Farmers' preferences for agri-environmental incentive
programs, learning from experiences in Ontario

by

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Abstract

Based on a literature review, an international benchmark, and a case study in Ontario, the dissertation explores farmers' preferences for agri-environmental incentive programs. We use literature in agricultural, environmental and behavioural economics, and social psychology to propose an original analytical framework of farmers' preferences. This framework is tested in Ontario and helps understand farmers' motivations to participate or not to participate in environmental incentive programs.

We then review the evolution of agri-environmental programs in Ontario since the 1930s. We develop original frameworks to compare programs fostering either collaboration or competition among farmers and use these frameworks to compare Ontario programs with contrasting programs in other provinces and OECD countries.

Based on program design analysis and semi-structured interviews, we identify program characteristics that matter to Ontario farmers. Through a choice experiment, we then test which characteristics matter most in farmers' decisions and segment Ontario farmers into groups of heterogeneous preferences.

The dissertation decisively adopts a mixed-methodology approach. Qualitative research is used to design the choice experiment (exploratory sequential design). Open-ended questions in the experiment link farmer choice-profiles with qualitative results, thus confirming, illustrating or nuancing choice experiment findings (convergent design). Finally, the participation of informal field advisors all along the research process allows for a research design targeted on current policy questions and continuous verification of intermediate findings.

We find that programs designed to be the most competitive are not necessarily the most cost-efficient because medium and long-term dimensions are not considered. We identify five farmer profiles with different preferences and attitudinal traits. While ‘Business Farmers’ and ‘Busy Farmers’ have a strong preference for high incentive levels, other types of farmers either value technical assistance above the monetary incentive, are only willing to participate if their contact point is a fellow farmer, or are largely unwilling to participate. Several farmer profiles would prefer collective approaches. We also find that preferences are endogenous. They evolve as information emerges, applications succeed or fail, engagement takes place, and farmers discuss approaches and their impacts. The concluding chapter presents, on this basis, a series of research-grounded recommendations for agri-environmental policy design in Ontario.

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After many years pushing back at the idea of engaging in a Ph.D. thesis, I remember a calm winter day, looking at the trees and fluffy snow by the cross-country ski tracks and finally realizing that I was ready for the adventure.

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List of Acronyms

AAFC: Agriculture and Agri-Food Canada

AIC: Akaike Information Criterion

ALUS: Alternative Land Use Service Program

APF: Agricultural Policy Framework

AWSA: Assiniboine Watershed Stewardship Association

BIC: Bayesian Information Criterion

BMPs: Beneficial Management Practices

CA: Conservation Authority

CE: Choice Experiment

CE: Conservation Easements

CFFO: Christian Farmers Federation of Ontario

COI: Central Office of Information of the United-Kingdom government

CRP: Conservation Reserve Program (in the United States)

CRSB: Canadian Roundtable for Sustainable Beef

CURB: Clean Up Rural Beaches Program

DUC: Ducks Unlimited Canada

ECFSC: East Central Farm Stewardship Collaborative

EEA: European Environmental Agency

EEPRN: Economics and Environmental Policy Research Network

EFA: Ecological Focus Area

EFAO: Ecological Farmers' Association of Ontario

EFP: Environmental Farm Plan

ERDA: Economic and Regional Development Agreement

ES: Environmental Services

EU CAP: European Union Common Agricultural Policy

EU: European Union

FAO: Food and Agriculture Organization of the United Nations

FEF: Fisheries Enhancement Fund

FO: Farmer Organization

GF2: Growing Forward 2

GHFIP: Grassland Habitat Farm Incentive Program

GIEE: Groupements d'intérêt économique et écologique

GLASI: Great Lakes Agricultural Stewardship Initiative

HSP: Habitat Stewardship Program

IFAO: Innovative Farmers' Association of Ontario

iid: identically and independently distributed

IJC: International Joint Commission

IPCC: Intergovernmental Panel on Climate Change

LCA: Landcare Associations (in Germany)

LEARN: Linking Environment and Agriculture Research Network

LSP: Land Stewardship Program

MPS: Market Price Support

NEPI: New Environmental Policy Instruments

NGO: Non-Governmental Organization

NMFAP: Nutrient Management Financial Assistance Program

NSCP: National Soil Conservation Program

OECD: Organization for Economic Co-operation and Development

OFA: Ontario Farmers' Association

OFEC: Ontario Farm Environmental Coalition

OLA: Ontario Landowners Association

OMAF: Ontario Ministry of Agriculture and Food

OMAFRA: Ontario Ministry of Agriculture, Food and Rural Affairs

OME: Ontario Ministry of Environment

OPERA: Ontario Property and Environmental Rights Association

OSCEPAP: Ontario Soil Conservation & Environmental Protection Assistance Program

OSCIA: Ontario Soil and Crop Improvement Association

PEI: Prince Edwards Island

PES: Payments for Environmental Services

PLUARG: Pollution from Land Use Activities Reference Group

RCCP: Rural Conservation Club Program

REDD+: Reducing Emissions from Deforestation and Forest Degradation plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks

RUM: Random Utility Maximization

SARA: Species at Risk Act

SARFIP: Species at Risk Farm Incentive Program

SNC: South Nation Conservation Authority

TA: Technical Assistance

US: United States of America

WG-EGS: Federal-Provincial Working Group on Ecological Goods and Services

Chapter 1: Introduction

“By seeking to understand how people make decisions and act upon those decisions, governments can design and re-design public services that better reflect how people respond to, engage with and use these services.” (McMahon in Ontario Behavioural Insights Unit (ed.), 2018, p. 2)

“In addition to conventional field surveys which try to find possible universal socio-economic variables that explain farm-management behaviour, drivers of and barriers to behavioural change could be considered in more depth by applying theory and recent findings of behavioural economics (i.e. enriching economic theory by applying findings from the psychology literature). (...) it is widely considered that actual (not hypothesised) human behaviour needs to be taken into consideration to tackle climate change, and incentives should thus be adapted as appropriate. However, there are few such studies of agriculture and agricultural policies at present.” (OECD, 2012, p. 12).

1.1 Policy and research questions: should PES foster competition or collaboration?

Farmers face multiple societal demands. Society entrusts a shrinking number of farmers with the reliable production of affordable, palatable, transportable, storable, transformable and safe food and bioproducts, in a context of international competition. Farmers are also given environmental objectives with increasing public attention and expectations. Agricultural land-use decisions have environmental impacts. What grows, how it is grown, and for how long often have environmental consequences beyond plot boundaries and present generations. Land use practices influence soil health, water quality, landscapes, biodiversity, air quality, and climate, impacting different actors at various geographical and temporal scales. Unlike other stakes associated with agricultural production, environmental impacts are rarely integrated into market transactions. Economists classify them as environmental externalities. To foster environmentally-friendly land use and to correct market failures associated with environmental externalities, governments have used public

research and technical assistance, regulations, fiscal measures, cross-compliance requirements, environmental markets, and voluntary instruments (including conditional incentive schemes).

However, several environmental policy targets for the agriculture sector are not on track to being reached either in developing or industrialized countries. Despite decades of agricultural environmental policies, agricultural practices continue to contribute to soil erosion, climate change, water and air pollution, and biodiversity and water depletion in large areas, including in OECD countries¹ (Dalín et al., 2017; Dudley & Alexander, 2017; European Environment Agency [EEA], 2019a; Food and Agriculture Organization of the United Nations [FAO], 2017, 2020, 2021a, 2021b; Intergovernmental Panel on Climate Change [IPCC], 2014²). Pollution attributed to agriculture remains a major concern in the European Union and North America. The European Environment State and Outlook 2020 notes that Europe falls far from meeting water policy objectives, agriculture is a particularly large source of diffuse pollution, and harmful emissions from agriculture are rising (EEA, 2019a)³. In Canada, water bodies in the Prairies, Quebec, Ontario and Prince Edwards Island face water quality issues associated with agriculture (Environment Canada, 2011).

¹ The Organization for Economic Co-operation and Development (OECD) estimated that, in its member countries alone, the environmental and social costs of water pollution caused by agriculture probably exceed billions of dollars annually (OECD, 2012). Efforts in reducing specific air pollutants in Europe are hindered by the agricultural sector: “For the fourth consecutive year, emissions of NH₃ increased. From 2016 to 2017, emissions increased by 0.4 % across the EU. Over the period 2014-2017, the overall increase was about 2.5 %. These increases are because of the lack of emission reductions in the agriculture sector.” (EEA, 2019b).

² According to IPCC 5th Assessment Report, 14% of green house gas come from agriculture, 24% when taking into account forestry and other land use (IPCC, 2014).

³ “addressing environmental pressures from economic sectors through environmental integration has not been successful, as illustrated by agriculture’s continued impacts on biodiversity and pollution of air, water and soil.” (EEA, 2019a, p. 13).

In various regions of the World, including in the North American Great Lakes area, nitrates or phosphate run-off trigger overwhelming algae blooms with local consequences for water quality. In shorelines and coastal areas, algae blooms affect tourism, aquaculture and fisheries. The impact of agricultural practices on biodiversity is also largely documented. Since 1980, the abundance of common birds, in particular common farmland birds, has drastically decreased in most parts of Europe (Pan-European Common Bird Monitoring Scheme, 2016)⁴. The State of Canada Birds 2019 outlines that Canada has lost nearly 60% of grassland birds and aerial insectivores since 1970 (North American Bird Conservation Initiative Canada, 2019). In the last decade, 80% of bird species newly assessed as threatened or endangered in Canada have been aerial insectivores or grassland birds, with agricultural practices reported as the main corresponding pressure due to the conversion of natural areas to cropland and broad-scale pesticide use. Birds that depend exclusively on native grasslands for breeding and wintering are estimated to have declined by 87% (North American Bird Conservation Initiative Canada, 2019).⁵ A very substantial decrease in Canadian prairie wetlands – particularly rich in biodiversity – is also associated with agricultural practices. Southern Ontario has lost nearly three-quarters of its wetlands in the last two centuries (Auditor General of Ontario, 2019). Finally, a 2016 study identifies agriculture as a major source of air pollution worldwide (Bauer et al., 2016). Despite

⁴ The farmland bird index, one of the best indicators of the health of Europe' farmland ecosystems and wildlife, showed that common farmland birds have declined by 57% in Europe between 1980 and 2014 (Pan-European Common Bird Monitoring Scheme, 2016).

⁵ Graph: <http://nabci.net/resources/state-of-canadas-birds-2019/>

“Birds that depend exclusively on native grasslands for breeding and wintering have declined dramatically by 87%, and even the other species that can tolerate agricultural landscapes have declined by 39%” (North American Bird Conservation Initiative Canada, 2019, p. 5).

improvements on several aspects, agri-environmental impacts and risks remain concerning worldwide, including in Ontario (Smith, 2015).

In this context, citizens, scientists and policy-makers continue to raise concern with agriculture's environmental impacts. The 2020 European Green Deal calls for a renewed environmental ambition of the European Union (EU) agricultural funding programs. In Canada, the Pan-Canadian Framework on Clean Growth and Climate Change (2017-2021) includes: (1) \$25 million in funding to Agriculture and Agri-Food Canada (AAFC) to develop a clean technology program for the agriculture, agri-food and agri-based products sector in Canada, as well as (2) land use and conservation measures to protect and enhance carbon sinks, including in forests, wetlands, and agricultural lands. In Ontario, questions remain open on environmental incentive policy design, particularly on integrating behavioural aspects, including attitudinal segmentation, in agri-environmental policies (Weber, 2017). The present dissertation intends to bring policy insight in this ambitious context.

Concerns with competitiveness, employment, and social peace⁶ restrict political will to introduce new environmental regulations and taxes. **Voluntary approaches**, including agri-environmental incentive schemes, are thus attractive policy options; used as standalone instruments or in a policy-mix associated with technical assistance, regulation, fiscal measures, or voluntary certification. For more than 25 years, governments, NGOs and private institutions have implemented, supported or promoted various types of

⁶ In France, for example, major social movements with substantial economic and sometimes tragic consequences were triggered by proposed environmental tax reforms (e.g. "Mouvement des Bonnets rouges" in 2013, "Mouvement des Gilets jaunes" in 2018).

voluntary agri-environmental incentive schemes. These schemes are regrouped in this dissertation under the term '**Payments for Environmental Services**' (PES).

Building on Karsenty (2011) and Tacconi (2012), we define Payments for Environmental Services (PES) as a system for the additional provision of ecosystem services through conditional payments to landholders who voluntarily commit to restrict land use or invest to preserve, restore or increase an agreed upon ecosystem service. In the international literature on PES, some authors consider that only schemes based on Coasean bargaining *stricto sensu* (i.e. direct negotiations between ecosystem service providers and beneficiaries) should be qualified as PES (e.g. Wunder, 2005). However, most instruments labelled as PES by policy-makers are funded and often administered by public institutions or NGOs on behalf of ecosystem services beneficiaries. Other authors label as PES any instrument rewarding land users adopting environmentally beneficial practices, including markets for green products, ecotourism or compensations for mandatory requirements (e.g. Milder et al., 2010). This definition blurs the limits between radically different instruments, including voluntary and mandatory approaches. In Canada, PES often refer to recurring payment systems such as the Alternative Land Use Service Program (ALUS) that compensate for a recurring opportunity cost associated with preserving an ecosystem service. This dissertation adopts a median approach in the international literature, between Wunder's strict definition and Milder et al.'s much wider one. It is broader than the frequent Canadian focus on recurring payments. We restrict our analysis to schemes respecting three criteria: (1) environmental services (ES) providers participate voluntarily, (2) payments are stand-alone based on agreements negotiated up-front, and (3) PES focus on specific ecosystem services even if those are usually not precisely quantified and monitored. Most

governmental incentives, including cost-share programs, fall under this definition, together with instruments financed or co-financed by the private sector (conservancy easements, annual conservation payments, conservation offsets...). As defined in the dissertation, PES can rely on one-time or recurring payments. Payments can compensate for forgone income, share investment costs, or be adjusted to the service provided. Under this definition, PES can be administered by public institutions, based on agreements between private entities, or combine public and private governance. PES can support a reduction in negative externalities (e.g. reducing fertilizer inputs to decrease nutrient run-offs affecting water quality) or an increase in positive externalities associated with agriculture, such as carbon fixation and storage, attractive rural landscapes, and the maintenance or restoration of open grasslands rich in biodiversity. Worldwide, PES are used to fight climate change through carbon sequestration, improve watershed management and water quality, conserve biodiversity, and preserve heritage landscapes (Wunder, 2005).

PES schemes appeared in the 1980s in Europe and North America and have been tested in developing countries since the late 1990s. Responding to concerns with regulatory approaches, OECD countries in the 1990s deployed New Environmental Policy Instruments⁷, giving priority to voluntary approaches, competitiveness, and decentralized governance (Jordan, 2001⁸). Interest in PES expanded in this context. Already used in numerous locations in Latin America, PES are expanding in Asia and Africa. In 2018, there

⁷ “New Environmental Policy Instruments” include market-based instruments and instruments based on voluntary action (voluntary agreements and informational devices) (Jordan, 2001, p. 3).

⁸ “The reasons for the increasing popularity of NEPIs range from dissatisfaction with the effectiveness of traditional regulatory instruments, through to concerns about competitiveness and the desire for greater local-level control – i.e. subsidiarity.” (Jordan, 2001, p. 3).

were about 550 active PES worldwide, and PES channelled an estimated US\$36–42 billion annually (Salzman et al., 2018), including through national programs in China, Costa Rica, Mexico, the United Kingdom, and the United States. In contrast, the OECD estimated that environmental taxes and fees in OECD countries represented a total of US\$791 billion in 2018 in public revenues⁹.

Interest in PES is associated with two presumed advantages: their capacity to efficiently allocate a fixed budget and their capacity to attract private funding to support underfinanced environmental goals. PES are also valued by policy-makers for their flexibility (they allow for various public-private governance and funding mechanisms) and their acceptability (being voluntary, PES are more easily accepted by target landholders than regulations or taxes). Finally, numerous decision-makers see in PES an option to transfer financial resources or maintain economic activities in deprived areas with marginal agricultural or forestry activities, as environmentally-rich regions¹⁰ are often among the poorest areas in income terms at regional, national and international levels. PES have been promoted by numerous researchers and international institutions. Flagship national and international environmental policies rely on further developing PES, including the international REDD+ program¹¹. The European Union's agri-environmental policy relies

⁹ OECD PINE database, retrieved in 2021; data is incomplete as several figures are missing in 2018, e.g. from United States and Canada.

¹⁰ I.e. the regions rich in biodiversity, or with a high potential for carbon storage or sequestration.

¹¹ Relevant policies include international climate change policies under the United Nations Framework Convention on Climate Change (e.g. REDD+: Reducing Emissions from Deforestation and Forest Degradation plus the sustainable management of forests and the conservation and enhancement of forest

on PES in addition to cross-compliance measures. The United States Conservation Reserve Program, first launched in 1956¹², is based on PES. In North America and Europe, PES are seen as one of the key policy instruments to meet challenging water pollution reduction and biodiversity conservation targets. **However, some of the presumed advantages of PES are based on theoretical assumptions rather than empirical findings. In practice, schemes labelled as PES have had mixed results over more than 25 years of experience in the field, and policy-makers are looking for improvements in their design and implementation.** Researchers have identified four main limitations of PES. (1) PES are insufficiently targeted, often based on uniform payments uncorrelated with environmental impacts, prone to windfall effects, and thus lacking cost-efficiency (OECD, 2010; Stonehouse, 2000; Weersink et al., 1998). (2) Adoption is often low: too few landholders voluntarily subscribe to environmentally ambitious PES to achieve environmental goals (Aznar & Valette, 2010; Boxall et al., 2013; Christensen et al., 2011; Espinosa-Goded et al., 2010; Kuhfuss et al., 2016; Nailor, 1999). (3) Benefits may be short-lived: PES' positive impacts might not last after payments are discontinued (Muradian et al., 2010). (4) There is a trade-off between equity and efficiency in PES design (Pascual et al., 2010). Equity concerns insufficiently addressed in PES limit their durable uptake (Calvet-Mir et al., 2015; McGrath et al., 2017; Pascual et al., 2014).

carbon stocks); international, regional and national biodiversity policies (Convention for Biological Diversity, 2010; European Commission, 2011); etc.

¹² And launched in its current form in 1985.

Researchers have proposed policy improvements to address some of those issues. Two major schools of thought tend to drive policy design in opposite directions. Focusing on cost-efficiency, numerous economists recommend increasing **competition** between landholders, using **ranking systems** or **reverse auctions**¹³ to select and fund the most cost-efficient agri-environmental projects (ÉcoRessources Consultants, 2008; Johansson, 2006; OECD, 2010). Economists analyze that farmers have information on the cost of providing environmental services that service beneficiaries (e.g. water users) and institutions acting on their behalf (governments, environmental NGOs...) cannot easily access. In such a context of asymmetric information, reverse auctions intend to reveal the costs of providing environmental services. The most emblematic reverse auctions for environmental conservation have been developed in Australia since the early 2000s. Australia has trialled nearly 100 tenders for biodiversity protection (Rolfe et al., 2017). In the United States, 75% of the acreage in the Conservation Reserve Program is recruited through auctions (Hellerstein, 2017). In France, the Water Agency *Agence de l'Eau Artois-Picardie* tested reverse auctions from 2011 to 2014 (Kuhfuss et al., 2012; Thoyer, 2015). Reverse conservation auction programs have also been implemented in Canada, Finland, Germany, Indonesia, Kenya, Tanzania, and the United Kingdom (FAO, 2011; Novak, 2017). In Canada, the Universities of Alberta and Manitoba and the conservation non-governmental organization Ducks Unlimited researched and experimented with conservation auctions at

¹³ A reverse auction is an auction in which sellers rather than buyers compete for a transaction. In a conservation tender, sellers of a specific ecosystem service compete to access a payment scheme by proposing the cheapest offer for a given level of service(s). In multi-attribute auctions, bidders can specify both a price and levels of non-price attributes. Offers are then ranked using point systems. Ranking systems can also be used to select the best offers for a fixed pre-defined price. Ranking criteria can include location, environmental sensitivity, level of environmental investment, co-benefits on non-primarily targeted ecosystem services, etc.

least since 2002 (Boxall et al., 2013, 2017; Brown et al., 2011; Hill et al. 2011; Kits et al., 2014, 2015; Novak, 2017; Packman & Boxall, 2010; Wichmann et al., 2017). Ranking systems and reverse auctions (i.e. conservation tenders) are also used to select agri-environmental projects in Ontario (Ontario Soil and Crop Improvement Association [OSCIA], 2014a).

Many economists recommend competitive approaches, with **extensive theoretical and experimental research on auction design, including bidding and pricing systems** (summarized in Hellerstein et al., 2015; Rolfe et al., 2017). On the other hand, several institutionalists, behavioural and ecological economists have developed a different school of thought based on the analysis of farmers' **behaviours and motivations**. These scholars insist on the importance of landholders' **non-financial** motivations in their decisions to participate in PES and adopt environmentally beneficial practices for the long-term. In particular, they argue that preferences associated with **social norms, social networks and personal values** (social preferences) impact land-use decisions. These researchers also highlight that individual decisions may not trigger the necessary scale associated with environmental improvements. They analyze PES in the context of a **collective action** issue. To improve PES uptake, reach critical environmental improvement thresholds, and improve durability and equity, they recommend fostering further collaboration between landholders, including to influence social norms in the agricultural sector (Kuhfuss et al., 2016; Muradian et al., 2010; Prager et al., 2012; Westerink et al., 2017).

Collective approaches involving farmers' networks in PES design and implementation have been implemented in Ontario since the early 1990s. In the Netherlands, farmers'

cooperatives directly contract results-based PES agreements on behalf of their members. In Alsace (France) and Ohio, aggregation bonuses provide additional incentives when a large number of farmers in close proximity adopt coherent environmental practices to reach local environmental thresholds. In Quebec and France, farmer groups with coherent or joint agri-environmental projects may receive free technical support. Approaches based on collective action theories are currently developing and raising interest in Europe and the United States, particularly in locations where they can rely on a strong pre-existing social capital.

These two schools of thought – recommending either more competition or more collaboration among landholders – rely on different theoretical grounding and lead to diverging conclusions and opposite policy options, leaving policy-makers in a dilemma between competitive and collaborative designs. Conversations between competitive and collaborative schools of thought are scarce. Researchers along these two trends often refer to different disciplines, policy objectives, indicators of success, and case studies. Even within one school of thought, research is fragmented. Most research on landholders' social preferences, for example, concentrates on either personal norms (altruism, environmental attitude) or social norms (and, or social networks). Some surveys consider both personal and social norms (Atari et al., 2009; Wilson & Hart, 2000), but **little research has explicitly tried to explain farmers' heterogeneous conservation behaviours by considering both types of other-regarding preferences together with other financial and non-financial decision factors.**

Some exceptions are important to mention. Building on theories developed by Lynn and his colleagues over the years, Chouinard et al. (2016) developed an integrated ‘**meta-utility**’ framework of farmers’ conservation behaviours. To explain farmers’ adoption of conservation practices, Chouinard et al. proposed taking into account three components: (1) motives (including stewardship); (2) firm practices and technology choice; and (3) impacts. Using variables appearing recurrently in the conservation literature, they developed an econometric model to explain the adoption of conservation practices, and applied it to soil conservation in a survey of 29 respondents. Their model assembled socio-economic, demographic, and attitudinal variables (‘profit perception’ and ‘conservation risk attitude’). Our research adopts some of the same premises, but we judged it essential to consider a **broader range of motives** to analyze farmers’ decisions for participating or not in PES, and to introduce a hierarchy between motives, practices and impacts with decisions factors as our primary entry point. Kuhfuss, Thoyer, Le Coent and their colleagues explored successively competitive and collaborative PES approaches in France, using laboratory experiments, a natural experiment, and a choice experiment (Kuhfuss et al., 2012, 2016; Thoyer, 2015). Morrison (2012) analyzed how adoption differed across groups of landholders and types of market-based instruments in an Australian region. To differentiate landholders, Morrison developed a conceptual model based upon the Theory of Planned Behaviour (Ajzen, 1991, 2006), and identified environmental attitude as an explanatory variable, along with trust, innovativeness, and social connectedness. Finally, taking into account social networks, Kits et al. (2015) studied how leadership can influence conservation auctions, drawing on social networks theories.

To our knowledge, no research has proposed an **integrated framework of decision factors** that affect whether farmers decide to participate or not to participate in PES from the farmer's perspective. In addition, no research has specifically assessed how landholders with contrasting social preferences react to broad alternatives in PES design as studied in our dissertation, including collaborative and competitive approaches. By investigating these subjects, the thesis brings original insight to the debate on PES design.

