusz 2014).
- For actions use specific rather than general recommendations tailored to practice (Dwyer et al. 2007), Use second message pronouns such as “you” to make the messages less general. For some types of issues such as water quality, increase the perceived efficacy of the impact of collective action rather than individual action. Provide opportunities for direct experience.
- In targeting farm segments, link actions to beliefs and experiences to the “symbolic capital” associated with different segments (Dwyer et al. 2007). Carlisle (2016) recommends highlighting the growing use of soil health practices by mainstream producers and researchers to normalize soil health practices.
- Recognize that adoption is a multistage process, with different motivations for positive attitudes towards adoption versus actual adoption (Niles et al. 2016). Use 3-prong approach to increase adoption for adopters, remove barriers for potential adopters, and change minds of non-adopters (Carlisle 2016);
- There was very little evidence to support specific internet or IT specific approaches.

4.3 TECHNOLOGY TRANSFER APPROACHES

- Extension should focus on selection and management of cover crops. The following are cover crop extension recommendations from Carlisle (2016), Arbuckle (2013) and NWF (2012). Cover crop extension requires both written and in person outreach, and must clearly identify benefits; target specific cropping systems, and feature local successful farmers. A calculator should be developed to estimate costs and benefits of adoption. Cover crop seed storage should be included. Overcome barriers by increasing the availability of cover crop services provided by trained custom operators and expand opportunities to borrow or rent specialized equipment rentals for equipment that farmers are familiar with but do not necessarily own (such as no-till drills).
- Dwyer et al. (2007) highlights the success of bottom-up community-led schemes such as Landcare and Monitor farms which have local community ownership and commitment combined with the input of specialists and industry to aid planning and implementation. Both the Landcare and EQIP examples suggest that making farmers aware that there is a problem and they are part of the solution was critical to encouraging action
- For soil health practices, knowledge barriers to adoption include lack of information about benefits of practices and how to measure them; lack of understanding of how to optimize cover cropping and crop rotation with cash cropping, and lack of regionally specific information on cover crop variety selection (Carlisle 2016)
- The ability to trial a method or technology influenced the likelihood of adoption. For a trial to be effective in persuading producers, it must have easily observable outcomes to confirm to producers themselves that a skill has been properly learned and the technology is useful (Pannell et al. 2006). Emphasis should be on understanding the compatibility of these environmental practices with farm productivity (Carlisle 2016).
- Use adaptive management with peer to peer experimentation to understand the efficacy of different practices for different farm types. Knowledge transfer is a two-way exchange, and sometimes farmers do not have sufficient information, their range of practices may be restricted. Distinguish Knowledge of impact of practice on GHG and water quality is a science problem from knowledge of how to apply the practice is a farm problem. Extension is a learning process and collective development of solutions with farmers can be iterative and experimental – as in the Landcare and Monitor farm examples – taking advantage of local understanding and knowledge, not overselling benefits, and collective recognition of risk and innovation.
- One-one farm visits with extension agents were identified as the most effective means of encouraging practice change. In all Ontario surveys farmers underscored the need for more extension, and extension by neutral agents (such as OMAFRA extension agents) who are familiar with the local community, or farming practices, or from a farm. OSCIA and OMAFRA representatives can also be trained to facilitate the development of grassroots associations and clubs for producers with shared interests.
- Workshops, short seminars, demonstration events, farmer clubs and one-to-one farm visits are more influential than telephone advice and written material. On the content of the workshops: “it is a waste of time telling farmers about their options, most guys know what their problem with the environment is, but that is part of the EFP”, “the 2nd time around with the EFP is a waste of time” (PRA 2011).

- Tailor services to meet the different needs of different types of producers based on farm and farmer characteristics such as type of commodity, experience, age, size of operation, education and culture (PRA 2011). Build on past successes in reaching out to Mennonite, Francophone and First Nation farmers.
- To deal with overcoming barriers to economies of scale for motivated small producers encourage low cost investment experiments through cooperative associations and publicly supported infrastructure to remove scale related barriers. Help farmers purchase specialized equipment through bulk discounts and long-term low interest loans or financing provided to custom operators and cooperatives to assist early adopters (Carlisle 2016).