Specifically, the research concentrates on the following research areas:

- (1) **What are the main motivation factors affecting farmers' decisions to participate or not to participate in PES?** In particular, our research questions non-financial motivations (including social preferences associated with equity, concerns for nature, and social norms), the extent those motivations matter when compared with financial motives, and potential differences among groups of farmers with heterogeneous preferences. While previous research has targeted this question, our research is original by proposing a framework focusing on motivation factors rather than combining socio-economic, demographic, political, geographic and attitudinal factors.
- (2) **How do Ontario PES evolve and compare with international programs with regard to competitive and collaborative features?** Our research systematically reviews PES in Ontario and compares them with contrasting programs in OECD countries.
- (3) **How do various PES design features associated with key decision factors impact farmers' willingness to participate?** The analysis documents heterogeneities among farmers.

All three areas of questioning are relevant to current agri-environmental policy design issues. In Ontario, in particular, policy experts and programs managers call for behavioural

research, with results allowing them to **adapt agri-environmental programs to farmer motivation profiles**, taking into account potential differences among farmers through attitudinal segmentation (Ontario, 2015; Weber, 2017).

Our research adds value by combining several fields of literature: the literature on social preferences - which demonstrates the importance of other-regarding concerns, perceived fairness and reciprocal behaviours on individual decisions (Bowles, 2004; Fehr & Schmidt, 2003); the literature on agri-environmental contract design - that demonstrated that landholders have heterogeneous preferences for various contracts' attributes (Kuhfuss et al., 2014; Ruto & Garrod, 2009); and the literature delineating options in PES design focusing for example on delivery mechanisms (in Canada, see Harris et al., 2014; OSCIA, 2014a; etc.). This combination, associated with fieldwork in Ontario, helps the research feed in several behavioural questions in agri-environmental policies, particularly in the open debate between competitive and collaborative approaches in PES design.

The research also adds value by providing more comprehensive but functional analytical frameworks on themes that have been fragmented in the literature, in particular on landholders' decision criteria to participate in PES.

1.2 Conceptual and theoretical frameworks draw from various disciplines

The dissertation decisively adopts an **interdisciplinary** perspective. Our research started with questions arising from public policy science and environmental economics: on the policy design of economic instruments. However, behavioural economics notions were rapidly brought in, with important references to personal norms and social norms as influencing farmer behaviours. As the research developed further, theoretical frameworks

from social psychology – strongly interconnected with behavioural economics – emerged as particularly relevant. Finally, when facing some of the limits of existing conceptual frameworks, the research called on theories further developed in psychology and organizational behaviour literature. As a consequence, concepts used in the dissertation draw from agricultural, environmental and behavioural economics, psychology, sociology, social psychology, and organizational behaviour theories.

The research considers both individual and collective behaviours. We discuss the role of institutions: municipal, provincial and federal governments, environmental NGOs, local resource management authorities and committees. However, the dissertation concentrates primarily on individual landholders' (mainly farmers') behaviours and their social networks, in particular farmer organizations. The term landholder is used in the dissertation to qualify either a landowner or a person who retains the right to use a piece of land, whether they own, borrow, rent or share-crop it. In a PES, landholders act as providers of environmental services (Figure 1).

1.2.1 Policy instruments considered

Our research focuses on payments for environmental services (PES) as defined above while paying attention to complementary instruments in an **agri-environmental policy-mix**. Payment for environmental services are considered in the context of a policy mix, i.e. a combination of policy instruments aimed at achieving a policy objective, and processes by which those instruments emerge, interact and have effects (Flanagan et al., 2011; Rogge &

Reichardt, 2013¹⁴). Financial incentive programs can be either combined or not with extension or information programs that release technical bottlenecks in the adoption of environmental practices. They can also be combined with labelling schemes and green markets, used to complement or take over an initial payment. In addition, the fear of more stringent regulatory obligations is a factor that can play a role in the adoption of voluntary programs and their promotion by farmer organizations as a reliable alternative to regulation. Thus analyzing farmers' willingness to participate in agri-environmental incentive programs often requires understanding the broader policy context and range of instruments used or considered at a certain point in time, in the past and for the future. This overall framework of actors and policy instruments is presented schematically in Figure 1.

Figure 1: Policy framework

TA: Technical assistance; PES: Payment for Environmental Service program; REG: regulatory measure
Red and green circles represent formal or informal social networks, including groups of common interest (e.g. landholder cooperatives, municipal water users, etc.).

¹⁴ Rogge and Reichardt (2013) insisted that the notion of policy-mix should consider complexity, policy processes and strategies.

1.2.2 Behavioural references

This research builds primarily on two theoretical fields: (1) Behavioural economics theories, in particular theories on social preferences, and (2) Decision theories in social psychology, in particular theories on the articulation between attitudes and behaviours.

The following section introduces concepts from behavioural economics and social psychology as a foundation for the analysis in Chapters 2 to 4.

Insights from economics, including behavioural economics:

In economics, multidimensional utility theories recognize that the value a person derives from a good or a situation can have multiple components besides individual monetary profit (profitability). In conservation research, many economists recognize that farmers' decisions are best analyzed when taking into account several dimensions of utility (Chouinard et al., 2016). Drawing from economics, the term '**preferences**' is used in the dissertation to qualify the relative weights a person or a group of persons gives to different components of utility¹⁵.

Economists usually recognize that different people weigh differently various components of utility, depending on their tastes, situation and experience. In line with extensive research findings on conservation behaviours, the dissertation assumes that farmers have **heterogeneous preferences** for conservation practices and agri-environmental programs.

Chapter 4, in particular, helps reveal heterogeneities in Ontario farmers' preferences.

¹⁵ The terms 'stated' and 'revealed preferences' refer to methods used to identify preferences. Stated preferences are deduced from choices people declare they would make when presented with hypothetical situations. Revealed preferences on the other hand are identified by analyzing actual decisions. This dissertation uses both types of approaches.

Theories in behavioural economics particularly relevant to conservation research refer to the notion of **social preferences**. People who exhibit social preferences “*care directly about the material outcomes and/or beliefs of others*” (Hsiaw, 2011, p. 1)¹⁶. Social preferences include altruism, inequity aversion, reciprocity, social reputation, conformity, peer effects, social comparisons, identity (Hsiaw, 2011), guilt aversion (Ellingsen et al., 2010). In this dissertation, we differentiate between social preferences associated with **personal norms** and **social norms**. Following Baah Odoom (2012, p. 80), we define personal norms as “standards and values (e.g. moral values) that the individual uses to evaluate the worth of behaviours”¹⁷; and following McLeod (2008, online) social norms as “unwritten rules about how to behave [that] provide us with an expected idea of how to behave in a particular social group or culture.” Personal norms differ from social norms in that they refer to internal standards concerning a particular behaviour rather than reflecting externally imposed rules (Kallgren et al., 2000).

In this dissertation, we refer primarily to personal norms in terms of individual environmental motives and underlying altruistic preferences (concerns for nature, future

¹⁶ On the importance of social preferences, see for example Hsiaw (2011, p. 1): “One of the basic assumptions of standard economic theory is that individuals are driven entirely by self-interest in material outcomes. However, there is extensive evidence from a variety of disciplines that many people exhibit social preferences. That is, rather than caring exclusively about their own material outcomes, they care directly about the material outcomes and/or beliefs of others. Social preferences have a significant impact on behavior in a number of economic settings [...]. Thus, understanding the nature of social preferences and how they interact with material incentives is highly relevant to improving economists’ ability to predict behavior, analyze welfare, and make policy recommendations.”

¹⁷ According to Schwartz (1977), cited more than 2250 times (Science Direct, 2021), personal norms reflect internalized values and are experienced as moral obligations to engage in decision-making processes. Personal norms influence altruistic behavioral intention and action.

generations, neighbours, downstream communities...). We also refer to the perceived fairness of agri-environmental programs and corresponding behavioural reactions¹⁸. In particular, perceived program unfairness may drive reactions associated with **inequity aversion**. Inequity aversion can for example drive a person to forego a gain to prevent another person from receiving an inferior reward (Bowles, 2004; Fehr & Fischbacher, 2003). In agri-environmental programs, inequity aversion can hypothetically drive farmers to refuse to participate in incentive programs perceived as unfair, even if they might personally gain from participation. Social preferences can also drive a person to punish a behaviour deemed unacceptable (or not in line with accepted social norms), at the expense of the person implementing the “punishment” (Fehr & Fischbacher, 2004).

Following Fishbein and Ajzen (2010), our analysis also distinguishes between injunctive and descriptive social norms. **Injunctive social norms** refer to beliefs people form “that important individuals or groups in their lives would approve or disapprove of their performing the behavior”. In farming communities, the views of neighbours or other fellow farmers in the same social network can, in particular, be an important conscious or unconscious consideration in farmers’ adoption of environmentally friendly practices. **Descriptive social norms** refer to “beliefs that these referents themselves perform or don’t perform the behavior in question”. Farming is a constant learning process; besides their own experience, farmers learn from the successes or mistakes of their peers, thus being influenced by evolutions in their farming community and collective experimentation. “In

¹⁸ Reciprocity motives are another important example of social preferences, according to which people are generous towards people who have behaved well, while punishing those who have not behaved well (Bowles, 2004, p. 96).

their totality, these injunctive and descriptive normative beliefs produce a perceived norm, that is, perceived social pressure to engage or not engage in the behavior.” (Fishbein & Ajzen, 2010, p. 20).

Risk aversion and **Endowment Effect** (loss aversion) are some of the other notions from behavioural economics that the thesis builds on, beyond social preferences. Risk aversion can be defined as the tendency of people to prefer outcomes with low exposure to risk to outcomes with higher exposure, even if the average outcome of the latter is equal to or higher in expected monetary value (Werner, 2008). For example, farmers may choose not to apply for an environmental incentive program they would most likely gain from if they consider this program could expose them to a high-stake risk, even at a very low probability. The Endowment Effect is a bias that occurs when one overvalues something that she owns (or has otherwise developed an attachment to), regardless of its objective market value (Kahneman et al., 1991). In agri-environmental programs, farmers may be leier of a project proposal being rejected for funding if they have personally invested time and efforts in its preparation and ‘own’ their proposal. Those effects, and the corresponding literature, are discussed in more detail in Chapter 2.

Insight from psychology and social psychology:

In the literature on agri-environmental behaviours, personal norms are often considered ‘attitudinal factors’. The concept of **Attitude** comes from psychology. In psychology, “an attitude is the cognitive construction and affective evaluation of an attitude object by an agent” (Bergman, 1998, p. 87). The attitude object can, for example, be a person, place, thing, or event. Attitude is also defined as “a latent disposition or tendency to respond with

some degree of favorableness or unfavourableness to a psychological object.” (Fishbein & Ajzen, 2010, p. 76). The relation between attitudes and behaviour has been debated by researchers for decades¹⁹, including in environmental literature (Eilam & Trop, 2012). Some of this debate was carried in our research, as discussed in Chapter 2.

Social networks, self-identification in a group, and their influence on farmers’ behaviours: Social network theory focuses on the role of social relationships in transmitting information, channelling personal or media influence, and enabling attitudinal or behavioural change (Liu et al., 2017). Our dissertation mainly refers to theories on social networks to analyze the influence of a group of peers or opinion leaders on the adoption of conservation practices and participation in environmental incentive programs. For example, Garforth et al. (2008) studied farmer behavioural inclinations towards a single payment scheme in England²⁰ and highlighted the influence of farmers’ close peer groups (‘farmers’ clubs’) in farmers’ intentions²¹. The dissertation primarily considers producer organizations (as key trusted networks conveying social and technical norms in the agricultural sector and defending farmers’ interests). In addition to theories on the influence

¹⁹ The Central Office of Information of the United-Kingdom government (COI, 2009) states that: “Early psychological models show attitudes leading to intention in a predominantly linear fashion. In later models, attitude still plays a role but appears alongside other factors. While attitudes can influence behaviour, evidence now suggests that the link is not as strong as we might previously have thought. The so-called ‘Value Action Gap’ describes those situations where a person holds values that are inconsistent with their behaviour.” (Gordon, 2011, p. 178, quoting COI, 2009).

²⁰ using a postcard survey with 683 useable responses.

²¹ Garforth et al. (2008, p. 1) found that respondents were: “least motivated to comply with what Defra, consultants and land agents might suggest. They were also not likely to follow the views of other farmers, except the views of those with whom they associate closely in farmers’ clubs.”

of social networks and social norms on individual behaviours, interviews with Ontario farmers led us to mobilize **social identity theory**. The impact of farmers' **self-identification** in a group (i.e. self-categorization²²) on their behaviour has been previously highlighted, for example, by Fielding et al. (2008). Fielding et al. (2008) advocated integrating the theory of planned behaviour with core aspects of social identity theory to understand how farmers decide to engage in sustainable agricultural practices. The authors advocated for taking into account **group norms** and **intergroup perceptions**, highlighting, in particular, the importance of relations between rural and urban groups. Group norms are a sub-set of social norms specific to a group of common experience, profile or interest. They may contrast with norms carried by other groups in the same society. In Ontario, farmers identify as 'rural' rather than 'urban' citizens, with differing experiences, views and interests. Reynolds et al. (2015) emphasized the importance of including social identity theory in the study of social norms when intending to design policies taking social norms into account. Work by Burton (1998) is also very relevant to our dissertation. Studying farmers' willingness to participate in future community forests, Burton (1998) developed an original conceptual framework based on Stryker's (1968) identity theory to "introduce into geography the concept that the 'self' should not be viewed as a single entity (as in attitude studies), but should be viewed as a hierarchical structure of identities mirroring the

²² Self-categorization theory is a theory in social psychology that describes the circumstances under which a person will perceive collections of people (including themselves) as groups, as well as the consequences of perceiving people in group terms (Haslam et al., 1997).

structured nature of society.” The author concluded that “Salience of these identities influences choice of role-behaviour, particularly in times of crisis where a change of role may be required”. The author distinguished four basic ‘**identity sub-cultures**’²³, namely, ‘agricultural producer’, ‘diversifiers/entrepreneur’, ‘conservationist’, and ‘agribusinessman’. Through analyzing preferred role-behaviour and identity salience, he established that “farmers with distinct identities generally exhibit behavioural patterns consistent with these identities. In particular, farmers who see themselves as ‘conservationists’ and ‘diversifiers’ appear more willing to accept the role changes required by the Community Forest than those whose identity centres on agricultural production” (Burton, 1998, p. iii). In Ontario, we also observed that farmers tend to self-identify in a ‘farming profile’ with specific motivations, as further discussed in Chapters 2 and 4. Weber (2017) refers along this line to the notion of ‘**symbolic capital**’ associated with sub-cultures of what it means to be a ‘good farmer’ in Ontario.

1.3 Research methods

1.3.1 Origin and evolution of the research

The research presented in this dissertation originated in policy questions on the design of PES programs. These questions emerged from our participation in international negotiations, national policy design in France, and OECD expert groups on biodiversity, water and climate change policies, from 2009 to 2013. Policy debates on farmers’

²³ Farming sub-cultures are said to be a collection of landholders who share similar concepts of what is involved in ‘good land management’. The concept of ‘good land management’ differs between landholders, being socially constructed and defined through interaction between farmers, through participation in extension activities, and through the rural media (Howden & Vanclay, 2000, p. 297).

motivations to protect the environment and/or participate in PES, and debates on competitive versus collaborative approaches in PES particularly raised our attention. Our original interests also included debates on equity–efficiency trade-offs in PES design and analyzing precise PES distributional impacts. Extensive exchanges with the research supervisor and research committee all along the research helped narrow down the research focus and questions. Accordingly, extensive research on the distributional impacts of PES around the world was not included in the dissertation, which progressively focused on aspects relevant to OECD countries and fieldwork in Ontario.

1.3.2 Literature reviews, preparatory interviews and conceptual design

We reviewed: (1) conservation literature, in particular literature on agri-environmental practices; (2) literature on agri-environmental policy instruments; in particular on PES design; (3) literature on decision factors and motivations to act, in behavioural economics, social psychology, psychology, and market research. In particular, the literature review mobilized a range of empirical and theoretical research on behavioural factors affecting farmer decisions to adopt conservation measures or participate in environmental incentive programs in OECD countries. We assumed that motivations driving farmers’ adoption of environmental practices were also likely to play a role in farmers’ decisions to participate or not in incentive programs, and thus included adoption literature in our review.

We then designed an **original conceptual framework** to analyze what motivates farmers to participate or not to participate in PES, based on the interdisciplinary literature review on farmer behaviours, and our experience of more than fifteen years interviewing farmers on the ground on their constraints and decision factors. While we only tested this

framework and research method in Ontario, we argue in the conclusion of Chapter 2 that it could help tailor PES programs in various developed and developing countries.

To identify a relevant case study to test the proposed framework, we also conducted a **systematic review of agri-environmental incentive programs in Canada**, through a directed study course with Professor Graeme Auld (School of Public Policy and Administration, Carleton University), in 2014. Some elements of this review are presented in Appendix 3.

1.3.3 Contribution of the informal advisory committee of field experts, EEPRN and OMAFRA

An **interdisciplinary scientific committee** supported the research. Professor Stephan Schott supervised the dissertation, bringing in particular specialized knowledge and experience in behavioural economics, Canadian environmental policies, social network analysis, and mixed-methodology approaches. Professor Graeme Auld helped target and frame the analysis within the broader international debate on agri-environmental policies, develop a qualitative methodology, and build the Ontario case study. Professor Mehdi Ammi helped design and analyze the quantitative research, in particular sharing experience and critical advice on choice experiment design, analysis and interpretation.

To prepare the research proposal, we also consulted **25 experts in Ontario, Canada and France**, including researchers in various disciplines, policy-makers, program managers, farmer organizations, and conservation specialists. These experts provided invaluable insight at the design stage. The consultation helped: (1) narrow down research questions and design, (2) identify a precise case study with embedded cases in Canada (see details

below), and (3) identify contrasting PES worldwide to be used as a basis for comparison in the dissertation. Those PES were chosen to cover the maximum diversity of design options fostering collaboration or competition among potentially participating farmers in OECD countries (Chapter 3).

Ten to thirteen field experts in Ontario (depending on the research stage) remained involved throughout the research, forming an **informal field advisory committee** with various profiles, viewpoints and experiences. Participants in this informal committee were policy-makers, program managers, farmer organization managers, and conservation authorities. Some experts are involved in policy research and decisions; others work with farmers on the ground; some are farmers themselves. Consultations included bilateral meetings, exchanges by email and phone on draft research tools, and stakeholder meetings. We discussed research priorities and research tools with informal field advisors at four critical stages of the research: (1) during the preparation of the research proposal, as described above; (2) at the beginning of the qualitative research, to test and discuss the questionnaire and expand the list of key informants to be interviewed; (3) at the end of the qualitative research (December 2016), to discuss policy options to be tested in priority during the choice experiment (Chapter 4), and identify most relevant and feasible approaches to advertise the choice experiment survey; (4) when we drafted the choice experiment to ensure that choice scenarios, attributes and attribute levels were in line with current practices or relevant potential projects in Ontario.

Finally, **policy-makers and key partners** provided important feedback on the preliminary research results. We presented and discussed preliminary findings with researchers and policy advisers on three occasions: with the **Canadian Economics and Environmental**

Policy Research Network (EEPRN) - which contributed to funding the research - at a research policy workshop in April 2017, and with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) through two dedicated several-hour long Visio-conferences in October and December 2017. Those meetings provided feedback on the findings and their potential relevance for future agri-environmental programs in Ontario and Canada.

Those interactions all along the research were a very important contribution to the final results and are considered an integral part of the methodology.

1.3.4 Qualitative research

Our formal research started with a qualitative phase. We used semi-structured questionnaires (Appendix 1) to collect qualitative data on farmers' motivations for participating in incentive programs, barriers to participation, and heterogeneities in motivation and barriers across program designs and agri-environmental practices. From June 2016 to July 2017, we conducted 70 semi-structured interviews with farmers, farmer organizations and program managers in Ontario and 12 interviews in other provinces and countries. Key informants were identified using the systematic review of Ontario PES, the identification of contrasting PES in OECD countries, contacts available on the Internet, and snowball sampling. Farmers were chosen through heterogeneous purposive sampling²⁴ for their participation in contrasting Ontario PES, with the support of a recognized farmer

²⁴ "A purposive sample is a non-probability sample that is selected based on characteristics of a population and the objective of the study." (Crossman, 2020, para 1). We used expert purposive sampling to identify key informants, and heterogeneous purposive sampling to interview farmers.

organization administering various incentive programs in Ontario, the Ontario Soil and Crop Improvement Association, and diverse other organizations managing incentive programs. **Qualitative data collected feed in an Ontario case study presented in Chapters 2 and 3.** While interviews did not ensure a statistically relevant representation of Ontario farmers, the diversity of information sources allowed us to identify converging results. Interview responses also helped us identify gaps in our initial analytical framework and prepare a revised conceptual framework presented in Chapter 2. Interviews on program design in other provinces and OECD countries fed in **interprovincial and international comparisons**, used in Chapter 3 to understand historical, current and potential future evolutions in Ontario agri-environmental incentives design.

1.3.5 Quantitative research

Based on qualitative findings and exchanges with our scientific committee and informal field advisory committee, we designed a **choice experiment** with Ontario farmers. Potential scenarios and choice attributes derived from qualitative research findings. An extensive workshop and interviews with members of the informal field advisory committee helped prioritize among potential scenarios and attributes. We refined attribute levels with field practitioners and program managers. Socio-economic and attitudinal questions were included in the choice experiment to analyze segmentation in preferences. Open-ended questions were also included to draw connections between qualitative and quantitative analyzes. Chapter 4 presents detailed methods and software used to design the choice experiment and treat data. Recognizing that our farmer sample could not pretend to be representative along the variables of interest (in particular attitudinal factors), we chose to

disseminate our choice experiment to Ontario farmers, using a diversity of methods (postcard, emails...), and with the support of farmer organizations of various profiles, assuming a potential correlation between self-identification in a farmer ‘profile’ and attitude (Chapter 4).

1.3.6 Advantages of a mixed-methodology approach

Figure 2: Mixed-methodology approach adopted in the research

Researchers increasingly use mixed methods worldwide (Coyle et al., 2016; Mc Kim, 2017). Our dissertation decisively adopts a mixed-methodology approach (Figure 2). It combines reviews of scientific literature and project documents, and semi-structured interviews (qualitative approach); and a choice experiment (quantitative approach). The Ontario case study, in particular, fully benefited from the mixed-

methodology approach. “Case study integrates well with mixed methods, which seeks a more complete understanding through the integration of qualitative and quantitative research” (Guetterman & Fetters, 2018, p. 900).

Qualitative research helped target and design the choice experiment, and helped limit hypothetical bias by grounding scenarios in reality participants were mostly familiar with (exploratory **sequential design**²⁵). The choice experiment helped identify groups of farmers with heterogeneous preferences and hierarchize decision factors. Open-ended questions in the choice experiment helped connect quantitative findings with our qualitative research, linking farmer choice-profiles with comments in qualitative interviews, thus allowing us to confirm, illustrate and nuance CE results through **triangulation (convergent design)**. Finally, the participation of informal field advisors all along the research allowed for continuous **verification**.

1.4 Ontario, a revelatory case study with embedded comparisons

In Canada, agri-environmental policies rely on a complementary set of instruments, with three main building blocks: (1) a long-standing farmer-led self-assessment program: The **Environmental Farm Plan**; (2) a set of agricultural practices recognized for their environmental and economic benefits, referred to as **Beneficial Management Practices** (BMPs); and (3) **cost-share programs** with various approaches, eligibility criteria, and funding sources. Other economic instruments used in Canada include conservation easements, environmental offsets, fiscal incentives, and annual payment schemes.

²⁵ As per Creswell and Plano Clark (2011) mixed methods design typology.

Several considerations have led to the selection of a case study area. Case studies should be **insightful, transferable, feasible**, and, if possible, **fit in a locally active policy debate**.

To identify a region filling those criteria, we listed and compared PES implemented all across Canada in a directed study course (in 2014). We identified agri-environmental policy innovations and previous policy transfers across regions. We also studied agro-ecological conditions and socio-economic data from the Census of Agriculture. Ontario appeared particularly promising for a case study.

With almost 50,000 farms, agriculture in Ontario covers a broad range of industries (Statistics Canada, 2017). 44% of Ontario farms are mainly field crop producers, with a majority in oil and grain production. 41% are primarily livestock producers (with 14% in beef, 7% in dairy, and 6% in poultry & swine). The other 15% produce fruits, vegetables, flowers, or maple syrup. Compared with other Canadian provinces, the average area per farm (250 acres) has been increasing relatively slowly, and most farms remain comparatively small, with 53% farms of less than 130 acres.²⁶ However, these numbers hide a substantial disparity, with an increase in both the proportions of large farms (above 1000 acres) and of small farms (below 70 acres), as Ontario moves away from integrated crop-livestock farming and cattle farming declines. Since the late 1970s, Ontario cattle numbers have almost halved. In the last 15 years alone, almost half of dairy and beef farms have disappeared. Land use has evolved in parallel. Since the 1920s, areas in hay and pasture have plunged. From 2001 to 2016, pasture land has declined twofold, summerfallows threefold, and hay lost 32% of its coverage. Since the 1960s and the 1980s,

²⁶ 52.6 hectares.

respectively, corn and soybean productions have gained considerable acreage, occupying together 58% of all cropland in 2016. The bloom in cash crops and periods of high commodity prices have driven the price of farmland up. Agricultural land prices have multiplied by four from 2000 to 2015 and by two in the last five years of the period alone (Farm Credit Canada, 2016), well above the increase in Consumer Price Index (Figure 3). The increase in oil and grain production, reduction in natural and cultivated pastures, and a strong decrease in integrated crop-livestock farming raise potential environmental concerns, as grasslands are more prone to biodiversity, carbon storage, use less artificial inputs (pesticides and fertilizers) than crop fields; and using manure on fields is an important source of soil carbon.

Figure 3: Agricultural land prices dynamics compared to Consumer Price Index
Source: Farm Credit Canada, 2016

Over the last decades, improvements in some agri-environmental indicators testify to the rise of stewardship efforts in Ontario. Those trends include a reduction in pesticide and phosphorus fertilizer use. Conservation tillage has been promoted to benefit soil health and limit erosion since the 1980s and emerged rapidly in Ontario in the 1990s. In addition, “Sustainability and environmental performance is now becoming a factor in securing and

retaining market access” (Smith, 2015, p. 33), in particular through collective efforts to promote sustainable food systems since the early 2000s. However, recent data are raising concerns. After twenty years of steady increase, no-till is regressing to the expense of reduced tillage (Statistics Canada, 2017)²⁷. In addition, the decrease in hay acreage undermines the use of forages in crop rotation to build soil health and, together with the sharp reduction in pastures, results in declining organic matter in many Ontario soils (Eilers et al., 2010). Finally, fertilizer use and livestock concentration can negatively impact water quality. In 2015, Smith noted that “Despite relative improvements, continuing and emerging concerns exist [in Ontario] about agri-environmental risks include soil health, phosphorus management, water quality, habitat and pesticides.” (Smith, 2015, p. 49).

Agri-environmental issues are not a new policy matter in Ontario. Conservation Ontario²⁸ has referenced agri-environmental reports since 1971 and targeted research projects since 1972²⁹. Governments and environmental NGOs have supported environmental investments on farms through cost-share programs since the mid-1980s. In the early 1990s, a consortium of Ontario farmer organizations developed the Environmental Farm Plan³⁰ approach. In the late 2010s, Ontario PES include voluntary cost-share programs, conservancy easements and phosphorus offsets, with the recent development of competitive approaches (OSCIA, 2014a). Cost-share programs have various objectives,

²⁷ In 2016, farmers reported no-till practices on 28% of cropland, and reduced tillage on 34%.

²⁸ A network of 36 watershed-based conservation authorities.

²⁹ See archives collected on: <http://agrienvarchive.ca/>

³⁰ Summers et al. (2008, p. 442) describes: “The core instrument of the EFP is a workbook which outlines possible risks to the environment or to human health which may exist on a farm. [...] Accompanying this series of questions was text explaining potential risks in detail and discussing possible solutions that could be undertaken to address them (approaches to mitigation).” 70 to 75% of farm businesses in Ontario have completed the program (Morrison & FitzGibbon, 2014).

designs, funding sources, geographical scope, duration, and governance models. Farmer organizations take part in extension, awareness-raising, and grant programs. Municipalities finance local water quality programs through watershed-based conservation authorities. Environmental NGOs support landholders who preserve or restore wetlands and environmentally emblematic features on agricultural land. Federal and provincial governments and private foundations call for on-farm environmental projects, for example, to restore or protect species at risk. Intermediary institutions, such as the Ontario Soil and Crop Improvement Association (OSCIA), develop and test original PES designs.

Ontario - in particular South-Western and Eastern Ontario - fits the criteria listed above for the selection of a case study area:

Insightful: PES have been implemented in Ontario for 30 years, forming a basis for analysis of at least 20 programs with diverse payment designs, governance and delivery mechanisms. Diverse programs implemented in Ontario in the mid-2010s include:

- Growing Forward 2, a cost-share program implemented Ontario-wide under the federal-provincial agri-environmental policy framework;
- South Nation Phosphorus Offset program, a private-private instrument managed by the local conservation authority;
- Alternative Land Use Service Program (ALUS), a farmer-led community-based program organizing annual payments for environmental investments requiring to set aside agricultural land;

- Grassland Habitat Farm Incentive Program, a conservation tender to improve grassland habitats for two species at risk, designed and implemented by a farmer organization (OSCIA) with provincial funding...

This diversity allows for **intra-case comparison**, i.e. the comparison of schemes implemented in the same case-study area. The comparison between **collaborative and competitive approaches**, in particular, is possible in Ontario, where classic stewardship programs building on personal and social norms are partially giving way to more competitive approaches, including conservation tenders (OSCIA, 2014a).

Transferable: South-Western and Eastern Ontario are agro-ecologically comparable with agricultural regions in Quebec, Eastern Canada and parts of Europe³¹. In Canada, Ontario has been an early adopter of agri-environmental incentive, education and awareness-raising programs. Agri-environmental instruments developed in Ontario have been a source of inspiration and policy transfer in other provinces and countries. The Ontario Environmental Farm Plan, in particular, has been mainstreamed in Canada with government support, and remains a reference worldwide and a model to date.

Locally policy-relevant: Policy-makers and farmer organizations in Ontario have expressed interest in research on agri-environmental policies and policy evolutions. OMAFRA, researchers and farmer organizations continue to investigate potential improvements in agri-environmental policies with a particular interest in the design of delivery mechanisms to increase participation or cost-efficiency (Nailor, 1999; OSCIA,

³¹ With similar agro-ecological conditions, diverse farming systems, and urban sprawl affecting the most productive agricultural land.

2014a; Rosenberg, 2010). Behavioural aspects, including the influence of social networks, have explicitly been identified by researchers and policy-makers as an area requiring further investigation (Ontario, 2015; Prairie Research Associates, 2011; Rosenberg, 2010). In particular, OMAFRA has expressed interest in behavioural research on land use practices beneficial to soil health (Ontario Ministry of Agriculture, Food and Rural Affairs [OMAFRA], 2015; Weber, 2017).

Feasible: Ontario experts (researchers, policy-makers, program managers, and farmer organizations) were consulted during the design of the research proposal, and confirmed their interest in participating in the research or using research results for insight on future decisions.

Thus Ontario (in particular South-Western & Eastern Ontario) offers propitious conditions for a **revelatory case study with embedded comparisons** across programs, according to Yin's classification of relevant case studies (Yin, 2009)³². While not out of reach of social science inquiry and not unique per se, Ontario – being an early adopter of a range of PES - has some interesting and unique features in Canada. It can help reveal what could become a broader reality in the future with PES diversifying and becoming more mature programs. Ontario is also unique in the sense that stakeholders have acquired sufficient experience with contrasting programs to provide first-hand comparisons.

³² Yin's definition of a revelatory case study: "The investigator has an opportunity to observe and analyze a phenomenon previously inaccessible to social science inquiry" (Yin, 2009, p. 48).

1.5 A thesis organized around three research papers

The Ph.D. dissertation is organized as a thesis by articles, around three research papers, presented in Chapters 2, 3 and 4. **Chapters are much longer than typical papers.** They fully detail the research background, methodological process and research choices. Research papers would thus summarize current chapters by cutting out methodological and background details. Chapters build on each other in chronological order. Collectively, they bring insight to the three research areas above mentioned:

- (1) What are the main motivation factors affecting farmers' decisions to participate or not to participate in PES?
- (2) How do Ontario PES evolve and compare with international programs with regard to competitive and collaborative features?
- (3) How do various PES design features associated with key decision factors impact Ontario farmers' willingness to participate?

Heterogeneities among farmers are analyzed, and results feed in policy debates. Each chapter answers stand-alone research questions while contributing to the overall research objective. Chapter 2 focuses on the first research area, and Chapter 4 on the third one. Chapter 3 brings insights to both the second and third research areas. Elements of the Ontario case study support all three chapters to different degrees. The chapters have different geographical scopes and use various research methods. Table 1 below presents the chapters, their specific research questions, methods, contribution to the overall research, and connections with other chapters in the dissertation. The chapters have been conceived as standalone pieces to feed in future papers, which involves some limited repetition in their introduction.

Chapter 2: Chapter 2 focuses on the following research question: What are the main motivation factors affecting farmers' decisions to participate or not to participate in PES? In particular, the research questions non-financial motivations (including social preferences associated with equity, concerns for nature, and social norms). Using theoretical and empirical literature and a case study in Ontario, Chapter 2 proposes an **original framework** for analyzing individual decisions. An interdisciplinary literature review and personal experience interviewing farmers helped us identify five groups of factors that can play a key role in farmers' decisions on participating or not in PES. Extensive theoretical literature supports each of these groups of decision factors. Four groups are also frequently discussed in agri-environmental papers: financial and market impact, feasibility and risks, personal norms, and social norms. Conservation literature rarely investigated the fifth group (ownership and self-direction). However, this group is central in theories of organizational behaviours, and we argue that it is essential to understanding PES uptake. In the academic literature, those factors are usually studied in different articles, often in different disciplines. Previous research has considered several of those factors together, but the five of them have not been assembled in an integrated decision framework.

The second part of Chapter 2 presents an Ontario case study on farmers' motivations and barriers to participation. This case study follows two main objectives: (1) firstly, to help us validate and, if necessary, refine the proposed framework; and (2) secondly, to help us identify specific aspects – under the five groups of factors in our analytical framework – that matter in Ontario and could be relevant to take into account in policy design. We use this analysis to target our research in Chapters 3 and 4. In other words, by asking farmers,

program managers, and farmer organizations open-ended questions on farmers' motivations to participate or not in contrasting Ontario PES, we were able to: (1) Determine if most motivations of Ontario farmers fall under the five factors in the proposed framework with minimum gaps and overlap among factors; (2) Adjust our analytical framework as required; (3) Target specific aspects in program design that may affect farmers' decisions in Ontario, to be further investigated in Chapters 3 and 4.

Chapter 3: The literature on PES design is divided between researchers who promote further competition between farmers - to concentrate funding on the most cost-efficient environmental improvements -, and researchers who promote collaborative approaches - for widespread and long-term changes in agri-environmental practices. Both approaches have been implemented in Ontario. Chapter 3 is embedded in this debate and answers the following research question: How do Ontario PES evolve and compare with international programs on competitive and collaborative features? Answering this research question also allows us to identify which PES design features impact Ontario farmers' willingness to participate (secondary question). To answer those questions, we conducted a systematic review of Ontario PES designs and compared them with contrasting PES in other OECD jurisdictions, using program reports, advertisement booklets and online descriptions, as well as interviews with program managers, farmers and farmer organizations as data sources. These sources allowed us to consider 22 programs in Ontario and ten programs in other provinces and countries. Interviews with landholders, mostly farmers (n=30), were conducted through purposive sampling to contrast a few key examples of competitive and collaborative approaches in Ontario. However, most farmers interviewed knew of or had experience with various programs and could thus compare a range of approaches. Open-

ended questions in the survey associated with the choice experiment also helped us gather feedback from Ontario farmers on various PES design options. In Chapter 3, we use these qualitative results to complement and confirm interview findings.

Chapter 4: We used the diversity of design options presented in Chapter 3 to design a choice experiment described in Chapter 4. The choice experiment focuses on the following question: How do various PES design features associated with key decision factors impact Ontario farmers' willingness to participate? Two sub-questions derive from this general research question: (i) How would farmers with heterogeneous preferences react to various PES designs in Ontario? (ii) Along which criteria can we differentiate farmers with heterogeneous motivations to participate or not in PES schemes? Building on Chapters 2 and 3, the choice experiment presents design options familiar to the respondents and uses vocabulary widespread in Ontario. This approach strengthens our analysis by reducing hypothetical bias. 324 farmers accepted to participate in the survey, and 280 completed it. The choice experiment helps understand how farmers with varying social preferences and preferences for ownership and self-direction react to different PES designs.

Finally, **Chapter 5** builds on policy insights from Chapters 2 to 4 to develop a general policy conclusion on the design of agri-environmental incentive programs in Ontario.

In summary, Chapter 1 (Introduction) frames the analysis and introduces the main concepts used throughout the dissertation. Chapter 2 discusses factors impacting individual behaviours. The analytical framework developed in Chapter 2 to analyze farmers' motivations is used in Chapters 3 and 4 to understand how program designs affect farmers' motivations for participating in PES programs in a context of heterogeneous preferences.

Heterogeneities in program design identified in Ontario in Chapter 3 are used to design and test hypothetical programs in Chapter 4. Chapter 4 brings further insights on heterogeneous preferences among groups of farmers and thus puts in perspective findings presented in Chapters 2 and 3. Chapter 5 is a general conclusion and policy recommendation chapter. Following the mixed-methodology approach, all Chapters rely on several research methods. Chapter 2 builds on (1) a broad review of the theoretical and empirical literature, (2) semi-structured interviews in Ontario, and (3) relevant farmers' responses to open-ended questions in the online choice experiment survey. By using a mixed methodology approach, we were able in Chapter 2 to propose an original framework grounded on various theoretical backgrounds and to test its completeness, coherence and usefulness. Chapter 3 builds on: (1) local documents not published in the research literature (project documents, legal documents, newspaper articles, policy reports, expert analyzes, online blogs and social media); (2) semi-structured interviews with program managers, farmer organizations and farmers; and (3) relevant farmers' responses to open-ended questions in the online choice experiment survey. This approach allowed us to combine a precise understanding of program design with undocumented information on lessons learnt by program managers and field experts (practitioners); and farmers' perceptions. Chapter 4 reports the results of the choice experiment. Its design and interpretation are grounded in the review of program designs (Chapter 3) and the qualitative analyzes of motivations (Chapter 2).

Two other potential papers were sketched out during the research. While those potential papers are not part of the dissertation, a lot of time in the research process was allocated to thinking them through and collecting relevant material.

A first additional paper, originally described in the research proposal, would focus on the distributional consequences of PES programs, examining the literature on interactions and trade-offs between equity and efficiency principles in PES, through a **systematic literature review**. While we gathered and started analyzing a lot of material to implement this review (with dozens of relevant articles worldwide), it appeared in the preparation process that most literature referred to developing countries and had little potential connections with the case study in Ontario that became central to our research. In agreement with our research supervisor, we considered it more relevant to develop further the conceptual backing of the research with literature relevant to the Ontario case study.

Another potential paper emerged during our research, and was largely thought through and sketched out. The current dissertation focuses on farmers' individual behaviours, i.e. on individual decisions on participating or not participating in PES, with a specific interest in the influence of perceived fairness (including perceived distributive impacts) and social networks on farmers' decisions. However, interviews in Ontario and Prince Edward Island revealed that perceived fairness of **distributive impacts**, and **social networks** could also play a more structural role: they can shape policy negotiations, policy mixes, and broad trends in PES adoption, thus impacting collective decisions. A future paper would focus on those **collective dynamics**, insisting in particular on negotiations on agri-environmental decisions between groups of diverging interests and viewpoints. Our Conclusion (Chapter 5) frames this potential paper.

Table 1: Articulations across research chapters

	Research questions	Unit of analysis	Research method(s)	Data sources	Main result	Contribution to the thesis	Contribution to other papers
Chapter 2	What are the main motivation factors affecting farmers' decisions to participate in PES?	Individual decisions	- Literature review - Ontario case study	- Theoretical & empirical literature - Semi-structured interviews in Ontario - Qualitative answers in the choice experiment (CE) online survey	Proposes an original behavioural framework to analyze farmers' decisions to participate in PES.	Contextualizes the influence of social preferences and other motivation factors on individual landholder behaviours in an integrated decision framework.	The framework developed in Chapter 2 is used in Chapters 3 & 4 to understand the impact of program design on farmers' decisions to participate, and heterogeneities among groups of farmers with different behavioural traits.
Chapter 3	How do Ontario PES evolve and compare with international programs with regards to competitive and collaborative features? (secondary question: Which PES design features impact Ontario farmers' willingness to participate?)	Individual programs	- Systematic analysis of PES designs in Ontario with a historical perspective - Design comparisons within Ontario & with other regions, countries	- Semi-structured interviews in Ontario and other provinces and countries to map out contrasting design options - Program documents - Qualitative answers in the choice experiment (CE) online survey	Identifies features in Program design impacting Ontario farmers' willingness to participate.	Determines how programs differ, in particular with regards to social network participation and perceived fairness.	Program features identified as impacting farmers' willingness to participate in Ontario PES in Chapter 3 are used to design the choice experiment (Chapter 4).
Chapter 4	How do various PES design features associated with key decision factors impact Ontario farmers' willingness to participate?	Groups of farmers with similar preferences	Online choice experiment with Ontario farmers Latent class models	Choice experiment	Identifies groups of farmers with heterogeneous preferences, and impactful PES features for each group.	Concludes on the relative importance of various project design features for farmers with heterogeneous preferences.	Chapter 4 confirms that design features and motivation factors identified in Chapters 2 and 3 contribute to explaining heterogeneities in farmers' willingness to participate in Ontario PES.

Chapter 2: Farmers' motivations for participating in agri-environmental incentive programs, a qualitative analysis

“The most important lesson for public policy analysis from the intellectual journey I have outlined here is that humans have a more complex motivational structure and more capability to solve social dilemmas than posited in earlier rational-choice theory. Designing institutions to force (or nudge) entirely self-interested individuals to achieve better outcomes has been the major goal posited by policy analysts for governments to accomplish for much of the past century. Extensive empirical research leads me to argue that instead, a core goal of public policy should be to facilitate the development of institutions that bring the best out of humans.” (Ostrom, 2009, p. 435-436)

2.1 Introduction

For more than 30 years, agri-environmental programs have financially supported the adoption of environmentally friendly practices on farms, with mixed results. To inform program design, scholars in a wide variety of fields, from agricultural economics to social psychology, have analyzed farmers' financial and non-financial motivations for adopting environmental practices and participating in environmental incentive programs. Despite extensive academic research, no consistent results explain why certain farmers choose to participate, and others do not, and why certain incentive programs are successful in fostering durable agricultural transitions and others fail. Reviewing the literature on farmers' adoption of conservation practices, Knowler and Bradshaw (2007) concluded that no variables consistently explain adoption. Knowler and Bradshaw even pointed out that “with increasing investigation of individual variables thought to influence adoption, their causal impact only becomes less certain” (Knowler & Bradshaw, 2007, p. 40). Later reviews confirmed this conclusion on a range of agri-environmental practices (Carlisle,

2016³³; OECD, 2012; Prokopy et al., 2008³⁴; Scottish Government, 2012). Building on previous research³⁵, Brick (2013) noted that **local factors** such as the profile of local environmental issues, programming activities, and information networks could significantly influence adoption decisions and prevent generalizations. Recent studies in the European Union on farmers' perceptions of agri-environmental programs converge in highlighting the need to target incentive schemes to 'real' farmers (Dessart, 2019).

In the absence of universal conclusions, those literature reviews call for local, contextualized studies to inform on a case-by-case basis agri-environmental program design and targeting. However, no consistent analytical framework has been proposed to conduct such local analyzes. In the absence of a recognized framework, most empirical studies on farmers' environmental behaviours rely on previous empirical work rather than theories to identify variables to be tested locally.

Several researchers have used the Theory of Reasoned Action (Fishbein, 1967) and its extension, the Theory of Planned Behaviour (Ajzen, 1985), to draw integrated models of farmers' decision processes. Those social psychology frameworks bring a solid theoretical background in conservation studies but explicitly account for only some of the decision factors discussed in conservation literature. This chapter argues that theoretical literature on decision-making and empirical studies on farmers' conservation behaviours can help **design a simple analytical framework that could be used in local diagnoses**. Our thesis

³³ Review on the adoption of soil health practices in the United States.

³⁴ Prokopy et al. (2008) reviewed literature on the adoption of various types of agricultural best management practices in the United States to examine general trends in the categories of capacity, awareness, attitudes and farm characteristics. They used a vote count method on 55 studies. The authors identified some general trends, but their results were inconclusive as to which factors consistently determine adoption.

³⁵ Ahnström et al. (2009); Lamba et al. (2009); Reimer et al. (2012).

is that looking at agri-environmental programs from the **farmers' perspective** using a standardized analytical framework can help single out **locally relevant motivations, participation barriers, and heterogeneities in preferences**. In this chapter, we propose such a framework and test it on a case study in Ontario. Our objective is not to list a ubiquitous set of factors that would consistently explain behaviours but to build a framework and research process that can help identify relevant factors locally, understand differences across groups of farmers, and inform program design.

Bavel and Dessart (2018) made a case for a **qualitative approach** in behavioural studies for EU policy-making, particularly when exploring a policy area where the problems or potential solutions are not well defined³⁶, or to prepare broader quantitative studies in a **mixed-methods** approach. Quoting Tierney and Clemens (2011), Van Bavel and Dessart argue that a qualitative approach is better suited to identify relevant social, cultural, and experiential aspects that need to be considered to understand behaviour better. Our research methodology aligns with this recommendation. Findings in the current Chapter 2 and Chapter 3 mostly rely on qualitative approaches, while quantitative results, building on the qualitative research, are presented in Chapter 4.

The research for this chapter was organized in four steps:

Step 1: We first built a **preliminary analytical framework** of farmers motivations to participate in agri-environmental incentive programs, using an interdisciplinary review of theoretical literature on decision-making (in behavioural economics, psychology, social

³⁶ “A qualitative approach will remain open to surprises, seeking to identify as many relevant factors and viewpoints as possible” (Van Bavel & Dessart, 2018, p. 31).

psychology, and market research), empirical articles on farmers' motivations for adopting conservation practices and participating in environmental incentive programs in OECD countries, and our experience of more than fifteen years interviewing farmers on the ground on their constraints and decision factors. To draw insight from a broad empirical literature, we did not limit our review to research on farmers' participation in payments for environmental services programs (PES). We assumed that motivations driving farmers' adoption of environmental practices were also likely to play a role in farmers' decisions to participate or not in PES and thus included adoption literature in our review.

Step 2: Secondly, we collected **original data in an Ontario case study** on farmers' motivations for participating in environmental incentive programs, barriers to participation, and differences in motivation and barriers across various types of program designs and agri-environmental practices. From June 2016 to July 2017, we conducted 70 semi-structured interviews with farmers, farmer organizations, program managers, researchers, experts and policy-makers in Ontario. While interviews did not ensure a statistically relevant representation of Ontario farmers, the diversity of information sources allowed us to identify converging views presented in the 'results' section of this chapter.

Step 3: Using information collected in the interviews, we **tested** if the **proposed framework** was sufficient and helpful to: (1) **organize and analyze responses to open-ended questions** on farmers' motivations and participation barriers; (2) **identify heterogeneities** in motivations across **groups of farmers**, and types of **agri-environmental practices**; (3) understand variations in farmers' willingness to participate across program designs; and (4) derive policy recommendations. The first two points are discussed in this chapter, while points (3) and (4) are the subject of Chapters 3 and 4, with

Chapter 3 presenting the results of a qualitative analysis and Chapter 4 developing a quantitative approach.

Step 4: Interview responses also helped us identify a gap in our initial framework. We verified that this gap was consistent with empirical findings in other research papers and prepared a **revised framework**.

In the first section, this chapter discusses the literature on farmers' decisions to participate in agri-environmental programs or to adopt environmentally beneficial practices. In a second section, we propose an original framework to analyze farmers' motivations for participating in environmental incentive programs and participation barriers. We show that this framework is coherent with theoretical and empirical research on decision-making and conservation behaviours. A third section evaluates the proposed framework using a case study in Ontario. Finally, we propose a revised framework, based on the findings from the Ontario case study, and discuss its relevance to guide further research on farmers' motivations to join environmental incentive programs in Ontario and other OECD regions.