5. RECOMMENDATIONS

1. Develop a Farm Segmentation Framework and Test Engagement Strategies
 - Undertake research to understand farming styles and their potential role in engagement particularly how farming styles might reveal factors relevant to engage weakly and non-participating farmers. Use the framework to test engagement strategies that target particular farm styles. Develop a monitoring program to test approaches tracking indicators of individual farmer change including attitudes, beliefs, knowledge, and capacity constraints. The farm segmentation and engagement strategy should focus on developing information to populate Table 1 of the report – that is, linking styles to farm goals, symbolic capital, networks and then targeted engagement using these elements.
 - An adaptive approach to market segmentation would look at different ways to define and target farmer styles, learn what works, and then adapt. Common value and attitudes in different external contexts will generate different farming styles due to local constraints. Segmentation should also address diverse local technological and market constraints.
2. Provide Additional Extension to Encourage Farmers to Implement Soil Health Practices
 - This recommendation is adapted from Recommendation 4 from PRA (2011) and includes:
 - Tours of environmental practices used on other farms
 - One-to-one on-farm visits by technical specialists
 - On-farm demonstrations of specific practices or technologies
 - Discussions with other farmers about how to implement certain practices
 - Supplemental workshops/presentations on specific topics or practices
3. Establish EFP as a Clearinghouse for Agri-environmental and Stewardship Programs
 - Build on the strengths of the EFP to make it the clearinghouse for all stewardship programs in the province. Many stewardship programs already require an EFP for eligibility. Farmers have complained about conflicting requirements between different programs. EFP coordinators could work with farmers to ensure that they maximize the opportunities to leverage conservation funds and strategically help them develop action plans for their farms to maximize leverage. Outreach should build on established farmer-farmer and farmer-adviser networks and groups, in order to streamline funding processes, avoid duplication of effort. Some farmers have even asked for a central clearinghouse for program information, and to ensure that programs are aligned – that is, don't ask for contradictory things.
 - Enhance social Interaction among Farmers through EFP implementation including establishing forums for peer discussion, mentorship, or environmental clubs (based on Recommendation 5 from PRA 2011).
 - Work with key stakeholders in the agri-environmental programming that are key for farmer engagement to develop sector/style specific messages and strategies for encouraging soil health BMPs and bring these partners together under the EFP clearinghouse umbrella. Key stakeholders include: OMAFRA, OSCIA, EFP, Cattleman's Association; Conservation Authorities, ALUS, DUC, CFFO, OFA.

4. Develop a Peer-Peer Experimentation Program for Trialing Soil Health BMPs
 - Build on the Environmental Farm Plan Approach to facilitate peer to peer learning. Farmers have indicated that more extension and a greater understanding of practice efficacy either for financial or environmental benefits would increase their interest in adoption. However as pointed out in the literature review by Carlisle, some practices for soil health may not fit well with current farming systems, particularly for soy which is one of Ontario’s largest crops and more research is required to understand how to fit soil health practices such as cover crops and crop rotation into some farm systems. The literature review showed that farmers want to be more involved in designing programs, and value extension and peer to peer learning.
 - The EFP workshops could facilitate peer led sub-committees to address challenges in implementing soil health actions, and in particular follow the model of Landcare and Monitor Farms to take a peer-based experimental approach to testing new approaches. The strengths of this recommendation include building stronger connections between peers with weak connections – one of the ways that has been identified as effective knowledge transfer for farmers in Ontario. By collectively testing approaches the farmers can collectively share risks. For example, funds could be tied soil health funding could be tied to experimentation through group applications and group rewards. As a next step it would be important to work with OSCIA to further assess whether this could work. Built into the experimentation approach is the need for monitoring.
 - Provide program-policy financial support for on-farm trials of certain practices
5. Test the recommendations through implementation of the Ontario Cover Crops Strategy (OMAFRA, 2017)
 - The Ontario Cover Crops Strategy was developed by the Ontario Cover Crops Steering Committee to increase the adoption of cover crops. The strategy focuses on increased awareness of the importance of cover crops for soil health and water quality, peer led research and experimentation to address specific barriers faced by Ontario farmers within their own soil, geography, rotation, and technology specific production systems, and to identify and remove policy barriers including improved risk management programs, paperwork, and inadequate incentives.
 - The Strategy should incorporate the recommendations in this report by adopting a segmentation approach to target engagement for different farm types and farmer styles in order to better understand and motivate non-adopters. The strategy should be implemented through the Environmental Farm Plan to take advantage of existing capacity to support BMP adoption. In particular, the EFP workshops provide an opportunity to develop peer led strategies (see recommendations 1-4 above).
 - Particular Ontario Cover Crop Strategy recommendations that are aligned with our recommendations include funding farmer-to-farmer initiatives and on-farm trials for learning as well as establishing baseline data and tracking metrics for cover crop adoption. Baseline data collection should include metrics for attitudes and awareness towards cover cropping, as well as baseline environmental and economic data to measure practice efficacy.

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