2.2 Farmers' motivations for participating in environmental incentive programs and adopting environmental practices: a rich but fragmented literature

Social psychologists have analyzed farmers' values, attitudes and behaviours since the 1920s (Garforth, 2010); this body of work has identified multiple factors that may explain farmers' decisions. McGregor et al. (1996) listed nine groups of psychological factors

impacting farmers' decision-making, in addition to economic motives and risks³⁷. Reviewing 21 studies on farmers' adoption of conservation agriculture, Knowler and Bradshaw (2007) listed no less than 142 significant factors in 31 analyzes³⁸. Knowler and Bradshaw grouped these factors in four categories: farmer and farm household characteristics (including farmer attitudinal factors); farm biophysical characteristics; farm financial/management characteristics; and exogenous factors. In a more recent review of factors influencing farmers' adoption of soil health practices in the United States, Carlisle (2016) listed ten groups of factors recurrently discussed in the literature. These include attitudinal variables, demographic characteristics, policy features, and economic context.³⁹ To date, most studies on farmers' environmental practices and participation in environmental programs tend to either focus on one or two specific motivation factors grounded in theory or - when they aim at a more comprehensive analysis - to consider a case-by-case list of psychological, socio-economic and agro-ecological variables, without a theoretical justification detailing how the factors tested were selected.

However, some researchers have adopted an integrated theoretical framework to guide their empirical analyzes. Two theories in social psychology have been particularly

³⁷ In addition to maximising income, McGregor et al. (1996) identify that farmers' decisions are influenced by: objectives and goals in farming; attitude towards the traditional/ethical approach to farming; stress and the ability to cope with stress, satisfaction with and optimism about farming, attitudes to legislation; risk-taking, autonomy, management attitudes; conservation attitudes; quality and quantity of information; who is involved in the decision-making process; the individual's ability to solve problems; and aspects of their personality. Wichmann et al. (2017, p. 1111) found that participants in conservation reserve auctions with risky conservation contracts "decrease their bids as risk aversion increases, even in auctions with cost risk, suggesting that the risk of losing the auction dominates. These findings uncover new challenges for the practical implementation of conservation auctions as an efficient policy instrument".

³⁸ Factors significant in at least one of the 31 analyzes.

³⁹ Agronomic, financial, land tenure, public policy, knowledge and information, social networks, community perception and aesthetics, awareness of and concern about the environmental impact of agriculture, farmland characteristics, demographic factors.

insightful in understanding the relationship between attitudes, norms and behaviours: The **Theory of Reasoned Action** (Fishbein, 1967) and its extension, the **Theory of Planned Behaviour** (Ajzen, 1985, 1987, 1991). In 2010, Fishbein and Ajzen consolidated these theories and developed the **Reasoned Action Model** (Figure 4). This model considers that people’s beliefs impact three factors: their ‘attitudes towards a behaviour’, their ‘perceived norms’ (“the perceived social pressure to perform or not to perform the behaviour”, Ajzen, 1991, p. 188), and their ‘perceived behavioural control’, i.e. their perceived capacity to implement the behaviour. These three factors combine to drive a person’s behavioural intention. Together, intention and actual behavioural control determine a person’s behaviour. These theories have inspired numerous studies. The seminal paper by Ajzen (1991) has been cited more than 16,000 times (Scopus, April 2016).

Figure 4: Schematic presentation of the Reasoned Action Model (Fishbein & Ajzen, 2010, p. 22)

Environmental psychology is one of the main fields to which these socio-psychology theories are applied. Academic studies on farmers' attitude towards environmental practices or environmental information have used, as their main conceptual framework, the Theory of Reasoned Action (Artikov et al., 2006; Bergevoet et al., 2004; Chouinard et al., 2016; Elliot et al., 2011) or the Theory of Planned Behaviour (Beedell & Rehman, 2000; Lynne et al., 1995; Maybery et al., 2005; Morrison et al., 2012; Toric, 2006; Tutkun & Lehmann, 2006; Tutkun et al., 2006). These theories have been particularly insightful in analyzing **causal relations between beliefs and behaviours**. They have helped identify critical beliefs facilitating or limiting the adoption of environmental practices, and have been a strong asset in informing **environmental awareness-raising and education programs**.

However, it appeared early in our research that the Reasoned Action Model was not fulfilling our objective to guide local analyzes on farmer's motivations for participating in environmental incentive programs. In particular, based on conservation literature, it appeared critical to disaggregate Fishbein and Ajzen's notion of behavioural beliefs. We acknowledge that Fishbein and Ajzen's notion of behavioural beliefs is not a simple one-dimensional factor. However, it is our conviction that extensive literature in agricultural economics, behavioural economics and conservation behaviour allows itemizing factors or groups of factors that often drive farmers' decisions on participating or not in environmental programs and are worth considering in any local analysis. The notion of 'behavioural beliefs' encompasses factors that have been extensively debated in agricultural and behavioural economics and deserve specific attention in a framework

tailored to analyze farmers' motivations for participating in environmental incentive programs. An important area not explicitly covered in the Reasoned Action Model but at the heart of conservation literature is the **balance between financial and non-financial motives** in farmers' environmental decisions, in particular the influence of **personal norms**. As further discussed below, the Reasoned Action Model's reference to normative beliefs refers to social norms (unwritten external rules) rather than personal norms (internal standards)⁴⁰. In the context of conservation policies, considering explicitly personal norms and their potential heterogeneity among groups of farmers with different social preferences appeared to be a necessary addition to the Reasoned Action Model.

Agricultural economists have also produced abundant literature on farmers' **attitudes towards risk**. This literature goes beyond Fishbein and Ajzen's notion of perceived behavioural control to encompass risks independent of farmers' capacity to implement a project (and thus related to Fishbein and Ajzen's 'behavioural beliefs' rather than 'behavioural control'). In Ontario, for example, some farmers are wondering if, by participating in an environmental program, they may increase their exposure to current or future regulations, inspections, and sanctions.

Few theories have provided an alternative to the Theory of Reasoned Action – Theory of Planned Behaviour duo in the study of farmers' decisions to adopt environmental practices. However, it is worth noting the framework developed by Swinkels and Franzel to analyze the adoption of agroforestry practices from a farmer's perspective. The authors identify three dimensions that farmers consider when deciding on adoption: **feasibility**,

⁴⁰ See presentation and discussion of those concepts in Introduction (Chapter 1).

profitability, and **acceptability** (Franzel, 1999; Swinkels & Franzel, 1997). Examining decisions along these three dimensions helped Franzel identify 13 main factors affecting farmers' potential adoption of improved forested fallows in Kenya, Cameroun and Zambia (Franzel, 1999, p. 310).

2.3 Proposing a simple integrated framework to analyze farmers' motivations, grounded in behavioural theories and empirical studies

Few academic papers conceptualize what motivates landholders to participate or not in PES schemes. Muradian et al. (2010) underlined the importance of personal conviction and collective action in PES uptake and sustainability. The authors referred to **theories of collective action choices**, managing the commons, and incentive-based policies as important elements to analyze PES. While they proposed a new PES definition, they did not develop a new theoretical model *per se*.

The economic literature on conservation practices in the United States offers theoretical developments relevant to our research. In particular, Lynne (associated with a number of co-authors over the years) built on social-psychology theories and traditional economics to develop theoretical models integrating self-regarding and other-regarding preferences in conservation decisions (Bishop et al., 2010; Chouinard et al., 2008, 2016; Hayes & Lynne, 2004; Kalinowski et al., 2006; Lynne, 1999, 2002; Lynne et al., 1988, 1995; Lynne &

Casey, 1998; Lynne & Rola, 1988; Sheeder & Lynne, 2011)⁴¹. In Lynne's work, self-interested and other-regarding preferences are not separated but interact in a framework labelled '**metaeconomics**' (Lynne, 2006, 2020)⁴². Various empirical works based on Lynne's model confirm that both **self-interested** and **other-regarding preferences** matter in farmers' conservation decisions (e.g. Chouinard et al., 2008; Sheeder & Lynne, 2011). The framework we propose builds on this research while encompassing a broader range of factors.

2.3.1 A five-dimension framework

Based on the literature on agri-environmental policies, research in psychology, social psychology and behavioural economics, and our experience on the ground, we have identified five main factors or groups of factors that can explain landholders' decisions to participate or not in PES, from the farmer's perspective: (1) expected financial and market impact, (2) perceived feasibility and risks, (3) personal norms, (4) social norms, and (5) perceived ownership and self-direction (Figure 5 and Figure 6). Each factor can either have a positive or negative impact on a farmer's decision to participate, depending on local

⁴¹ Based on Lynne's work, Chouinard et al. (2008), for example, developed a producer behaviour model with an expanded utility framework integrating self-interest and societal/environmental motivations ('stewardship motives'). Using stated preferences (contingent valuation method), Chouinard et al. confirmed the theoretical model, showing that some farmers are willing to trade-off some degree of self-interest for more socially/environmentally friendly practices. The study differentiated 3 ideal types of farmers: farmers only interested in their own financial income and wealth, farmers purely self-interested but considering both financial and environmental factors as important parts of their wellbeing, and farmers having other-regarding environmental preferences as well as self-regarding preferences. In its empirical work, Lynne confirms that both dimensions matter (see for example Sheeder & Lynne, 2011).

⁴² Under this framework, a joint, empathy-sympathy based shared Other-interest evolve in regular interplay and mutual feedback with the egoistic-hedonistic based Self-interest, and adequate level of Self-control to balance the interests (Lynne, online: <https://www.metaeconomics.info/metaeconomics-an-overview> retrieved in July 2021).

and farm conditions and program design. The next section argues that selecting these factor groups relied on a solid body of theoretical and empirical research. Each proposed factor group has been extensively documented in decision-making literature, and most groups have been identified as highly significant to explain some farmers' environmental behaviours.

In our proposed framework, 'social norms' largely overlap with Fishbein and Ajzen's 'perceived norms'. Their 'perceived behavioural control' (perceived feasibility) is included in the group of factors we defined as 'perceived feasibility and risks'. Finally, the importance given by farmers to financial and market impacts, risks, personal norms, and ownership and self-direction might be considered elements of Fishbein and Ajzen's 'behavioural beliefs'. The framework we propose is thus compatible with the Reasoned Action Model while emphasizing aspects relevant to conservation and PES participation decisions, as further discussed below for each proposed group of factors.

2.3.1.1 Expected financial and market impact

Most literature in economics, including behavioural economics, considers that expected financial consequences are a key consideration when making an economic decision. Early research on farmers' behaviours considered economic motives alone (McGregor et al., 1996), and many empirical studies conclude that financial considerations matter in farmers' decisions on participating in environmental incentive programs and/or adopt conservation practices (Hopkins & Johansson, 2004; Napier & Camboni, 1993; Smith & Weinberg, 2004; Swinton, 2000; Wilson & Hart, 2000). Market access has also been identified as an influential factor. In a Presidential Address to the Agricultural Economics Society,

Blandford (2010) listed market-based incentives - through such factors as consumer preference for green products - as one of the three types of incentives that influence participation in voluntary agri-environmental programs. In Ontario, Smith (2015, p. 33) noted that “Sustainability and environmental performance is now becoming a factor in securing and retaining market access”. However, for more than 20 years, researchers have agreed that economic motives alone cannot explain farmers’ adoption of environmental practices or decision to participate in environmental incentive programs (Atari et al., 2009; Bishop et al., 2010; Carlisle, 2016; Chenard & Parkins, 2010; Chouinard et al., 2008; McGregor et al., 1996; Muradian et al., 2010; Perrot-Maitre, 2013; Ryan et al. 2003; Schaiblea et al., 2015; Sheeder & Lynne, 2011; Trenholm et al., 2013; Yiridoe et al., 2010). McGregor et al. (1996, p. 237) noted, for example: “The results have clearly shown that the farmers interviewed (...) have a multitude of objectives which rank maintenance of their land resource, the environment and their way of life ahead of the traditionally accepted objectives of profit maximisation and risk minimisation.” Twenty years later in a literature review on the adoption of soil health practices in the United States, Carlisle (2016, p. 604) concluded that “Researchers were surprised by the degree to which farmers appeared to act on non-economic motives. (...). In general, the role of economic factors appeared to be secondary rather than primary”. A number of authors find the relationship between financial compensation and participation in PES insignificant (e.g. Nomura & Yabe, 2007⁴³; Soule et al., 2000; Traore et al., 1998). In Canada, non-financial considerations were shown to dominate monetary considerations in farmers’ reasons for participating in

⁴³ Cited from OECD, 2012, p. 8.

the Nova Scotia Environmental Farm Plan (Atari et al., 2009; Yiridoe et al., 2010). Compensation alone may not ensure the success of a conservation program (Wynn et al., 2001). However, economic factors cannot be overlooked. Carlisle (2016, p. 604) noted, for example, that “while economic factors were unlikely to motivate farmer adoption of soil health practices, they could be important in removing barriers”. The role of cost-share “may be to remove financial barriers for farmers whose primary motivations are non-economic” (Carlisle 2016, p. 598, citing Arbuckle, 2012). Financial incentives, including cost-sharing, appear particularly important when farmers need to purchase new equipment, or try out new cropping methods with significant input or opportunity costs, and conservation benefits are only expected in the long-term.

2.3.1.2 Perceived feasibility and risks

Risk aversion is a well-documented phenomenon in behavioural economics (Neumann & Morgenstern, 1953; Tversky & Kahneman, 1981). Along with economic motives, risks were one of the first factors introduced in research modelling farmers’ behaviours (McGregor et al., 1996). Theoretical and empirical research has shown that risk and uncertainty can be important barriers to the adoption of new agricultural practices (Marra et al., 2003). Long-term contracts that would commit farmers to an uncertain economic environment have also been shown to decrease farmers’ willingness to participate in various contractual commitments, including in PES (Broch & Vedel, 2012; Hudson & Lusk, 2004; Lantz et al., 2012). These findings can be attributed to risk aversion. Prokopy et al. (2019), in a review of 35 years of quantitative research on farmer adoption of conservation practices in the United States, identifies risk tolerance/aversion as factors

often documented in quantitative studies, even if the review's test of impact by vote count is inconclusive⁴⁴. Carlisle (2016) also underlines that access to information and confidence in abilities to master conservation practices increase farmers' likelihood to adopt them⁴⁵ (this corresponds to the Reasoned Action Model 'control belief', embedded in our 'perceived feasibility and risks' factor). In Ontario, various perceived risks are documented as influencing decisions to participate in environmental incentive programs. Agronomic risks (associated with an uncertainty on the financial return) are mentioned, for example, by Verhallen (2014) as limiting participation in Ontario PES. Perceived legal risks seem to be another key consideration for Ontario farmers. Studies show that farmers' fears of legal exposure have limited early participation in Ontario's Environmental Farm Plan (Yiridoe, 2000). O'Grady (2011) also underlined the influence of perceived risks associated with liability transfer as limiting participation in an Ontario PES. These last dimensions go beyond the Reasoned Action Model 'control belief' and justify our consideration of a broader category.

2.3.1.3 Personal norms⁴⁶, ethics

The influence of personal norms on behaviours has been broadly documented. Altruistic behaviours have been repeatedly identified in behavioural experiments (Bowles, 2004).

⁴⁴ In this meta-study, "vote count" is a method used - in a context of very contrasting results across individual studies - to conclude if a factor globally has a positive, negative or insignificant impact on adoption.

⁴⁵ "Multiple studies found that farmer knowledge and access to information were critical factors influencing adoption of soil health practices (Arbuckle, 2012; CTIC, 2013, 2014, 2015; Miller, Chin, and Zook, 2012; Snapp et al., 2005; Vitale et al., 2011). Farmers who were more knowledgeable about the environmental and agronomic benefits of these practices, and who had confidence in their ability to properly implement them, were significantly more likely to adopt them". (Carlisle, 2016, p. 598-599).

⁴⁶ "Personal norms are standards and values (e.g. moral values) that the individual uses to evaluate the worth of behaviours" (Baah Odoom, 2012, p. 80).

For example, altruistic behaviours drive voluntary contributions to public goods (Burlando & Guala, 2005; Fischbacher et al., 2001; Fischbacher & Gächter, 2009, 2010, 2012). Inequity aversion also impacts individual decisions (Bowles, 2004). Behavioural research has shown that individuals are ready to act against their best economic interest to punish what they perceive to be unfair behaviours (notion of altruistic punishment, Fehr & Gächter, 2002).

Landholders who participate in environmentally ambitious PES⁴⁷ are voluntarily contributing to global or local public goods. They accept bearing costs or taking risks to preserve or increase ecosystem services with local or global benefits for other actors in the short or long-term⁴⁸. The importance of altruistic concerns for others in conservation decisions is underlined by Atari et al. (2009), Chouinard et al. (2008), Mzoughi (2011), Ryan et al. (2003), Sheeder and Lynne (2011), etc. Chouinard et al. (2008), for example, differentiated three groups of landholders, including a group with significant other-regarding preferences: “a sense of obligation to others (future generations, God, or spirit of the land) that requires personal sacrifice” (Chouinard et al., 2008, p. 80). In a broad review of soil health practices literature in the United States, Carlisle (2016, p. 600) concluded: “Farmers develop complex mental models about the environmental impact of their practices, and while intrinsic motivations for adopting soil health practices have been understudied, those researchers who did look seriously at them found them to be of key importance [to explain the adoption of soil health practices].”

⁴⁷ This excludes PES associated with large windfall effects.

⁴⁸ Even payments calibrated to offset costs do not necessarily compensate for all opportunity costs, transaction costs, labour costs, learning costs, and costs associated with potential changes in value-chains or access to specialized services.

Farmers in and around Ontario's Credit Valley declared that concerns for others weighed in their land-use decisions (Trenholm et al., 2013). Other authors conclude more broadly that landholders' environmental attitudes significantly impact their decisions (Schultz et al., 2014; Wilson & Hart, 2000). Public (off-farm) environmental benefits were the most significant motive reported by participants in six conservation programs in Indiana (Reimer & Prokopy, 2014). In Ontario, stewardship programs have long appealed to a sense of personal responsibility.

Perceived fairness may also play a role in farmers' decisions to participate or not in PES. Farmers interviewed on potential PES design evolutions in Prince Edward Island mentioned that they would not be willing to participate in a reverse auction (Lantz et al., 2012)⁴⁹. In a survey following workshops on potential conservation auctions in Manitoba⁵⁰, Packman and Boxall (2010) also found that some farmers perceive this selection system as unfair. In Ontario, Holmes (2015, p.96) noted that, for many Ontario farmers, "The very notion of competing against one's neighbour was antithetical [to a tradition of cooperation] (...), with the pervading sentiment that approaches with competitive leanings would struggle for traction."

2.3.1.4 Social norms

Beliefs about what others do and what others think one should do ('social norms') often guide a person's actions in a social setting (Mackie et al., 2015). Individuals may comply

⁴⁹ Only 6% of members and 12% of non-members responded that they would participate (Lantz et al., 2012, p. 25).

⁵⁰ "A majority of the respondents felt that it would generally be a bad program for producers because it would be unfair, and they did not like the competitive nature of auctions". (Packman & Boxall, 2010, p. 23).

with social norms because they think that others know best, they fear exclusion, or following accepted social norms is key to a broader system. In particular, in a farming community environment with a strong interest to cooperate, **reputation building** can be a form of an assurance game, and social networks might be the answer to coordinate on the more beneficial Nash equilibrium⁵¹ (Bowles, 2004, Chapter 7). In a literature review on social norms in wetland conservation decisions, Chenard and Parkins (2010), citing Lapinski and Rimal (2005), underline that:

“since the satisfaction of individual needs is often closely linked to cooperation with other members of society, individuals tend to adjust their behaviours accordingly to ensure that others will evaluate them favourably. (...) These collective behaviours and group formations evolve over time and represent conduct that typically promotes the survival and well-being of individuals or social groups and as such, adherence to normative behaviour is generally in the best interest of the individual.” (Chenard & Parkins, 2010, p. 3).

Carlisle (2016) cites a personal communication by a farmer and non-profit program manager outlining that farmers would be ready to forego short-term personal gains to comply with social norms and habits in their agricultural community: “people will make grossly economically negligent decisions because it saves them from making a decision that will put them in a nervous or uncomfortable social situation of challenging the status quo.” (Carlisle, 2016, p. 600)

The influence of social networks or **social norms** on farmers’ decisions to participate in PES has been described by Carlisle (2016), Chapin et al. (2009), Chen et al. (2009), Kuhfuss et al. (2014), Perrot-Maitre (2013), Siebert et al. (2006), Toogood et al. (2004), among others. In a laboratory experiment designed to inform agri-environmental policies,

⁵¹ A Nash equilibrium in game strategy is an outcome where no individual has any incentive to alter his strategy given the strategies adopted by all the others (Bowles, 2004, p. 33).

Le Coent et al. found that subjects who believe that others will contribute to a public good have a higher level of contribution, which is “coherent with a mixture of reciprocity, reputation building and risk-aversion.” (Le Coent et al., 2013, p. 26). Kuhfuss et al. (2014) found that beliefs on what others would do impact farmers’ intentions to participate in a hypothetical agri-environmental incentive scheme in a French vineyard. In a literature review, Chenard and Parkins (2010) found that social networks play a significant role in both the development of new PES initiatives and farmers’ decisions to participate; even though there is no consensus on the impact of specific social networks. Lantz et al. (2012), and Wilson and Hart (2000), for example, found little impact of neighbours and farmers’ unions on conservation decisions. In a worldwide literature review on the adoption of best management practices, Liu et al. (2018) concluded that social norms, including acceptance or adoption by neighbours, positively impact adoption. In a review of soil conservation practices in the United States, Carlisle (2016) found that farmers better connected to farmers using soil health practices, as well as technical assistance providers and retailers supporting those practices, were more likely to adopt them. The National Wildlife Federation found that the presence of cover crop champions (early adopters willing to share their experience) increased other farmers’ access to infrastructure, equipment, and knowledge (National Wildlife Federation [NFWF], 2012, p. 9). In Canada, helping to publicize positive farm stewardship practices was reported as the most important reason for participating in the Nova Scotia EFP scheme, followed by its use to help improve

relationships with non-farming neighbours (Atari et al., 2009)⁵². Farmers in and around Ontario's Credit Valley declared that they would be more motivated to restore wetlands if neighbours did so; they also indicated a greater willingness to work with other landowners if it meant the land would be better off (Trenholm et al., 2013).

Research has shown that farmers' decision to adopt or not to adopt conservation practices is influenced by the way they think neighbours or peers in their community are going to perceive the new form of land management (e.g. Armstrong, 2015; Bell, 2004; Carlisle, 2016; Ryan et al., 2003). Whether conservation land management is negatively or positively perceived in the farming community can positively or negatively impact adoption. Carlisle (2016) summarizes previous research as follows: "Since neighbors typically evaluated one another's farms visually, farmers were more likely to adopt soil health practices they considered aesthetically pleasing, which conveyed the message that they were good stewards of their land" (Carlisle, 2016, p. 600). In Michigan, Ryan et al. (2003) analyzed that conservation practices in riparian areas that were positively perceived by external viewers were more likely to be adopted. Ontario Christian farmers, interviewed by Armstrong (2015), underlined that some conservation practices might make their fields appear "messy" to peer farmers, constituting a potential barrier to adoption. Perrot-Maitre found that social networks can have a negative impact on adoption "Farmers' unions and other agricultural organizations were concerned that the changes would disturb the local

⁵² Atari et al. (2009, p. 1277): "The results from this study suggest that Nova Scotia farmers' primary reasons for participating in the EFP scheme are consistent with the potential of the scheme as a tool for managing public perceptions about environmental degradation linked to agriculture, and not primarily as a tool for reducing potential farm environmental risks." Yiridoe et al. (2003) reported that the primary reason for adoption of ISO 14001 environmental management systems standard by Canadian organizations was to establish an environmental profile, and publicize business environmental achievements and credentials.

farm economy and some farmers influenced by them were reluctant to accept the contract.” (Perrot-Maitre, 2006, p. 14). “Farmers who decided to enter the program lost their links with traditional farming networks (Chambers of Agriculture, Farmers’ Federation), and it was essential for the success of the program to provide new support networks and enable farmers to enter a new professional group” (Perrot-Maitre, 2006, p. 20).

Social networks were, however, not the focus of these studies. There remains a gap in the literature on the influence of social networks and social norms in conservation behaviours in Canada (Chenard & Parkins, 2010). In Ontario, Prairie Research Associates (2011) recommended, for example, investigating whether involving social networks can increase participation in Environmental Farm Plans. Internationally, research has not determined if individuals comply with social norms in PES because they think that others know best, or they reciprocate, or they fear exclusion, or following accepted social norms is key to a broader system. While not exclusively focused on social networks and social norms, our research contributes to filling these gaps.

2.3.1.5 Ownership, self-direction

Ownership has been shown to influence human attitudes, motivation, and behaviour, including the psychological ownership⁵³ of intangible objects and ideas (Van Dyne & Pierce, 2004). Ownership explains the **endowment effect** (see Chapter 1), documented in psychology and behavioural economics (Kahneman et al., 1991), and plays an important role in research on organizational behaviour. Literature on participation shows that

⁵³ Psychological ownership can be defined as the feeling that something is yours. It can apply to a good, an organization, an idea, or a project, etc. In organizational psychology and management, the concept of psychological ownership is used for example to study the impact of participation in decision-making on performances.

individuals tend to invest more in implementing decisions that they contributed to reaching (Alm et al., 1993) and more in projects that they have been involved in designing. In Ontario, Holmes noted, in a thesis on farmers' preferences among agri-environmental instruments, that

“The notion of affection as ‘involving one entirely’ raises a noteworthy issue that emerged in the course of the focus group discussions: that the level of engagement by the landowner in the plan development process itself may influence the sense of ‘authorship’ over it, and, in turn, the sense of ‘ownership’ (or feeling of being invested) in the associated stewardship efforts” (Holmes, 2015, p. 68).

PES vary greatly in the leeway landholders have in designing individual projects and thus in the level of ownership that farmers develop for the proposed project. This flexibility or lack of it may affect uptake (Greiner, 2015; Kuhfuss et al., 2014; Liu et al., 2018). As described in our research results, ownership may also affect farmers' reactions to their projects being denied funding.

In addition, individuals are more willing to make a decision that would not restrict their future choices. This factor corresponds to the value of **self-direction** in psychology (Lonnqvist et al., 2009). Farmers' sense of **autonomous control** over farming activities (owning their farm and having a broad control over it) has been shown to matter in conservation decisions (Sheeder & Lynne, 2011; Siebert et al., 2006), including in Ontario (Rosenberg, 2010). While the importance of ‘independence’ in farming decisions has long been highlighted in agricultural sociological research (Ahnström et al., 2009; Sheeder &

Lynne, 2009⁵⁴; Siebert et al., 2006), theoretical insights on the importance of self-direction are recent in the literature on farmers' behaviours. Charatsari et al. (2017) analyzed the relevance of the self-determination theory to farmers' motivational orientations towards participation in competence development projects (CDP). Their findings indicate that underestimating the needs for autonomy and competence predict farmers' decisions on participating in CDP. Their results "stressed the importance of designing CDP that promote self-directedness, emphasise choice rather than rewards, and generate the conditions that support farmers' autonomy." (Charatsari et al., 2017, p. 105).

2.3.2 The proposed framework is coherent with the theoretical and empirical literature

Social psychology is one of the disciplines most relevant to our research. While we do not directly use the Reasoned Action Model, we ensured that our conceptual framework was coherent with it. We use a compact presentation of our proposed conceptual framework in most of the thesis; however, a detailed version is first introduced below to highlight similarities and differences with the Reasoned Action Model.

⁵⁴ "The logit model considers three different exploratory control variables: control over farm processes, control exerted by others, and preferences for control over nature. The results of the logit models consistently show that farm control is a significant variable. (...) if a person believes that they can use conservation tillage techniques and still keep complete autonomous control over their farm, they will be more likely to use conservation techniques. However, if a farmer perceives a loss of control over their farm by using conservation tillage, the odds of conservation tillage adoption significantly deteriorate". (Sheeder & Lynne, 2009, p. 34).

Our proposed conceptual model identifies groups of decision factors that affect a farmer's **intention/decision⁵⁵ to participate in a PES.**

Figure 5: Our analytical framework in a Reasoned Action Model structure

In the disaggregated presentation (Figure 5), our conceptual model thus leads to an ‘intention /decision to participate’ (Figure 5, box on the right). This decision is impacted by a set of **decision factors** (Figure 5, middle section) according to the five main dimensions outlined above: (1) expected financial and market impact, (2) perceived

⁵⁵ Depending on the research methods and context, analyzes of farmers’ conservation behaviours examine either actual decisions (revealed preferences), or intentions (stated preferences). My qualitative research (Chapters 1 and 2) focusses mainly on revealed preferences in the context of past or present programs; while the quantitative research (Chapter 3) is based on hypothetical programs and stated preferences.

feasibility and risks, (3) personal norms, (4) social norms, and (5) perceived ownership and self-direction. The respective weight of each factor, in a specific decision context, depends on both the farmer's **expected outcome** of his/her decision (efficacy beliefs) and the farmer's **preference** for each factor ('**attitude towards the outcome**', e.g. attitude towards risks, willingness to comply with social norms, priority given to financial benefits, etc.). For example, a farmer will be more inclined to participate in a conservation program when he both has a strong preference for the environment ('environmental attitude') and expects a positive environmental benefit of the proposed action (expected outcome). In economics terms, our framework recognizes the multidimensional nature of utility, beyond expected profit alone, in line with previous authors (Bishop et al., 2010; Chouinard et al., 2008, 2016; Hayes & Lynne, 2004; Kalinowski et al., 2006; Lynne, 1999, 2002; Lynne et al., 1995; Lynne & Casey, 1998; Sheeder & Lynne, 2011).

Background factors (Figure 5, section on the left) impact how farmers anticipate the outcome of a potential decision to participate in an agri-environmental program (**expected outcome**). Background factors can also impact individual preferences (**attitudes towards expected outcomes**). Background factors listed in our model (Figure 5) account for factors identified in studies on conservation behaviour and participation in agri-environment incentive programs and thus differ somehow from background factors in the Reasoned Action Model. They draw in particular on literature reviews and meta-studies (Carlisle, 2016; Chenard & Parkins, 2010; Knowler & Bradshaw, 2007; Liu et al., 2018; Prokopy et al., 2008, 2019; etc.). Background factors also draw from our interviews. Several farmers mentioned, for example, that seeing the positive impact of conservation measures changed their preferences for the environment (e.g. "I never thought I would become a bird lover,

but since I saw the result of this first project, I go everywhere with my binoculars”, Ontario farmer, personal interview). Preferences are at least partially endogenous (Bowles, 2004⁵⁶); they evolve as information emerges, engagement takes place, and farmers discuss approaches and their impacts.

Fishbein and Ajzen’s Reasoned Action Model distinguishes between beliefs (expected outcome) and attitudes towards the behaviour (preferences). This difference drives the distinction between the second and third columns in Fishbein and Ajzen’s model but is not at the centre of our own research and thus does not appear explicitly in our model. In this regard, our work complements an analysis conducted by Weber (2017), which reviews factors affecting farmers’ participation in programs fostering soil health BMPs in Ontario, with particular interest for farmers’ behavioural beliefs, normative beliefs, control beliefs, and background factors. While our approaches differ, some of our findings concur (see Conclusion, Chapter 5).

As mentioned above, in our proposed framework, ‘social norms’ largely overlap with Fishbein and Ajzen’s ‘perceived norms’. Their ‘perceived behavioural control’ (perceived feasibility) is included in the group of factors we defined as ‘perceived feasibility and risks’. Finally, the relative importance given by farmers to financial and market impacts, risks, personal norms, and ownership and self-direction might be considered elements of Fishbein and Ajzen’s ‘behavioural beliefs’.

The proposed framework appears equally compatible with Swinkels and Franzel’s analysis of the farmer’s perspective. Swinkels and Franzel’s ‘feasibility’ is explicitly accounted for

⁵⁶ “Because endogenous preferences involve learning (...), behavior in the same situation changes over time” (Bowles, 2004, p. 97).

under our factor ‘feasibility and risks’. ‘Profitability’ is part of our ‘economic and market impact’. Our remaining factors – personal norms, social norms, and risks - can be considered components of Swinkels and Franzel’s ‘acceptability’.

Rather than using the linear model above (Figure 5), we prefer to present the five groups of decision factors (Figure 5 middle section) in a more compact visual (Figure 6).

Figure 6: Analyzing farmers’ decisions to apply or not to a PES: a five-dimension framework

Indeed, our research focuses on those five groups of factors. Using a five branches star could allow us to visually represent situations where factors would take different weights (Appendix 2). A more compact model also conveys the sense that factors do not necessarily weigh independently on decisions but may **interact**. This is coherent with Lynne’s conclusions that self-regarding and other-regarding motivations interact in conservation decisions. Abundant literature on PES discusses financial motivations crowding out or crowding in personal and, or social norms (Chenard & Parkins, 2010; Ezzine-de-Blas et

al., 2018; Rode et al., 2015; Toogood et al., 2004; Vincent, 2007). Organizational psychology studies also show that interactions exist between ownership and personal norms: when employees feel a strong sense of ownership, they are more inclined to engage in generous and helpful behaviours (Kouchaki et al., 2015). This is confirmed in some conservation research, e.g. Featherstone and Goodwin (1993), noted that farmers who participated in conservation programs were more likely to make additional long-term conservation investments.

Our proposed framework is also coherent with empirical findings on farmers' adoption of environmental practices and participation in incentive programs. A sample of eight particularly relevant literature reviews and 19 empirical studies is analyzed in Table 2 below. Previous research has shown that all five factors of the proposed framework matter, with significant differences in intensity across segmented groups of landholders, based on heterogeneous preferences (attitudes) and heterogeneous expected outcomes. Four out of the five groups of factors are considered in a number of reviews and studies. Ownership and self-direction are considered in fewer analyzes but then found highly relevant. Finally, "other factors" found significant in those studies are almost exclusively socioeconomic, demographic, geographic, agronomic, etc., rather than motivation factors.

Table 2: Decision factors discussed in 27 research on farmers' environmental behaviours and intentions

	Environmental practices or programs	Research method	Province / country	Financial / market impact	Feasibility / risk	Personal norms	Social norms	Ownership / self-direction	Other factor
Literature reviews, meta-studies									
Ahnström et al. (2009)	Conservation	Review	Worldwide	+/-+/- Incl. financial incentives		Stewardship	Aesthetics (tidiness)	Independence	Farm size (+/-); farmer age (+/-); farm history; plans for the future
Carlisle (2016)	Soil health	Review	United States	+/- Incl. financial incentives	- Risks: land tenure; loss of crop insurance coverage. Knowledge barriers	+ Awareness and concern about the environmental impact of agriculture	+ / - Incl. social networks; community perceptions and aesthetics		Agronomic +/-
*Chenard & Parkins (2010)	Wetland drainage	Literature review	Western Canada	+ Financial incentives			Focus of the paper		"context specific cultural, social, psychological, geographic, ecological and economic factors"
Knowler & Bradshaw (2007)	Conservation practices	Meta-study	Worldwide	High productivity soil (-); State subsidy (+/-); Farm income/profitability/wealth (+/-/-); Off-farm income (+/-);	Awareness of environmental threats (++) Farm experience (+/-); Land tenure (+/-/-)	Conservation attitude (+/-);	Cultural norm; Society's social capital (+/-)		Education (+/-/-); Age (+/-/-); Farm size (+/-/-); Rainfall (+/-/-); Labour arrangements (~); Information (+ when focused on conservation)
Liu et al. (2018) ⁱ	Best Management Practices (BMP)	Review	Worldwide	Financial incentive (+) BMP capital costs or lack of funds/credit (-) BMP cost-efficiency/profitability (+) Opportunity cost (-); Income (+)	Access to credible technical information (+) Uncertainties on prices and conservation regulations (-) Risk aversion (-) Flexibility (+)	Awareness of water quality, soil erosion, and impact of BMPs on the envt (+); Environmental stewardship or steward intentions (+)	Social norms including acceptance/adoption by neighbours (+) Increase of land aesthetic value (+)		Information & awareness (+); Age (+/-); Gender (Female +/-); Experience (+/-/-); Education (+/-/-); Policies, markets, business or agencies (~); Land tenure (+/-); Farm size (+/-); Farming activity (+/-/-); Interaction among BMPs (crowding in/out + spillover)
Prokopy et al., (2008)	Various	Review (vote count)	United States	Income (+/-/-)	Farm experience (+/-/-);	Environmental attitude (+,~)			Farm size (+/-/-); Age (+/-/-); Education (+/-/-); Labour (+/-/-)
Prokopy et al. (2019) ⁱⁱ	Conservation - practices	Comprehensive review of quantitative studies – <u>Vote count</u>	United States	Marketing that increases price (+); Positive expected effect on yield (+)		Envtl attitudes (+); Farmers self-identifying as not being primarily motivated by finances (+)			Farm size (+); Formal education (+); Vulnerable land (+); Awareness of a program/ practice (+); Actively seeking information (+); Age (-); Previous adoption of conservation practices (+); Positive attitude/program, practice (+)

	Environmental practices or programs	Research method	Province / country	Financial / market impact	Feasibility / risk	Personal norms	Social norms	Ownership / self-direction	Other factor
Siebert et al. (2006) Toogood et al. (2004)	Biodiversity policies	Literature review and survey of policy actors	Europe	Very important +/- Transactions costs (-)	'- Flexible schemes (+) Tenant farmers (-)	Stewardship values; long-term family concerns (future generations)	Local farm community; neighbour farmers; policy reps; professional groups (+/-)	Self-determination, independence, participation	Farm development plan Age (+/-/-); Gender; Experience with biodiversity initiative; Education (+/-)
Original empirical studies									
Atari et al. (2009)	Environmental Farm Plan	Postal survey	Canada (Nova Scotia)	Not dominant Farm income (+)	Comply with regulations (+) Minimize envtl risk (~)	Publicize positive farm stewardship practices (++dominant)	Improve relationships with non-farming neighbours (+)		Age (~); Education (~); Use of computer (~); Experience (+); farmers (+)
Brick (2013)	Envtl areas on farm (evolution of conservation area over time)	Postal survey	Canada (South-western Ontario)			Conservation attitude ⁱⁱⁱ (~?); (~?); Length of farm ownership ^{iv} (+);			Property size (+); Age (~?); Household income (~); Education (~); Reliance on farm income (~); Debt (~)
Chen et al. (2009)	Grain-to-Green Program (re-enrolment intentions)	Stated choices	China (Wolong)	Conservation payment (+)	Program duration (+/~)		Social norms ^v (+) Focus of the paper.		1. Household economic and demographic conditions, incl. farming & off-farm income (~) except for Farm size (+) and Labor migration (+) 2. Land plot features (~) except from walking distance to land plot (+) 3. Age (+); Gender (female +); Education (~)
Greiner & Cregg (2011)	Conservation practices on grassland	Surveys. Stated preferences and motivation barriers	Australia	Opportunity cost of conservation practices (-/~); Resource constraints (-/~); Financial incentives (+/~)	Uncertainty (~) Research, extension and education (+)		Recognition (+); Lack of industry coordination (-/~) Industry action (+) Gov. + community involvement (+/~)		Significant heterogeneity of preferences across farmer profiles / motivations: (1) Financial/economic; (2) Conservation and lifestyle; (3) Social motivation
Greiner (2015)	Pastoral practices	Choice experiment	Australia	Stewardship payment (+) ; Full grazing exclusion (-)	Duration (-); Flexibility (+); External monitoring (-)	Stewardship motivation (+) ; Attitude towards PES (+)	Peer influence (-)		Significant heterogeneity of preferences across all contract attributes (3 classes)
Kuhfuss et al. (2014)	Pesticide use	Choice experiment	France (South)	Payment (+)	Flexibility (+) Administrative and technical support (+)	Stewardship motivation, environmental awareness (+)	Conditional collective bonus (+)		Significant heterogeneity of preferences (3 classes)
Lantz et al. (2012)	Participation in ALUS program ^{vi}	Postal survey	Canada (Prince Edward Island)	Economic incentives (+/~); Higher prices for sustainable commodities (+/~); Income (+)	Farming experience (~)	Greater good (~/+); Pride for being a good steward (+)	Recognition (+)		Farm size (+); Potatoes/grain farmers (+); Gender (Female +); Age (+); Education (~);

	Environmental practices or programs	Research method	Province / country	Financial / market impact	Feasibility / risk	Personal norms	Social norms	Ownership / self-direction	Other factor
Le Coent et al. (2014)	Contribution to a public good	Laboratory experiment	France (Montpellier)	Subsidy (+)	Risk aversion (-)		Collective action conditionality (+) Belief that others will contribute (+)		
Mzoughi (2011)	Reducing pesticide use (integrated protection / organic)	Postal survey	France (South-East)	Production costs (-); Satisfying customers (~); Competition (-/~)	Risk aversion (-/~)	Moral concerns (+)	Showing environmental commitment (+); Being perceived the top one (~)		Age (~); Gender (~); Education (~); Fruit growing (+/~)
O'Grady (2008)	Phosphorus trading	"Learning by doing"	Canada (Ontario)	Compensation levels (+)	Fear of increased liability (-)		Fear of negative perception (-)		
Perrot-Maitre (2006; 2013)	Pesticide and fertilizer use (water quality)	"Learning by doing"	France (Center)	Compensation (+); Local development (+); Transaction costs (-)	Lack of trust (-); Financial risk (-); Techno., admin. and organizational support (+)		Farmer unions concerns (-);(-); Linking with new social and professional networks and services (+)		
*Prairie Research Associates (2011)	Environmental Farm Plan	Face-to-face survey of EFP participants	Canada (Ontario)	Funding (+) Income (+);	Confidentiality concerns (~/-)		Family, friends and neighbours: important source of information		Farm size (+); Education (+)
*Rosenberg (2010)	ALUS	Focus groups	Canada (Ontario)	Monetary incentive (+)	Trust (+); Confidentiality (+); Fear of increased liability (-)	Stewardship ethic motivation (+)	Community encouragement (+); Social capital (farmer outreach)	Participatory process (+); Fear of regulatory interference (-)	Community capacity, program simplicity, communication and expectation management.
Ryan, Erickson, & De Young (2003)	Riparian corridors	Postal survey	United States (Michigan)	Soil conservation makes economic sense (+) Conservation payment (~)		Intrinsic motivation / attachment to the land (+ highest factor)	External perception (farm looks well-managed) (+) Concern for neighbours (+/~)		Age (~); Income (+); Full-time versus part-time farmer (~/+/-)
Schultz et al. (2014)	EU Common Agricultural Policy Greening options	Choice experiment	Germany	Significant (lost rental value); correlated with land opportunity costs: vary across farmers and type of BMP		Conservation attitude (+)		Some farmers refuse any greening	Full time farmers (+)
Sheeder & Lynne (2009; 2011)	Tillage decisions (water quality)	Postal survey	United States (Kansas and Nebraska)	Farmers income/financial capacity (+)		Other-interest (Empathy/sympathy) vs self-interest (selfism) (+) (+)		Adoption preserves farm control (+)	Habitual tendencies (+)

	Environmental practices or programs	Research method	Province / country	Financial / market impact	Feasibility / risk	Personal norms	Social norms	Ownership / self-direction	Other factor
*Trenholm et al. (2013)	Wetland creation / restoration	Choice experiment	Canada (Ontario)	Financial incentive (+/~) Productive vs. marginal land set aside (opportunity cost) (-)	Contract duration (+/-) Technical assistance (+)	X	Public recognition (~) Neighbours actions (+)		Education (+ for non-farming landowners)
Wilson & Hart (2000)	Agri-environmental schemes	Interviews	Europe	Important factor	Tenure	Environmental concern (+)			Northern / Southern countries; grassland / cropland Goodness to fit; farm size; farm type

* Work not published in peer-reviewed journals (sources: working papers, reports, conference proceeds, etc.).

+ / - / ~ factor found to have respectively a significant positive impact / a significant negative impact / an insignificant impact on participation in environmental programs or adoption of conservation practices, or willingness to participate / adopt. When indicated in the papers, factors are considered significant for $p < 0.05$.

ⁱ Factors in a single study are not mentioned in this summary table.

ⁱⁱ This study goes beyond the analysis of contrasting empirical results and draws a statistical analysis of the prevalence of positive versus uncertain or negative relations in individual quantitative studies. Findings presented in this table result from this statistical analysis; whereas other reviews (e.g. Proposky, 2008) insist on contrast among individual results.

ⁱⁱⁱ Approached through a “Conservation ethics index”.

^{iv} Brick (2013) interprets farmer experience (duration of work on the farm) as a proxy of pride of ownership and sense of stewardship for the resources on the property.

^v Social norms are considered at the neighborhood level, and approached by the percentage of neighbors reconverting their enrolled land plots to agriculture.

^{vi} Annual payment program for land with critical environmental features set aside (‘Alternative Land Use Service’).

2.4 Ontario case study

We tested the proposed decision framework in Ontario to verify if it helps understand farmers' motivations and identify heterogeneities in preferences. More precisely, our test can be considered successful if the proposed framework fulfills the following three criteria: (1) The framework allows us to **map out all motivations and participation barriers reported in semi-structured interviews**. (2) The framework allows us to identify **locally relevant factors** under the broad categories in our framework. (3) The framework allows us to detect **heterogeneities in preferences** across groups of farmers and types of agri-environmental Beneficial Management Practices (BMPs).

2.4.1 Context of the Ontario case study

Ontario possesses some of Canada's most productive agricultural soils and represents about a quarter of Canada's agricultural production and farms (Census of Agriculture, 2016). Since the 1920s, major changes have been driven by intensification, concentration and specialization in farming, concomitant with a reduction in cattle, and hay and pasture acreage. Conversely, soybean and corn production has bloomed, as have poultry, swine and greenhouse productions. Since 1970, improvements in some agri-environmental indicators testify to the rise in stewardship: reduction in the use of pesticides, phosphorus fertilizer, and the development of no-till and reduced tillage (Smith, 2015). However, some of the most recent data are raising concerns again about fertilizer use, livestock concentration, and regression in conservation agriculture with potential consequences on long-term soil and water health. In 2015, Smith noted that "Despite relative improvements, continuing and emerging concerns exist [in Ontario] about agri-environmental risks

include soil health, phosphorus management, water quality, habitat and pesticides.” (Smith, 2015, p. 49).

Diverse agri-environmental programs have been implemented in Ontario. Agri-environmental incentive programs, introduced in Ontario in the early 1980s, include voluntary cost-share programs, conservancy easements and phosphorus offsets, with the recent development of competitive approaches (OSCIA, 2014a). Policy-makers and implementing institutions (including farmer organizations) show interest in new approaches, experimentation and evaluation. OMAFRA, researchers and farmer organizations continue to investigate potential improvements in agri-environmental policies with a particular interest in the design of delivery mechanisms to increase participation or cost-efficiency (Nailor, 1999; OSCIA, 2014a; Rosenberg, 2010). This context offers a very favourable ground for a revelatory case study.

2.4.2 Methodology

Our case study in Ontario relied primarily on semi-structured interviews with farmers and field experts (key informants). In our analysis, we took into account motivations and participation barriers directly stated by farmers, as well as field experts’ indirect reports of farmers’ motivations and barriers to participation. The first set of interviews was conducted with program managers, farmer organizations, and policy-makers (key informants) from June to December 2016. Key informants were identified through institutional websites, policy reports, and snowball sampling, with the objective of collecting information and viewpoints as broadly as possible. From September 2016 to July 2017, we conducted semi-structured interviews with Ontario farmers selected for their experience with contrasting

PES approaches. Farmer's recruitment aimed for purposive heterogeneous case sampling and benefited from the support of program managers and farmer organizations. In particular, the Ontario Soil and Crop Improvement Association advertised the survey to a random sample of farmers who applied for funding under two very different species at risk programs (a conservation tender and a first-come-first-served program, see Chapter 3). To protect respondents' confidentiality, farmers interested in participating contacted the researcher directly. Farmers were interviewed on what motivated them to apply or not to apply to specific PES, on their experiences and views on the different programs they had applied to, participated in, or were aware of, and on their preferences for future programs. Interviews started with open questions on motivations and then went through the main types of decision factors identified in the literature on agri-environmental practices. Farmers were directly questioned on the influence of social norms, social networks, distributive impacts, perceived fairness and trust. The interview protocol was finalized with end-users through the informal field advisory committee and approved by a Carleton University ethics review committee.

Data: 70 interviews were conducted in Ontario, including 30 interviews with landholders (mostly farmers), eight with farmer organizations (10 when counting farmers who were also interviewed as farmer organization representatives), 11 with conservation authorities (14 when counting farmers who are also working for conservation authorities), eight with government staff, six with university professors and experts, and seven with environmental and sustainable food associations. Several interviewees had multiple viewpoints. Some manage stewardship programs for farmer organizations or are personally involved in multiple functions (e.g. farming, on the board of a farmer organization, and responsible for

farmer outreach for a conservation authority)⁵⁷. Interviews lasted between 30 minutes and four hours, with the majority between an hour and an hour and a half. Most farmers interviewed were aware of several types of programs and could thus compare their experience with different approaches. Due to our recruitment method (through organizations managing environmental programs), only three of the 30 landholders interviewed had never participated in any environmental program. However, interviews were insightful on farmers' decisions not to participate in PES, as program managers, policy-makers, and farmer organizations representatives discussed at length barriers to participation. In addition, numerous farmers interviewed had chosen not to apply to specific programs or stopped applying and commented on their motivations for not participating. In addition, farmers often referred to the viewpoints of neighbouring farmers they personally had tried to convince to participate or neighbours who reached out to them to learn about potential programs and get help with their applications.

While not statistically representative, this phase of semi-structured interviews helped identify the motivations of farmers participating or not in PES, narrow down most relevant social networks, identify heterogeneities in motivations/decision criteria in the target population, and discuss motivations crowding in or crowding-out. That is, the decline or increase in these personal convictions or social norms that favour environmental practices when receiving conservation payment.

⁵⁷ Respondents have not been double-counted here, but when analyzing their responses, we took into account the perspective they adopted at the corresponding time of the interview. When needed, we asked respondents to clarify their perspective.

2.4.3 Results

Several sets of results are presented below. Firstly, our proposed analytical framework is tested for congruence with interview results. We outline how the framework helped us identify **motivations** and **participation barriers** in Ontario. Secondly, the chapter discusses to what extent the proposed framework helped identify **heterogeneities in preferences**. Finally, we highlight that motivations and participation barriers are not stable. Farmers' willingness to participate appeared to be positively or negatively impacted by their **past experiences**. Farmers who had either succeeded or failed in their application developed backward-looking expectations. In addition, farmers whose applications were rejected developed resentment, and negative feeling towards the funding program(s), often associated with perceived unfairness. On the contrary, farmers who were successful testify of a positive fulfillment associated with visible environmental achievements and external recognition.

2.4.4 Using the five-dimension framework to structure the analysis

The proposed five-dimension framework, slightly amended, was instrumental in guiding the analysis of Ontario farmers' motivations to participate in PES and participation barriers. Aspects that repeatedly appeared in interviews are reported in Figure 7 with barriers in orange boxes, motivation factors in green, and main factors in a darker colour than those cited less frequently or as less important. Figure 7 summarizes the results further described in the next sections.

Figure 7: Motivations and barriers to participation in Ontario in a five-dimension framework

2.4.4.1 Motivation: interviews in Ontario confirmed the relevance of our proposed framework, with one significant amendment

- **Financial and market impacts alone do not encompass all self-interested motivations**

Result 1: Many farmers reported that operational objectives (with both financial and non-financial implications) drove their decisions to apply for environmental incentives in Ontario. Applications for most investment projects were motivated by practical concerns on the farm and plans to improve farm management. A farmer in the choice experiment (see Chapter 4) reported, for example, as a reason for always choosing to participate in a hypothetical program: “We've decided to change our practices and are looking for funding to help us with the changes” (South-Western Ontario field crop farmer). Solving these practical issues may well have financial benefits, but non-financial benefits (that could potentially be estimated in financial terms but are not mentioned as such by farmers), including time-saving, easiness of work, cleanliness, animal welfare, and an increase in non-monetary productions are important factors. This result aligns with former empirical studies. Analyzing interviews in ten European countries, Wilson and Hart (2000) noted that, while financial reasons mattered in motivating farmers to participate in agri-environment schemes, fitting well with existing management plans was also important to a majority of farmers. Summarizing earlier research, Davies and Hodge (2006, p. 395) noted that adoption decisions often hinged on the ‘goodness of fit’ between farmers’ own management plans and the package of incentives and restrictions in a particular scheme. Thus, our original ‘financial and market impact’ factor should be expanded to encompass

a broader range of self-interested operational benefits. The first factor in our analytical framework was re-labelled ‘financial, market and operational impacts’ (Figure 7).

The importance of practical considerations with on-farm benefits should not lead us to overlook other factors. Farmers often have a range of potential solutions to solve a specific concern. Farmers’ environmental attitudes and awareness of opportunities for environmental funding may lead them to choose an environmentally beneficial solution within a range of technical options. In this regard, activities that help farmers analyze practical shortcomings and identify environmental solutions and opportunities for funding directly linked to these solutions appear particularly beneficial. The Ontario Environmental Farm Plan was built on this rationale, and the main demand for external support farmers reported in the quantitative survey associated with our choice experiment was for a **specialist to help them identify priorities on their farm and design their project** (see Chapter 4).

Result 2: Key informants identify market access as a major driver for future adoption of environmental practices, **but this factor is mentioned only occasionally by farmers**, as a side benefit or a congruent objective rather than a primary motivation to participate in incentive programs (it thus figures in light green in our summary Figure 7). Contrary to other jurisdictions (European Union, Quebec, Prince Edward Island...), no incentive program in Ontario supports the adoption of certified agricultural practices (such as organic farming⁵⁸). However, several key informants envisioned future agri-environmental

⁵⁸ At the time we conducted the research.

programs to be largely driven by new market requirements and opportunities, with new dimensions, including **traceability and third-party verification**, gaining importance. Multiple initiatives to develop **industry sustainability standards** and performance indicators have recently been released in Canada and Ontario or are being discussed. In 2013, a policy report examined the *Potential Role of the Ontario Environmental Farm Plan in Responding to Sustainability Demands of the Agri-food Supply Chain* (George Morris Centre, 2013). Ontario farmer organizations are working on future adaptations of the EFP to serve evolving market demands and opportunities, including requirements for improved traceability. Only a few farmers, however, mentioned marketing as a motivation for participating in environmental funding programs or adopting environmental practices. While market access was not reported as a primary motivation, there seems to be a congruence of objectives. Several farmers we interviewed participate in agri-environmental programs and seek markets where the environmental dimension of their farming practices is valued, in particular farmers whose farming systems have potentially high environmental value, such as grassland beef production. Those farmers often advertise their environmental commitments and projects. Several of them publicize their environmental actions online, particularly farmers selling on local markets. Participation in the ALUS program is publicized as a sign of quality and positive environmental impact. Projects such as wetland rehabilitation, species at risk or pollinator projects, and rotational grazing are particularly publicized. While marketing sustainable practices may not have been an original motivation to participate in stewardship programs, both reflect a specific vision for the farm, and marketing can benefit from PES participation.

- **Mitigating technical risks on the farm can be a motivation to apply to cost-share programs**

Result 3: Risks are primarily mentioned as participation barriers (see Result 8 below), **but mitigating risks can also be a motivation to participate in Ontario PES.** Several interviewees reported mitigating technical risks as a motivation to participate in annual payments or cost-share programs. The risks mentioned were associated with economic or sanitary motives. In the context of climate change, farmers mentioned, for example, interest in creating new wetlands with the support of environmental funding programs to serve as emergency irrigation or cattle watering systems. Fencing off streams and wetlands was mentioned by a farmer as primarily intending to reduce cattle exposure to foot rot, with added benefits on water quality (factor in light green in Figure 7). Liquid manure management infrastructures were also primarily intended to improve cattle health and circulation on the farm while having important water quality benefits, etc.

- **Personal & social norms matter, but references vary**

Result 4: Personal norms (values) are a primary motivation to participate in PES, with a broad range of views on what being a good steward means. Several farmers mentioned personal values as their main motivation to adopt BMPs and apply for cost-sharing. However, the focus of those values varies, with some farmers mentioning conserving or restoring nature, trees, or species at risk as their main objectives, while others are more preoccupied with farming practices' impacts in the middle and long-term for their children and their community.

Armstrong (2015) derived similar conclusions. She highlighted in particular that stewardship values in the Ontario Christian farming community were largely driven by concerns for others rather than for nature itself.

“As North American farmers, [Christian farmers] are seeing the effects of changes in the way humans treat the environment on their own families and their own communities. It is primarily their responsibility to these people around them that motivates their concern for the impact of their farming practices, and the farming practices of others on the environment.” (Armstrong, 2015, p. 4).

On the other hand, ‘environmentalists’ are perceived as focusing on nature, and some Christian farmers critically perceive them as making “a religion out of the environment” (Armstrong, 2015, p. 4). Differences also appear across groups of BMPs, with personal values more often mentioned as motivation to restore wetlands or plant trees than motivation to improve soil health using conservation agriculture. In 2013, Brick established that Ontario farmers tend to view themselves as good stewards of the land whether they preserve and increase environmental areas on their farm or reduce them. This is in line with Ahnström et al.'s (2009) findings that stewardship feelings do not necessarily lead to management changes. While we did not ask questions on how farmers perceive themselves, we collected information coherent with Brick’s findings in open-ended questions. A large range of BMPs are promoted in Ontario without necessarily being perceived as a complementary set of on-farm improvements. Some farmers consider that adopting some BMPs render others useless. Some farmers argue, in particular, that using cover crops and conservation tillage to improve soil health and limit erosion renders windbreaks and buffer strips redundant and remove those environmentally-friendly features on their land to gain cultivable acreage, while perceiving themselves as pro-environmental stewards.

Result 5: References vary in the farming community with regard to legitimate sources of social norms, with noticeable tensions between farming and non-farming communities. Farmers rarely mentioned the influence of others on their own decisions to participate in PES. Interviewees did mention though, that fellow farmers are influenced by their peers in their decisions to test new BMPs⁵⁹. We also got the sense that not adopting BMPs, or even removing existing ones (e.g. buffer strips, windbreaks) is influenced by the level of acceptability for such practices in the local farming sector. A number of interviewees and previous research in Ontario (Armstrong, 2015) mentioned the impact of farming community norms on adoption. Neighbours' perceptions were also mentioned as an important positive factor to adopt BMPs increasingly recognized as 'must do' in the farming community. This is the case for example of BMPs aiming at fencing cattle off the creek ("nobody wants to be the last one letting his cattle wander in").

But farmers' compliance with 'social norms' depend on the group carrying this 'norm'. Interviews and responses to open-ended questions in the choice experiment survey attest to a significant urban-rural divide in Ontario: a divide between farming and non-farming social networks. While norms within a farming community can have a strong influence on farming practices, expectations from urban or non-farming rural inhabitants are often considered illegitimate or ill-informed.

“It seems that urban citizens believe that much of southern Ontario farmland is like a park to provide scenic enjoyment and recreational playgrounds.” (Eastern Ontario field crop farmer)

⁵⁹ This difference between how respondents view their decisions and those of others is not surprising. To overcome such bias, researchers have used, for example, inferred valuation techniques, i.e. a questioning approach in which respondents are asked to predict other people's choices. Given the nature of our research, and our interest for analyzing heterogeneity in preferences, we did not elect this approach.

Heated debates on tree cutting by-laws, for example, attest to such a divide. Rosenberg (2010) found, in an Ontario focus group research on the ALUS approach, that “public pressure, from urban centres for example, would be a discouragement to signing up for a PEGS program (...) [but] if encouragement comes from a local farmer in the community, that it would instead be a positive motivator”, with farmer-to-farmer approach an important ALUS feature (Rosenberg, 2010, p. 145-146). Ontario farmers refuse to be pointed out as the major source of pollution. Attempts at organizing water quality offset markets in Ontario have been limited by a perceived unfairness from the farming community. Farmers in the Lake Simcoe region refused to participate in the new water quality offset because transferring the responsibility to mitigate urban-generated pollution to farmers was deemed unfair. South Nation offset program was accepted by farmer organizations only after it had been explicitly negotiated that there would be no liability transfer from municipalities to farmers, and offset ratios would be high enough to accommodate some farmers not fully implementing agreed BMPs, or BMPs not having the full expected impact (O’Grady, 2008). A popular section in a mainstream farmers’ magazine (Better Farming) reports twice a year on municipal bypass and spills. This report notes that there are far fewer manure spills than there are urban spills, and is proudly cited by farmers rejecting shaming. Initiatives from within the farming community, for example to develop voluntary instruments as an alternative to regulation, are much better received. This is in line with Siebert et al.’s (2006) finding that criticisms from non-farmers trigger a defensive attitude and bitterness rather than proactive action for greater social recognition. However, several farmers we interviewed reported that showing non-farmers that farmers “are not the bad guys” had been an important benefit they got from participating in PES, even if it was not

their primary motivation. Holmes (2015) underlined “growing tensions between the private landowner community and civil society broadly” in Eastern Ontario and made a case for a new **social contract**. Agri-environmental incentive programs can play a part in getting there, as further detailed in our general Conclusion.

2.4.4.2 Participation barriers: transaction costs, ownership and past experience

- **Transaction costs are a main barrier, while opportunity costs matter for some farmers**

Result 6: Farmers’ transaction costs matter, with time a primary concern. Farmers’ transaction costs when applying to PES in Ontario were at the center of most discussions on participation barriers. While financial costs were sometimes mentioned (some farmers recruit consultants to prepare their applications), time was the main transaction cost farmers and key informants referred to. Many of the farmers interviewed have multiple activities on-farm and off-farm, and time appeared to be highly valued in farmers’ decisions to apply or not to apply to environmental funding programs in Ontario. The 2016 Census of Agriculture found that over 46% of farm operators in Ontario did some off-farm work, and 33% worked an average of 30 hours a week or more off the farm. Farmers emphasized that the time required to seek information, attending mandatory workshops, and completing the paperwork was a barrier to participation. Several farmers reported that considering the amount of preparation and time required to apply to certain programs (such as the federal-provincial funded program Growing Forward 2), and their perceived likelihood of being selected, it was “not worth their time” to apply, in particular in regions that are not targeted

in priority under the program, or for complicated applications. Qualitative responses in the choice experiment survey confirmed such concerns, as reflected in the following quotes:

“From my experience, it is far too difficult to track down the grants, complete the paperwork and actually receive the money. (...) if you aren't successful, you lose money just in the application process, which is discouraging. It takes far too much time to complete the paperwork, for example, with Growing Forward 2, so that in the end the money is hardly worth the process. I would prefer to have less paperwork even over receiving administrative support.” (Eastern Ontario dairy farmer)

“To go through the whole process and do all the applications, and then race over before 8 AM to a persons' house and wait in line to see if it will be in time, is totally a non-starter for me. (...) I am too busy to fill in a huge amount of forms and go to meetings to see if I can get 30% funding on something to help the public. Pay it or don't have the program!!” (South-Western Ontario swine farmer)

Farmers who had experienced programs providing administrative support in completing the application (such as clean water or tree planting programs administered by conservation authorities or wetland programs supported by Ducks Unlimited) consider the difference between these two types of approaches to be a major distinction, and most were very appreciative of administrative support, despite a lower level of funding in programs administered by conservation authorities.

“Technical and paperwork support is critical. I don't have time to sort out pages and pages of applications. I have a project in mind and I am waiting for our local conservation to have funding to do it. I can't be bothered with Growing Forward or the SAR paperwork. We both work off-farm and farm, no time for all that paperwork and crap, then even if you do fill it out, you might not get it, or the intake is only open for a day.” (Central Ontario field crop farmer)

“It would be really helpful if I could call someone (...) who can match what I have in mind with a program, give me technical advice, or tell me if I should even try. (...) A site visit on my farm would be even better.” (Ontario farmer)

Result 7: Opportunity costs: a justification not to adopt. For farmers deciding not to adopt certain BMPs (in particular windbreaks and buffer strips that are viewed as taking

land out of production), the opportunity cost of land was mentioned as a significant barrier. As detailed in our introductory chapter, agricultural land prices have increased very significantly in Ontario, following increases in commodity prices. As we conducted the research, many actors reported tensions between farmers and non-farmers on cutting forested areas or on-farm hedges and isolated trees to increase cultivated land. Several tree-cutting municipal by-laws or potential by-laws were at the center of heated debates. Competitive access to rental land was also recurrently mentioned as a motive of tension between neighbouring farmers. In this context of particularly high demand for agricultural land, BMPs viewed as taking land out of production were analyzed by many respondents as having a high opportunity cost, including on marginal lands.

“Cost-share is a necessity now with the price of land.” (Eastern Ontario field crop farmer)

- **Several perceived risks limit participation in Ontario PES**

Result 8: Various sources of potential risk impact farmers’ decisions to participate or not in PES. Several interviewees mentioned risk as a participation barrier. Two risk factors were mentioned frequently: risks associated with **project timing** and **exposure to legal issues**. Limited access to public **technical assistance** or limited knowledge of conservation practices were also cited as barriers.

Timing: Farmers are concerned that timing in funding programs’ application-approval-disbursement process may prevent them from implementing their project as originally planned. Program timing may not be in line with cropping or building seasons, or may be uncertain. Program managers endeavour to accommodate farming schedules, but new programs and short-lived programs often face timing issues. Many PES in Ontario refuse

to fund costs incurred before an individual project is approved. On several occasions, farmers mentioned that they would be willing to take the risk of starting their project or ordering material before getting approved for cost-sharing if disbursements incurred before approval could be reimbursed when funding got approved. These farmers understand that, as long as their project is not formally approved, funding may still be denied. Still, farmers preferred to start their project on time while expecting a response awaiting formal approval, and then postpone their project completion or cancel an order if funding was never approved. This was viewed as a better option than the risk of delaying the project for a year to wait for their application to be reviewed.⁶⁰

“Programs often delay implementing practices because if you start something before a program is announced, you won't be eligible to participate in the program”
(South Western Ontario field crop farmer)

[We] “need to be able to apply for innovations already started to have costs incurred before approval is in place due to time restraints for an upcoming cropping year. Current programs that require to wait for full approval often have the approval too late to implement for the current crop year.” (South-Western Ontario dairy farmer)

Exposure to legal consequences: Some farmers are also concerned that participating in environmental programs may expose them to legal consequences. Ontario farmers expressed concerns about having to reveal detailed information on their farm and farming practices, welcoming conservation agents on their land, and investing in projects that benefit species at risk – regulated or potentially regulated in the future. These farmers fear that non-farmers may not make allowance for farming-specific constraints and that

⁶⁰ Hearing that some farmers would be ready to start the project they applied for before knowing if they would get funded led us to wonder if funding provides additional environmental benefits. While we did not systematically ask farmers what they would have done if they did not get funding, several farmers who did not get funding said they decided to postpone their projects, or implement smaller projects. In these cases, funding would have had an incremental impact on environmental investment.

conservation staff may identify species at risk on their land and restrict their farming activities accordingly, or discover infringements that farmers were not aware of. While the fear of legal repercussions has decreased with long-term agri-environmental programs such as the Environmental Farm Plan, it is still mentioned by several farmers and other key informants as a participation barrier.

“Conservation officers don't always have enough flexibility or understand that every farm and every individual is different, if you're too strict on the rules, farmers will be turned off.” (Eastern Ontario field crop farmer)

Technical uncertainties: A few farmers and key informants emphasized that some BMPs remain at an experimental stage, or are new to farmers getting funding to try, for example, certain cover crops. Public sector agricultural extension in rural Ontario has been cut down, and some farmers are concerned that, in the absence of expert advice, they would not know which techniques to choose or what to do if their project went wrong; if, for example, a cover crop did not grow or was difficult to get rid of.

“OMAFRA field staff has disappeared in Eastern Ontario over the years and now there isn't a single representative in Eastern Ontario. Farmers need support in the fields (...) needed in these stewardship programs” (Eastern Ontario field crop farmer)

“The courses I attended were awesome! Lots of material... They were sometimes too fast and they stopped short of expert advice on filling out the funding forms and going through the next steps. I also was at a bit of a loss in deciding what project I wanted/needed to do on the farm. I would have liked someone to talk to about planning and designing the layout for the projects.” (Central Ontario beef farmer)

Other interviewees mentioned that they get all the expertise required by contracting an independent agronomist and do not rely on advice provided by agricultural input suppliers alone, but not all farmers can afford independent advice.

- **Interviews in Ontario confirmed that ownership and self-direction are key**

Result 9: Ownership is an important driver of non-participation and repeat-participation.

“We are very leery of conservation authorities coming on to our land and dictating our practices.” (Eastern Ontario field crop farmer)

“I don't take part in the programs. If you do that, you give up the control. (...) I do not like to have government watching. (...) They would technically own the land. (...) Also, I don't stand in line for government hands out for religious reasons. According to the Bible, we have to make our own way in the World. Work hard and work well you should.” (Ontario farmer)

We interviewed two farmers who had chosen not to participate in any stewardship program.

While we first had the impression that these farmers did not want to risk government staff interfering with their farming activities, follow-up questions revealed that they are not interested in farmer-led programs either. They do not want anybody to tell them what to do on their farm. Both farmers have preserved environmentally sensitive areas on their land but consider sustainable land-use to be a private responsibility. The sense of private ownership and self-direction is an important value to the Ontario farming community, manifestly demonstrated by the landowners' rights movement. Sixty percent of Ontario farmers who participated in our choice experiment consider that there is too much government regulation on private land use, and 60% do not want anyone to tell them what to do on their farm (Figure 8). As our choice experiment revealed, these positions do not necessarily preclude participation in stewardship programs (Chapter 4). Farmers' sense of ownership and self-direction, however, can be a significant barrier to participation, and certain programs invest in building ownership with their participants. Program managers

are aware of these issues and have taken deliberate measures to build trust in the farming community.

ALUS, in particular, emphasizes in its vision and outreach messages being a ‘community-developed’ and ‘farmer-delivered’ program. Citing Aldo Leopold as a source of inspiration, ALUS builds on the recognition of private ownership. “Conservation will ultimately boil down to rewarding the private landowner who conserves the public interest” (Leopold, 1934; ALUS, 2017). In Eastern Ontario, ALUS goes even further in building farmers’ program ownership. Farmers alone have voting rights in its governance, while community partners – such as conservation authorities and environmental NGOs –only have advisory roles. In Eastern Ontario, each ALUS-funded project is tailored to support a landowner’s specific objectives. The ALUS conservation specialist – chosen and hired by a farmers’ committee – proposes successive designs until a project corresponds exactly to a farmer’s vision for his farm and management plan. Projects can be prepared over several years and readjusted as farmers learn from experience. For some ALUS participants we interviewed, the sense of owning their project was a key factor in their decision to participate and expand their participation over time.

Conservation authorities (CA) are seen by some farmers as having regulatory powers that can limit farmers’ freedom to make independent choices on their farms. To build trust, conservation authorities rely on long-term staff and long-term programs. They also tend to hire staff with expertise in farming (e.g. certified crop advisors or farmers) to build trust and provide technical advice relevant to the farming community. CA choose farmer field representatives, knowledgeable about environmental programs and well-respected in their community, to support or independently implement outreach activities. Some of those

farmers hold responsibilities in eminent farmer organizations, and CA build on their **social capital**. Respected farmer community members are, for example, local field representatives for the South Nation Clean Water program. They are responsible for contacting farmers. They help farmers develop their project, clarify program goals and requirements, manage farmers' expectations, complete a project field assessment, and present projects to the Clean Water program selection committee on farmers' behalf. The EFP, and the ALUS program also rely on farmer-to-farmer outreach. Relying on farmer field representatives helps reduce a program's transaction costs as representatives are not full-time staff, can concentrate on small geographical areas, and reduce transport delays and costs. Relaying on field program staff with a farming background is often cited as a condition to build trust. Some program managers who are not farmers mentioned avoiding being "the face of the program", in particular in Eastern Ontario where the landowners' rights movement is vivid, and thus not contacting farmers themselves. However, some farmers who do not trust CA, as an institution, have developed a personal, long-term trust-based relationship with their contact person at the local CA. In general, interviews revealed that the expertise, helpfulness, and long-standing presence of the farmers' contact person matters more than the nature of the institution, with some farmers – but not all - being more comfortable working with fellow farmers or program staff with an extensive farming background. Long-term presence on the ground, recognized agricultural experience, and understanding of agricultural constraints appear to be the main elements of social capital required to build trust in farmers hesitant to apply for environmental incentives. Other authors have highlighted the importance of the profile of the person representing a policy

on the ground and his or her attitude towards farmers, with top-down approaches deterring adoption (Siebert et al., 2006).

Figure 8: Survey items on ownership and self-direction (n=278 Ontario farmers)

While we did not interview farmers who mentioned being part of the landowners' rights movement, the Ontario case study confirmed the importance of considering ownership and self-direction in our analytical framework. One could argue that we found ownership and self-direction relevant only because we concentrated on participation in incentive programs rather than BMP adoption. This would, however, be only partially true. Potential interference by program staff is certainly a source of concern with respect to ownership and self-direction. However, several interviewees also mentioned concerns with BMP adoption per se. Specifically, they reported that some farmers would not adopt practices beneficial to species at risk or would prefer adopting practices beneficial to species at risk (such as delayed haying) on land they rent rather than land they own, to avoid undermining their ownership rights in the long-term. In an open field of our quantitative survey, farmers confirmed concerns with potential government interference as a participation barrier.

“I have paid for my property, if someone wants to encourage biodiversity, let them buy property and do as they wish. I am the third generation farming the property I presently own and I plan to leave this property in my children's possession when I

leave this place. Why would I do anything to jeopardize their chances at success”.
(Eastern Ontario field crop farmer)

- **Personal norms matter, but programs should be cautious when using messaging appealing to personal norms**

Result 10: Successful programs stay away from shaming. Shaming is a strategy used to increase the adoption of socially desirable behaviours (concept of ‘nudging’). In Ontario, however, several PES managers emphasized that they avoid finger-pointing. Those interviewees mentioned shaming can be counterproductive in the Ontario farming sector. Priority areas for environmental mitigation (e.g. areas particularly affected by nonpoint source pollution) are often identified in watersheds, but program managers do not always choose to publicize the information or to draw comparisons across areas on the level of environmental performance. Grand River Conservation Authority learned from experience to stay away from shaming. The conservation authority offered higher cost-share to a few farmers in an area of critical pollution. None of the targeted farmers agreed to participate. Messaging is key. In the GLASI program (a federal-provincial initiative), ‘priority sub-watersheds’ are targeted for intensive funding. Farmers’ local information booklets map out the eligible area, detail the BMPs funded, eligible and ineligible expenses, funding levels, and the application process⁶¹, but there is no indication why these areas are targeted.

⁶¹ See, for example, the brochure for GLASI Priority Subwatershed Project for the Gully Creek and Garvey-Glenn Watersheds (Ausable Bayfield Conservation Authority [ABCA], 2015). In the 10-page document, there is no indication why these watersheds were chosen (no indication that they are particularly environmentally degraded or sensitive). Brochure redactors emphasized positive messages instead, insisting on farmers’ initiative, farmers’ ownership and economic benefits. The brochure mentions for example that the program “helps farmers implement Best Management Practices (BMPs) on their land”; “allows farmers

The general brochure of the GLASI Subwatershed Program only mentions that chosen sub-watersheds are interesting test areas for a focused approach, with no indication of a critical state.⁶²

Result 11: Perceived fairness varies across programs, but we found no indication that perceived fairness is a significant participation barrier. Few farmers approved of the former first-come-first-served approach of PES funded under federal-provincial agreements in Ontario.

“don't put 'First-come-first-served' into these funding programs, as it is very unfair...” (Central Ontario beef farmer)

Recent merit-based approaches, however, raise several concerns about perceived fairness.

“All grant programs MUST treat all applicants even financially! They MUST not be lottery games!” (South-Western field crops farmer)

Innovative farmers complain that, having already adopted progressive practices, they cannot receive funding dedicated to new adopters. They consider that having taken the risk to introduce beneficial practices in Ontario, they deserve rewards for the public benefits they generate. Farmers whose applications are rejected take it personally, and some question the legitimacy of the selection process, have difficulty accepting their neighbours getting funding when they don't. Some farmers suspect that program managers are prejudiced against them. When programs use narrow geographical targeting to allocate funding, farmers outside the geographical scope do not feel personally excluded but still

to work with a Certified Crop Advisor (CCA), free of charge”; “develop BMPs specific to their operation”; “determine their environmental and economic effectiveness” (ABCA, 2015, p. 2, emphasis added).

⁶² “The GLASI Priority Subwatershed Project will evaluate the effectiveness of a focused stewardship approach, (...) By implementing several highly targeted BMP...” (OSCIA, 2015, p. 1).

raise concerns about perceived fairness; in particular, where mobile equipment is funded in a targeted area and can de facto be used elsewhere. An interviewee mentioned, for example: “I could buy a small piece of land in the eligible area, get funding for an expansive equipment that I would use all over my land, and sell back the small piece of land, even may be with a benefit” (Ontario farmer). Some farmers consider that funding costly equipment in restricted areas undermines fair competition. In general, we found a greater acceptance for narrowing eligible project categories than narrowing eligible locations. Perceived unfairness was discussed in several interviews, at farmer meetings we participated in, and by Ontario farmers on Twitter, sometimes with a certain resentment. However, we have no indication whether perceived unfairness has been a direct motivation in interviewees’ decisions not to participate in a specific PES. In conclusion, we noted farmers’ concerns with perceived fairness. Low chances of a project or a farmer location to be selected for funding triggers both reluctance to apply and perceived unfairness. We did not, however, get evidence that concerns with perceived fairness directly discouraged farmers from applying to funding programs⁶³.

- **Social norms can act as motivations or participation barriers**

Result 12: Social norms in farming cultures may conflict with environmental objectives (Aznar & Valette, 2010; Carlisle, 2016; Perrot-Maitre, 2013; Vanclay, 1992).

Farm and field apparent ‘tidiness’ and yield levels remain important elements of appreciation and may shape opinions in the farming community, acting against BMP

⁶³ Some farmers did not apply because they expected their chances of being funded to be very low, as funding programs focus, for example, on other regions. For the same reason, these farmers had concerns with perceived fairness; but we could not identify causal links between the two.

adoption. Several interviewees mentioned adopting innovative practices despite their neighbours' or community's perception as a strong stand on their part. Some programs use messages that reconcile conflicting purposes and values. Increasing production is often perceived as farming unique goal, and yield as the main unit of comparison across farmers. As a community, farmers are entrusted with the responsibility to 'feed the world' which translates into producing more while keeping prices in check. In this context, asking farmers to set land aside to serve environmental objectives is a conflicting message. Some programs explicitly take this contradiction into account when designing their communication strategy. In ALUS's messaging, land set aside is not framed as retired; it is presented as used to produce something else than food or bioproducts: to produce 'ecosystem services'. Producing ecosystem services is framed as a market-based solution to making the best use of all areas on the farm, including marginal areas. "ALUS is market-driven: The ecosystem services produced by ALUS projects have economic value on the marketplace" (ALUS, 2017). Through payments, the program recognizes that land set aside produces value. Even if, in monetary terms, the payment is not very significant⁶⁴ and actual ecosystem services are not evaluated, the symbolic value of the productive message can be important. It helps realign objectives. Society does not expect farmers to produce and not produce at the same time. They are expected to produce different things in different areas of the farm.

⁶⁴ "At the end of the year, I can buy a crate of beers".

2.4.4.3 Heterogeneities in motivations vary along several lines

Result 13: The influence of personal & social norms varies across groups of practices.

Based on the literature on social preferences, risk aversion, and self-direction, we expected our framework to help identify groups of landholders with heterogeneous preferences. Key informants mention differences in adoption and motivations across groups of farmers, but their responses are not necessarily convergent, in particular they differ on the influence of socio-demographic factors (farm size, age)⁶⁵. Heterogeneities appear more explicitly across **types of environmental practices** (see figures in Appendix 2). This finding is coherent with the literature (Prokopy et al., 2008). Brick analyzed that:

“It is clear from the literature that the factors that predict behaviour vary depending on the specific type of BMP measure that is adopted (...). The differences between BMPs can be explained by the sheer breadth of BMP measures that could be implemented and the different financial, cultural and socioeconomic factors that may influence these choices.” (Brick, 2013, p. 14)

Interviews led us to distinguish three groups of BMPs.

(1) Cropping practices beneficial to soil health, such as cover crops, no-till, strip-till, minimum tillage, fragmented application of fertilizers and pesticides, and precision-farming were often mentioned as innovations with positive productive and environmental impacts. Motivations to adopt these practices ranged from short-term time and input savings to long-term productivity gains (‘financial and market impact’, factor 1). Innovators and early adopters considered long-term impacts for themselves and their successors in their decisions and were proud to improve their soils in the long-term, reflecting an influence of concerns for others associated with personal norms (‘personal

⁶⁵ This is in line with the literature (see above), which shows no consistent impact of most demographic factors on BMP adoption and participation in PES.

norms', factor 4). Capacity and motivation to innovate were mentioned as primary factors differentiating adopters and non-adopters. Interviewees pointed out differences across farmers consistent with the diffusion of innovation theory (Ryan & Gross, 1943). Some directly referred to this theory, using terms such as innovators, early adopters, early or late majority, and laggards. Innovators expressed a strong sense of self-identity. They described themselves as inclined to look for information independently, take risks ('perceived feasibility and risks', factor 2), be ahead of other farmers, and often ahead of crop advisers on soil-health innovations. Key informants and innovators described mainstream farmers as more risk-averse than innovators (factor 2), but influenced by practices adopted by others "They look above the fence" ('social norms', factor 5). Innovations progressively become a new 'agricultural norm' (factor 5), as a majority of farmers become interested in testing them. However, adoption does not necessarily follow a linear path. While innovators are ready to fail and start again, the majority would test a practice others have adopted but are very discouraged by a potential failure. Several interviewees pointed out that limited access to local public extension is a critical barrier to long-term adoption, as it increases the risk of failure, leaving farmers with no clear path for improvement. Interviews on this category of practices brought us insights on heterogeneities in motivation across groups of farmers with different preferences for risk, and on preference formation across time.

(2) For practices that require taking land out of production, adoption seems to be largely driven by personal norms (factor 4). Because of the rapid increase in land prices, practices taking land out of crop production (buffers, hedgerows, windbreaks, wetlands restoration or creation...) are often regarded as a commitment to a public good rather than a profitable

investment. Perceptions, however, are not consistent across farmers and areas in the province. They seem to depend on awareness and agro-ecological conditions. Some farmers mentioned the positive agronomic and economic benefits of windbreaks, while others consider them a waste of arable land. In the survey accompanying our choice experiment, 85% of farmers responded that having buffer strips, windbreaks, fencerows, grassed waterways, or wetlands has a positive impact on their farm. This figure contrasts with the current tendency to remove tree rows and buffers to gain arable land, mentioned by numerous interviewees.

(3) A third group of BMPs is centred on practices that mitigate recognized environmental risks. In Ontario, this category includes investments for manure and livestock management to prevent water contamination (construction or improvement of manure storage areas, fencing cattle off the creeks...). Since the Walkerton Tragedy, manure contamination of drinking water is a recognized environmental risk and a potential legal liability. Personal, social and legal norms seem to have played a part in the diffusion of these BMPs, with social norms growing in influence as participation increases. “*Nobody wants to be the last one to have his cattle wandering in the creek*” (Ontario farmer, personal interview).

For practices associated with species at risk, exposure to potential legal risks and opportunity costs associated, for example, with delayed haying were the main barriers mentioned, while personal norms were primary motives for adoption.

Result 14: Social norms and experience with agri-environmental programs vary across disjoint social networks in the farming community. Looking at the influence of social norms in the farming sector helped us distinguish social networks with different

‘farming cultures’. Ontario farmers seem to self-identify in a certain farming profile, coherent with their participation in farming networks with specific social norms on agri-environmental practices.

Mainstream farmers. Policy-makers in Ontario have designed agri-environmental programs aimed at mainstream farmers, choosing to support ubiquitous practices rather than to single out ecological farming systems. The main farmers’ union in Ontario (Ontario Federation of Agriculture) and large commodity groups (Grain Farmers of Ontario, Beef Farmers of Ontario, Dairy Farmers of Ontario, etc.) play an influential role in Ontario agriculture. Mainstream farmer organizations in Ontario are supportive of stewardship programs. They participate in policy negotiations, negotiations with the private sector on environmental standards, and some organize environmental awards⁶⁶. Dairy Farmers of Ontario require its members to implement an Environmental Farm Plan. The Ontario Soil and Crop Improvement Association (OSCIA, with over 4,000 farmer members in 2021) has been at the forefront of Ontario stewardship programs for decades. OSCIA implements numerous public-funded stewardship programs, reflects on program design (see for example OSCIA, 2014a), proposes and tests policy innovations. Networks of OSCIA’s members also test innovative farming practices on the ground. The Ontario Federation of Agriculture (OFA), the major Ontario farmer association with 38,000 members, implements and participates in the governance of stewardship programs (e.g. the pay for performance pilot in Ontario). The Christian Farmers Federation of Ontario (CFFO) also

⁶⁶ Since 1996, Beef farmer federations and their partners have, for example, awarded annually The Environmental Stewardship Award (TESA) at provincial and national levels to recognize cattle producers’ leadership in conservation. The annual Mapleseed Pasture Award recognizes a good use of resources through selection and management of pastures in Ontario (Beef Farmers of Ontario, 2021).

promotes stewardship programs. CFFO is the second-largest farmers' union, representing 4,000 farm families. "The approach the CFFO has taken to family farms and to stewardship has helped to define its Christian identity further regarding farm policy in its current Canadian context." (Armstrong, 2015, p. 2). Several interviewees mentioned their Christian values as a motivation to be a good steward of the land. While government-funded programs are generally controversial in the Ontario Christian farming community⁶⁷, CFFO supports the Environmental Farm Plan, conceived by a consortium of farm organizations - including CFFO - and still implemented by OSCIA. CFFO also supports Alternative Land Use Service (ALUS), a privately funded program in Ontario, which pays farmers to turn less productive farmland into wetlands, pollinator strips, or other forms of habitat for wild species (Armstrong, 2015, p. 262-266).

Innovative farmers. Innovative farmers, we met in Ontario, pride themselves on their advancement in conservation agriculture. In this regard, they question the fairness of some Ontario funding programs. They consider that innovations they develop or adapt to Ontario conditions have significant public benefits but are not rewarded by environmental funding programs, which support the diffusion of well-recognized practices rather than more exploratory on-farm trials. They argue that majorities benefit, but innovators who take most risks, and provide the biggest intellectual contributions, do not get funding.

⁶⁷ "Some members find it important that the CFFO particularly emphasizes that agriculture should be, as much as possible, self-sustaining, and not rely on "government handouts" to remain financially viable as a basis for their approach to agricultural funding programs." (Armstrong, 2015, p. 84). "It is important for farmers in the CFFO in particular both in the sense that this is a form of voluntary stewardship on their part, and also in the sense that farmers are exercising sovereignty to self-regulate within their own sphere of expertise". (Armstrong, 2015, p. 264-265).

In earlier decades, critical innovations were introduced and disseminated with the support of stewardship funding programs. Experts involved in earlier programs remember, for example, that the diffusion of no-till and reduced tillage equipment was introduced with the support of government-funded programs and environmental NGOs. Farmer groups were subsidized to buy new equipment collectively and try it out. Joint equipment ownership across farms is now very rare in Ontario, where individual farmers own their equipment or rely on custom farming. Innovative farmers are active contributors and readers of social media, in particular Twitter. Concerns with a program's perceived fairness are relayed on Twitter and may colour the perception of the program in a farmers' network. Such concerns were expressed with several of the Ontario PES we studied.

“Financially compensating for direct purchases penalizes farmers who have already adopted new technologies or progressive practices. I.e. there is GF2 funding available for adopting practices that reduce broadcasting of fertilizer on the soil surface. Our farm is not eligible for this funding because we adopted this philosophy five years prior. (The funding for this area must be approved before the purchase is made). Essentially the message we hear is don't do anything progressive because if you wait, the government will step in and pay for it.” (Eastern Ontario dairy farmer)

Ecological farmers. Ecological farmers are perceived by mainstream farmers as a separate network, very critical of mainstream agriculture. Armstrong (2015) pointed out that even Christian farmers with strong stewardship values do want to be considered ‘environmentalists’⁶⁸. Some ecological farmers participate in agri-environmental incentive programs. However, no Ontario PES or PES component was specifically designed to

⁶⁸ “Most [Christian] farmers I met as part of this research do not wish to define themselves as environmentalists. Some pit themselves directly against what they understand as “an environmentalist agenda” (...) Farmers remain concerned, however, about issues related to the environment. They often use different language and focus on different issues than the type of deep ecology environmentalists” (Armstrong, 2015, p. 4).

support ecological farming at the time we conducted the research. In the European Union, agri-environmental contracts support specific farming systems recognized for their environmental benefits, including transition to organic farming and low-intensity grazing. In Canada, support for organic farming is available in Quebec and Prince Edward Island, for example, but not in Ontario. Some key informants wondered why Ontario programs support a limited reduction in chemical fertilizers or pesticide use, through precision-farming or improved equipment, but not organic farming that results in greater pesticide reductions. While transition to organic farming is a primary agri-environmental objective in Europe (in particular in environmentally sensitive areas), perception is very divided in Ontario. Several Ontario interviewees even mentioned considering organic farming as ‘environmentally damaging’ due to tillage practices. However, notable evolutions can be noted in recent years, after our field research was concluded. In particular, the Ecological Farmers of Ontario (EFAO)’s Farmer-Led Research Program has been the first recipient of the inaugural Excellence in Agriculture Award, delivered by OMAFRA in 2019 (Ecological Farmers Association of Ontario, 2019).

Farmers in the landowners’ rights movement. Eastern Ontario is the “heartland of the landowners’ rights movement in Canada”, and the landowners’ rights movement has “firm and seemingly intensifying grip” in Southern Ontario (Holmes, 2015, p. 35, p. 45). We did not interview farmers who mentioned being part of the landowners’ rights movement. However, during our research, key informants mentioned the landowners’ rights movement, and numerous online documents helped us grasp some of its messages. Holmes (2015) conducted a focus group on approaches supporting the provision of ecosystem services with landowners representing the landowners’ rights movement in Eastern

Ontario, and documents posted by landowners' rights movements online give us a sense of their position. Landowners' rights movements are very critical of instruments limiting ownership rights (e.g. conservation easements). They have strongly opposed potential restrictions on agricultural land use associated with species at risk protection and tree-cutting by-laws or asked for compensations, and are often critical of conservation authorities. However, at least an association part of the landowners' rights movement has expressed interest in stewardship funding.⁶⁹

Result 15: Emphasis on soil health and farmer-ambassador programs provide mutually beneficial opportunities to bridge networks with complementary experiences. Over recent years, a new emphasis has been put on soil health on Ontario farmland with the International Year on Soils (2015), a roundtable on soil carbon and a report on soil health by the Environmental Commissioner of Ontario (2013, 2016), and a call for research projects from OMAFRA (2015), among other initiatives. Farmer organizations such as Innovative Farmers of Ontario and OSCIA are very active in improving farmland soils. The focus of interest is not only on soil structure: biology and microbiology are taking increasing importance in farmers' networks with a long-standing interest in soil health. Initiatives on soil health can thus bridge the gap between mainstream, innovative, and ecological farmers. While mainstream and innovative farmers' networks have long-standing experience in conservation tillage methods and cover crops (with

⁶⁹ In a brief to the Senate Committee Energy, Environment and Natural Resources, on the Species at Risk Act, the Ontario Property and Environmental Rights Alliance (OPERA) pleaded for a compensation for landowners under the Species At Risk Act, while requesting to "Keep compensation independent of stewardship programs. No landowner should be compelled to refuse stewardship participation in order to qualify for compensation." (OPERA, 2002).

primary benefits on soil structure), ecological farmers have a strong background in reducing pesticide and fertilizer use with benefits on soil biology and microbiology. The 2017 Ontario Soil Network Leadership Course, for example, is supported by various industry organizations in Ontario, including OSCIA, Innovative Farmers' Association of Ontario (IFAO), Ecological Farmers' Association of Ontario (EFAO), and Farm and Food Care Ontario, thus combining mainstream, innovative and ecological farmer networks.

2.4.4.4 Motivations and barriers to participation evolve and should be considered in a dynamic framework

Several farmers and key informants emphasized that motivations and participation barriers change over time as farmers' experiences, attitudes, perceptions, and trust evolve. This is in line with literature review findings (Siebert et al., 2006)⁷⁰.

Result 16: Risk perception is influenced by past experience. In interviews, we frequently heard that trust – a key component of participation in PES – can be built. Evolutions are, however, asymmetrical. While building trust and confidence in programs and program staff takes a long process, a single negative experience triggers long-term distrust. When a conflict with an institution is personal, time alone is not sufficient to overcome it. Several farmers said, for example, they would not be willing to work with conservation authorities because a building permit application they submitted had been denied or delayed in the past. On the other hand, farmers who have worked with

⁷⁰ “it is important to view support for practices oriented towards biodiversity protection not in a static sense – as a situation determined by one or several influencing factors – but rather as a process marked by interaction” (Siebert et al., 2006, p. 318).

conservation authorities are grateful for financial, administrative and technical support, as well as for the role their contact person from the conservation authority on the ground played in connecting them with other technical partners and funding opportunities. Globally, the attitude of the program contact personnel, their long-lasting presence on the ground, and their farming and technical expertise seem to matter more in building trust than does the profile of their institution.

Perceived legal risks limited participation in the early years of the EFP (Prairie Research Associates, 2011). However, over 25 years, no farmer has been prosecuted for information released in an EFP. Trust has largely been built. Few farmers still fear that completing an EFP increases their exposure to legal hurdles. Information being handled by farmer organizations with a strict confidentiality policy helps to alleviate this fear, although fear of legal repercussions is still mentioned as a participation barrier for programs managed by governments or those requesting detailed information on farms and farming practices. In Prince Edward Island, for example, fewer farmers participate in government-led ALUS than in the federal-provincial cost-share program. A program manager interviewed in PEI mentioned that government-managed ALUS is seen as riskier because program staff visit farms and request more detailed information.

Result 17: In the context of repeat participation, motivations evolve. Participation in incentive programs was reported to enhance environmental motivations, with farmers adopting progressively more environmentally ambitious projects as trust, awareness, experience, and positive recognition develop. In several interviews, farmers described that their motivations for participating in environmental cost-share programs evolved with

time. While their first project was largely motivated by operational concerns on their farm and funding opportunities, successive projects were primarily driven by environmental motives. Positive recognition - through environmental awards, interest from researchers and fellow farmers - and positive feedback from customers are elements that drove a sense of ownership and pride and led to the adoption of further environmental projects. Farmers could also see first hand their project's impact on soil health, erosion, and biodiversity increasing trust in environmental programs and awareness of environmental issues. Having the opportunity to interact with researchers and environmentalists, they fully appreciated the extent of their projects' benefits. Success and positive feedback motivated repeat participation. Some farmers also had the opportunity to identify market potential for their environmental projects and fully integrated them into their vision for their farm. This finding mitigates the conclusion by Trenholm et al. (2013), in an Ontario choice experiment, that public recognition is not an important motivation for farmers. While our interviews confirmed that it was not an original motivation (farmers did not participate to be recognized), public recognition triggered by a first project can lead recognized farmers to become environmental champions, expanding both their own projects and their influence on others. Environmental awards mentioned by key informants included awards delivered by farmer and environmental organizations; e.g. The Environmental Stewardship Award of the Canadian Cattlemen's Association delivered since 1996, the annual Mapleseed Pasture Award for Ontario sheep farmers, the Farmer Rancher Pollinator Conservation Award delivered by the Pollinator Partnership (Canadian Cattlemen Association, n.d.; Ontario Sheep Farmers, 2021; Pollinator Partnership, 2021). While financial awards are often of symbolic nature, positive exposure in the farming and non-farming communities,

including through social networks and other media broadcasting, is noted as positively impacting future participation. In 2019, OMAFRA also launched the Excellence in Agriculture Award, with EFAO being the first recipient.

Result 18: Being denied funding discourages farmers from reapplying.

“I lost interest in applying again. I have a lot of experience with many different programs outside of farming: I understand what it takes. But I did not get the funding and, if I have no feedback, it is not a good use of my time. (...) During the course, I learned a lot. It was time well spent”.

Most farmers we interviewed who have had one of their first applications rejected have not reapplied. Program managers confirmed that, unless expectations are managed and clear directions for improvement are provided, farmers whose project has been denied funding tend not to reapply. This is different for farmers who have already successfully applied a number of times. The proportion of applications rejected, the level of feedback provided, the program staff’s capacity to manage expectations, the motives for denying funding and their impact vary with program design, with long-term consequences on farmers’ motivations. This analysis is further detailed in our comparison of program designs (Chapter 3).

2.5 Discussion and conclusion

2.5.1 Internal validity

In this chapter, we present viewpoints on Ontario farmers’ motivations to participate in PES and participation barriers which are coherent across interviews. Our analysis is not based on a statistically significant survey, and some of our findings may be biased by the

dominant discourse⁷¹ or limited sampling. However, having chosen a broad range of key informants with different viewpoints through purposive sampling, we are confident that our findings can be considered solid.

2.5.2 External validity

This chapter does not aim to lay out universal findings on farmers' motivations to participate or not to participate in PES. Our scientific ambition, however, goes beyond the Ontario case study. We propose an analytical framework that assembles motivation factors and participation barriers discussed in separate branches of the agri-environmental literature and can help with local diagnoses in various geographical settings. With an adjustment to account for operational impacts, the proposed framework helped analyze farmers' motivations to participate in PES and participation barriers in Ontario. It also helped identify significant heterogeneities across BMPs and across farmers' networks. In Chapter 3, we show that this framework can be used to compare program designs and draw policy insights. Finally, when we analyzed the recent empirical literature on farmers' conservation behaviours, we found no significant gap in the proposed framework. Given strong constants in human preferences stated in the literature, we are confident that this analytical framework is a useful tool for local diagnoses beyond Ontario.

⁷¹ The term 'discourse' is used here with Foucault's definition: "a system of thoughts composed of ideas, attitudes, courses of action, beliefs and practices that systematically construct the subjects and the worlds of which they speak." (Lessa, 2006, p. 285). Lessa also notes that Foucault "traces the role of discourses in wider social processes of legitimation and power, emphasizing the constitution of current truths, how they are maintained and what power relations they carry with them" (Lessa, 2006, p. 285).

2.5.3 Perspective for further research

Considering efficacy beliefs. Contrary to Fishbein and Ajzen's Reasoned Action Model, our framework does not explicitly distinguish between expected outcome (efficacy beliefs) and preferences (attitude towards this outcome). Previous research, and several literature reviews, have described farmers' efficacy beliefs in similar environments, for example on soil health BMPs in North America (see Table 2). Our research aims to complement this work by broadening the prospective of former research on the different components of motivation, while proposing a simple multi-dimensional framework. In Ontario, this framework has helped shed light on the relative importance of factors not considered under the same umbrella in previous work. In Chapter 3 and 4 this framework is also used to understand how various decision factors play a different role depending on farmers' profiles. A future development could be to distinguish, under the five groups of factors, aspects associated with efficacy beliefs and preferences for the outcomes. Some key findings along these two dimensions and the five groups of factors are summarized in Table 3 below.

Table 3: Distinguishing expected outcome and preference for the outcome in our five-factor framework

	Expected outcome (perceived efficacy)	Preference for the outcome
Financial, market and operational impact	<p>Cost-sharing can be important to remove investment barriers, and thus allow or accelerate adoption.</p> <p>In Ontario, recurring payments (e.g. ALUS) are often perceived as insignificant financially (e.g. not a significant financial benefit for the farm, when compared to overall income), but may still have an important symbolic value (cf. preference)</p> <p>Market opportunities are not usually identified as a potential benefit when joining the program.</p> <p>Perception of economic benefits of soil health BMPs (incl. time savings) are impacted by positive experiences and discourse in farmers networks.</p>	<p>Individual preferences vary (business-minded versus conservation minded-farmers...)</p> <p>Preferences also vary based on the importance of symbolic features (e.g. by paying even a symbolic amount, society recognizes that farmers invest in public goods, and benefit the environment).</p>
Feasibility and risks	<p>Perceptions vary among farmers and over time (e.g. perception of exposure to legal risks decrease with positive experience; perception of technical risk increase if a BMP – e.g. cover crop – has failed; etc.).</p> <p>Risk perception decreases when TA is provided, when contact person is an experienced farmer...</p>	<p>Preferences vary among farmers (innovators vs. laggards...)</p>
Personal norms	<p>Perception on the environmental / public goods benefits of the BMPs vary among farmers, with limited documented impact evaluation</p> <p>Perceptions vary over time, in particular when farmers see first-hand benefits on their lands, or benefits from positive discourse of early adopters.</p>	<p>Regard for environmental concern and environmental impact on others (altruism) vary across farmers</p>
Social norms	<p>Perceptions vary among BMPs</p> <ul style="list-style-type: none"> - BMPs which look untidy go against social norms in the agricultural sector - BMPs with recognized distributional impacts or risks (e.g. fencing cattle of the waterways) are supported by social norms - Removing environmental features on-farm is often perceived as socially acceptable among farmers, norms carried by urban citizen are often rejected 	<p>Regard for social norms vary among farmers.</p> <p>Several interviewees boast about their capacity to make independent choices despite agricultural social norms</p> <p>Even if urban citizen are rejected as a legitimate source of social norms, showing urbanites that “farmers are not the bad guy” matters</p>
Ownership and self- direction	<p>Perceptions vary among farmers (differ between farmers collaborating with governments vs. farmers in the landowners’ right movement (LRM))</p>	<p>Preferences vary among farmers with strong preferences for ownership and self-direction driving some farmers not to participate (e.g. LRM)</p>

Taking work/life balance into account? Other case studies would, however, be necessary to confirm the relevance of the proposed framework in other settings and may lead to further adjustments. In particular, how we take time into account when considering farmers' motives may be an area for debate. Coming from the assumption that time has a cost, we have considered the time farmers spend to apply for funding as a transaction cost under 'financial and market impact'. Speaking about the application process, several interviewees mentioned "it is not worth my time" or "I always ask myself, if it is worth my time". This wording tends to confirm that time is translated in financial terms in farmers' decisions. Ontario farmers often having multiple jobs or economic activities, their time has a financial value even outside peaks in farming workload. Time does not, however, translate in monetary terms alone, and further research could analyze if work/life balance would be worth including as an additional factor in the proposed framework. Nuances may even be further explored, as time spent applying may be considered both in quantity and quality. Some farmers mentioned that how they spend their time matters in their quality of life; being in front of their computer being much less appealing to them than working outside.

2.5.4 Conclusions and insights for the next chapters

Understanding heterogeneities in preferences across farmers requires further investigation. While interviews allowed us to identify heterogeneities in motivations across groups of BMPs and farmer networks, we could not single out explicit variables segmenting farmers into groups of contrasting motivations. Another methodology is required to segment preferences. To do so, we conducted a choice experiment with latent

class models. The conclusions of the choice experiment are presented in Chapter 4. The framework and findings described in this chapter were used to design the choice experiment and select accompanying survey questions, as described below.

Personal norms and past experience: Interviewees confirmed that personal norms matter in Ontario farmers' decisions to adopt BMPs and participate in PES, with heterogeneities among farmers as broadly documented in the literature. Attitude statements will thus be included in the choice experiment to qualify farmers' personal norms with regards to conservation.

Interviews also brought light on potential heterogeneities among BMPs on farmers' motivations to adopt. We deduced that the choice experiment should not present BMPs of different nature in the same choice set or even to the same respondent in successive choice sets, as this would increase the cognitive burden and confuse our understanding of decision factors. As our qualitative research led to identifying two main groups of BMPs corresponding to different motivations, we segmented our choice experiment in two treatments presented randomly to different respondents, each treatment corresponding to one group of contrasting BMPs.

Finally, motivations appeared to vary with past experience. Questions on past experience were thus included in the survey associated with the choice experiment.

Self-identification into a farmer's profile: In interviews, farmers' motivations and goals for their farms appeared to be often associated with self-identification in a farmer's profile. Farmers identify themselves as business-minded, caring for the environment, innovative, etc. While some farmers describe all three objectives, refusing to be "put in a box", others clearly state their dominant objective as a personal mindset.

Membership in a certain farming organization seems often associated with this self-identification, with differences across organizations of mainstream farmers, ecological farmers and innovative farmers. As our research targets differences in motivations, we needed to be vigilant in our choice experiment dissemination to try and reach all three groups. To reach a diversity of farmer profiles, we advertised the survey through different farmer organizations and farming media.

Social networks and peer influence: While many interviewees mentioned some level of peer influence in farmers' decisions to adopt or not to adopt environmental practices and participate in PES, most interviewed farmers did not recognize that they were influenced by their peers. We certainly interviewed farmers more independently minded and willing to share experience and thoughts than the average farmer. However, we derived from interviews that inferred valuation techniques might be more appropriate than a choice experiment in quantifying peer influence in the farming sector. Thus, while questions on peer influence are included in the choice experiment, we decided – together with the field advisory committee – not to include a dimension associated with peer influence in the choice experiment attributes.

Ownership and self-direction: We are not aware of any choice experiment on agri-environmental contracts investigating attributes associated with ownership and self-direction; however, our qualitative research revealed that this group of motivation factors could be very important to Ontario farmers. We found the profile of the person who represents the program on the ground to be a particularly important element associated with ownership and self-direction in farmers' decisions, as Ontario farmers do not want to have decisions imposed on their farm or participate in stewardship program risking to increase

unwelcomed scrutiny, and trust in their contact person matters. We directly used this finding in the choice experiment design by choosing ‘the contact person profile’ as one of the choice attributes.

Technical assistance: A number of interviewees emphasized the importance of technical assistance in agri-environmental programs. In some instances, technical assistance was even mentioned as more important than funding. Access to technical assistance was thus chosen as one of the attributes in the choice experiment, in line with previous research.

Competition or collaboration: interviews brought very substantial information on the respective merits and issues associated with different project selection approaches. Three levels of increasing competition, most significant to Ontario farmers interviewed, were retained in the choice experiment. Barriers to more collaborative designs were also discussed in interviews. Those findings have not been discussed in the present chapter. They are at the centre of Chapter 3. Chapter 3 also discusses further the role of local institutions, including municipal, provincial and federal governments, as well as environmental NGOs, local resource management authorities and committees.

Chapter 3: Fostering competition or collaboration in agri-environmental incentive programs, pros, cons, and trends

“The very notion of competing against one’s neighbour was antithetical for many, and was accompanied by intimations that a distinctive ‘culture of cooperation’ exists in eastern Ontario. As such, cooperative approaches held more appeal among landowners, with the pervading sentiment that approaches with competitive leanings would struggle for traction. The existence of this palpable culture of cooperation produces some intriguing policy questions. How best to capitalize on such cooperative sensibilities?” (Holmes, 2015, p. 96)

3.1 Introduction

3.1.1 Policy and research debates

For more than 30 years, agri-environmental programs have offered farmers financial incentives to adopt or maintain environmentally beneficial land uses. These programs have slowed down deforestation in Latin America (Alatorre-Troncoso, 2014; Costedoat et al., 2015), preserved grasslands in Europe (Science for Environment Policy, 2017; Siebert et al., 2006), accelerated the adoption of conservation agriculture in the Canadian Prairies (Lafond et al., 2014), prevented the pollution of mineral water sources in France (Perrot-Maitre, 2013), restored populations of endangered birds in Cambodia (Clement et al., 2010), preserved endemic vegetation in Australia (Defra, 2013), restored wetlands in the United States (Molnar & Kubiszewski, 2012), etc. Many governance and funding systems have been deployed. Some resemble public subsidies. Others rely on offset markets. Some are funded, or implemented, by private companies or NGOs. In this dissertation, we use the umbrella term ‘Payments for Environmental Services’ (PES) to encompass a range of public or private instruments financially supporting farmers in the adoption of environmentally beneficial practices, including cost-share programs.

Over the years, researchers have pointed out five main limitations of PES: (1) Most programs support practices with limited environmental ambition; those are insufficiently targeted, often based on uniform payments uncorrelated with environmental impacts, prone to windfall effects, and thus lacking cost-efficiency (OECD, 2012; Weersink et al., 1998). (2) When programs support environmentally ambitious transitions, uptake is often insufficient to achieve environmental goals (Aznar & Valette, 2010; Boxall et al., 2013; Christensen et al., 2011; Espinosa-Goded et al., 2010; Kuhfuss et al., 2016; Nailor, 2000). (3) Positive impacts might not last after payments are discontinued (Muradian et al., 2010). (4) There is a trade-off between equity and efficiency in PES design (Pascual et al., 2010), and incentive programs often raise equity concerns (Calvet-Mir et al., 2015). (5) Payments can crowd out intrinsic motivations (Chenard & Parkins, 2010; Ezzine-de-Blas et al., 2018; Rode et al., 2015; Toogood et al., 2004).

In light of those criticisms, two main schools of thought have emerged, which drive policy recommendations in opposite directions, i.e. towards fostering either more competition or more collaboration among farmers eligible to apply for agri-environmental incentives. Many economists recommend fostering, or at least exploring, competition through **environmental benefit ranking systems** and **reverse auctions** (competitive tendering systems) to concentrate funding on the most cost-efficient projects (Engel et al., 2008; Groth, 2011; Palm-Forster et al., 2016; Zandersen & Tol, 2009). Social scientists, institutionalists, and behavioural economists, on the other hand, focus on farmers' motivations and behaviours. They count on the evolution of **local agricultural norms** to induce a broad and long-term adoption of environmentally ambitious practices. To achieve

this transformation, they recommend approaches based on **collective action** (Muradian et al., 2010).

This debate between schools of thought could inform public policies in Canada. The next federal-provincial agricultural policy framework for Canada and agriculture-based carbon offsets were discussed in 2017, as we concluded and presented our research. In Ontario, the Ministry of Agriculture expressed a particular interest in behavioural research (Weber, 2017), and our preliminary conclusions were presented and discussed on several occasions with Ontario policy analysts and program managers in 2016 and 2017. In a context when potential policy reforms were being discussed, we found it particularly useful to **learn from past and current experiences**. In Canada, supporting voluntary private initiatives has long been the panacea of conservation policies on private lands. Multiple stewardship programs have been funded by federal, provincial, or municipal governments, private foundations and environmental NGOs. Tens of PES programs with different approaches have been tried in Ontario since the late 1980s. Practitioners have accumulated a wealth of knowledge, but lessons learned have rarely been published and shared. While previous research has analyzed Ontario PES (Nailor, 2000; O' Grady, 2008; Rosenberg, 2010; Stonehouse, 2000), most studies focused on single programs with limited bridges across programs and implementation structures, or examined a range of program designs with limited emphasis on lessons learned (Marcano, 2011). None has specifically looked at competitive mechanisms implemented in Ontario or compared collective and competitive designs in the province.

Some Canadian studies have analyzed how competitive or collaborative approaches could *a priori* impact farmers' motivations. Using a series of focus group meetings, Holmes (2015) analyzed stakeholders' views on a range of instruments susceptible to support the provision of ecosystem services in Eastern Ontario in the future. She identified ten key characteristics in the design of instruments for provisioning ecosystem services ('heuristic analytical fields')⁷² and contrasted seven approaches represented by emblematic programs in the United Kingdom, Australia, Bolivia, Costa Rica, and Ontario (3 programs). While none of her analytical fields explicitly focuses on describing competitive or collaborative features in program design, competitive and collaborative programs were included in the selection of models debated, and arguments for competition or collaboration among farmers were raised by participants in focus groups discussions⁷³. Our research brings additional insight by focusing on the debate between competition and collaboration, and learning from **stakeholders' personal experience with competitive and collaborative designs**. Whereas Holmes' work focuses on farmers' viewpoints on potential programs, most of which they had not personally experienced (intentions), our interviews mainly focused on programs farmers had first-hand knowledge of. This chapter thus fills a gap in the literature by comparing stakeholders' experiences with various approaches in the same jurisdiction.

⁷² (1) Initiated / administered by whom (e.g., State, NGO, other); (2) Reactionary or anticipatory; (3) Financing structure / resourced by; (4) Scale of implementation (e.g., highly localized vs broad-scale); (5) Inclusivity of landowner participants or ES 'providers'; (6) What ecosystem service(s) /who decides; (7) Mode of delivery; (8) Form of landowner support/ incentive/recognition; (9) Nature of landowner commitment; (10) Nature of monitoring /auditing / verification of outcomes.

⁷³ See quote at the beginning of the chapter.

3.1.2 Research objective

Our research uses evidence from the field to bring insight to the debate on competitive and collaborative PES approaches along four research questions:

1. How have PES design features evolved over time in Ontario, in particular on competitive and collaborative aspects?
2. How do Ontario designs compare on competitive and collaborative features with PES in other Canadian provinces and OECD countries?
3. Are design features fostering competition and collaboration antagonistic, or have hybrid designs been developed?
4. Do broad differences in PES design impact farmers' motivations to participate in Ontario PES?

The research develops and uses an original conceptual framework to compare program designs along competitive and collaborative features (Figure 12 and Figure 15 below).

3.1.3 Structure of the chapter

This chapter is divided into five sections. First, we present our methodology and the choice of a **comparative design analysis** with a focus on Ontario. In a second section, we review the evolution of agri-environmental policy and PES in Ontario since the 1930s. This historical retrospective is particularly useful to understand how objectives and policy ideas evolve but also re-emerge over time. It also gives insight into the experiences which have impacted current farmers' perceptions of PES and motivations, including competitive and collaborative design features. A third section analyzes how PES translate in practice principles of competition and collaboration among farmers, and compares Ontario PES

with contrasting designs in other provinces and OECD countries. Finally, in conclusion, we draw on our analyzes to sketch recommendations for the design of future Ontario programs.

3.2 Methodology

3.2.1 Choice of the case study

Most of the research for this chapter took place in South-Western and Eastern Ontario. South-Western and Eastern Ontario share relatively rich agricultural soils, intensive agriculture, urban extension on agricultural land, and pressing concerns with environmental issues, including soil health, water quality and biodiversity loss. Since the late 1980s, cost-share programs, annual payments, offsets, and fiscal measures have been introduced in Ontario and offer a solid ground to compare PES designs. Solutions, as varied as water quality markets, conservation easements and collective actions, have been tested. Those economic instruments are often combined with other policy approaches including public research, awareness-raising, capacity building and self-assessment programs, in an agri-environmental policy-mix. Some Ontario PES involve local municipalities or private companies. Others are led by farmer organizations or governments, with a wide range of partnerships. Competitive and collaborative designs have been tested. Some programs are administered by NGOs with government financial support. Others are conceived, implemented, or monitored by farmers and farmer-led organizations. The involvement of mainstream farmer organizations varies across programs and has evolved over time (Morrison & FitzGibbon, 2014). The variability of program designs tested over the years in Ontario offers a particularly interesting ground for a **single case study (Ontario) with**

individual programs as embedded units of comparison. In a systematic review of agri-environmental PES in Ontario, we cover the diversity of current and recent programs, with a particular interest in competitive and collaborative features.

3.2.2 Methodological approach

We conducted a **systematic review of Ontario PES**, and compared Ontario PES on farmland with programs in other provinces and OECD countries selected to represent a **broad diversity of competitive and collaborative** approaches, along the four dimensions of our analytical frameworks (presented below). Our findings rely on four sources of information: program and policy documents (grey literature); semi-structured interviews with program managers, farmer organizations, and policy-makers in Canada and abroad; semi-structured interviews with Ontario farmers; and a survey accompanying a choice experiment implemented online with about 300 Ontario farmers in 2017 (Chapter 4). While data does not ensure a statistical representation of Ontario farmers, the opportunity to identify converging results across sources of information gives credibility to our findings. The first set of interviews was conducted with program managers, farmer organizations, and policy-makers from June to December 2016. Various sources were used to ensure that the identification of key informants covered as much program diversity as possible. In particular, we built on the results of a direct study course on Canadian PES with Professor Graeme Auld at Carleton University (in 2014) and a report on Ontario environmental markets by Sustainable Prosperity (Marcano, 2011) to identify as many Ontario PES on agricultural lands as we could, going back to the emergence of agri-environmental programs in the 1930s. In December 2016, we discussed our preliminary findings with an

informal field advisory committee - composed of Ontario government policy advisors, program managers in the public and private sectors, at provincial and municipal levels, and farmer organization advisers and leaders. We conducted complementary interviews in 2017 to follow-up on subjects that appeared particularly promising in our preliminary analysis. Our interview guidelines outlined questions on PES design, farmers' motivations to participate or not to participate in PES, participation barriers, policy lessons, and evolutions expected or wished for in future program designs (interview guidelines in Appendix 1). Following a semi-structured approach, we started with factual and open-ended questions and followed up with questions adapted to the respondents' first answers.

We conducted 70 interviews in Ontario and 11 interviews in other provinces and countries: 30 interviews with landholders (mostly farmers), 10 with farmer organizations, 11 with conservation authorities, 14 with government experts, nine with environmental and sustainable food associations, and seven with university professors and private experts. Key informants were identified using the systematic review of Ontario PES, the identification of contrasting PES in OECD countries, contacts available on the Internet, and snowball sampling. Farmers were chosen through purposive sampling for their participation in contrasting Ontario PES, with the support of recognized farmer organizations administering incentive programs in Ontario. In particular, farmers having participated in two contrasting programs with similar objectives (a first-come-first-served program and a conservation tender) were identified with the support of the Ontario Soil and Crop Improvement Association (OSCIA).

Twenty-two former and current Ontario programs were considered in our comparative design analysis, and ten programs in other provinces and countries (two in Prince Edwards Island, one in the Canadian prairies, three in the United States, one in The Netherlands, two in France, and one in Germany). Criteria used to select those programs are further detailed below in section 4. Seventeen of the Ontario programs were ongoing at the time of the research, while five had ended. Our analysis takes an interest in **individual program designs**, as well as in the **trajectory over time** of successive designs pursuing the same objectives.

3.3 Agri-environmental policies and PES in Ontario: a historical perspective

While most of our primary research focused on current programs, revisiting past interventions helped gather lessons learned and understand policy trajectories. A more detailed analysis is presented in Appendix 3. It is worth noting that while official program reports provide details on program governance, activities and disbursement, they contain little critical analysis to build future programs on, with the exception of recent work by OSCIA (2014a). Interviews with key informants with a long-term perspective on Ontario programs and research articles helped us develop a more critical understanding of policy evolutions and **lessons learned**⁷⁴. We identified five phases in Ontario agri-environmental policies. A sixth phase is emerging in 2017 that followed the endpoint of the analysis for this chapter.

⁷⁴ Since we first developed this paper, Rudy (2018) published a very insightful first hand retrospective of 30 years of OSCIA's experience.

3.3.1 1930s – 1970s: Setting up institutions

Agri-environmental research, extension and on-farm incentive programs are not new to Canada. Soil health on agricultural land has been a concern in North America at least since the 1920s⁷⁵. Concerns considerably increased in the 1930s, with the Dust Bowl greatly damaging soils and agriculture in the American and Canadian prairies. In the United States, the **Soil Conservation Act** of 1935 and **Soil Conservation and Domestic Allotment Act** of 1936 allowed governments to pay farmers, including tenants and share-croppers⁷⁶, who voluntarily reduce production and adopt soil conservation practices, introducing PES in a broad sense (Cain & Lovejoy, 2004; Sheener & Lynne, 2011). Payments were dimensioned to compensate for additional costs and foregone income and conditional to practices being adopted⁷⁷. Agri-environmental incentive programs, including land retirement programs, further developed in the United States in the 1950s with the adoption of the first **Conservation Reserve Program** in the Agricultural Act of 1956 (Title I: Soil Bank Act). The **Soil Bank Act** authorized governments to pay farmers to retire sensitive land and establish and maintain a protective vegetative cover under a multi-year contractual agreement⁷⁸.

We could not identify similar programs in Canada during this period; contrary to the United States, soil health and water conservation programs in Canada from the 1930s to 1970s did

⁷⁵ See presentation in Arizona from the 1920s “The biggest problem in American Agriculture (...) How should we maintain the crops producing power of our soils” (Soil Improvement Committee of the National Fertilizer Association, n.d.); and Forge (1998).

⁷⁶ Under the 1936 Act, landlords were required to share the payments they received from the government for cutting back production with those who worked on their land.

⁷⁷ 74th Congress Session I Chs 84, 85 April 25, 27, 1935, Soil Conservation Act (Public Law 74-46) and 74th Congress Session I Chs 104. February 29, 1936 – Soil Conservation and Domestic Allotment Act (Public Law 74-461); (Congress of the USA, 1935, 1936).

⁷⁸ Agricultural Act of 1956 – Title I: Soil Bank Act (Public Law 84-540, 70 Stat. 188).

not include individual financial incentives to private landowners or tenants. Under the Canadian Constitution Acts, agriculture is a shared responsibility between federal and provincial governments. In Canada, the Dust Bowl led to the creation of the **Prairie Farm Rehabilitation Administration** in 1935 (International Institute for Sustainable Development [IISD], 1994). In Ontario, the **Ontario Soil and Crop Improvement Association** (OSCIA) was founded in 1939, federating local farmer-led groups interested in improving soil health and crop management techniques. In 1946, the **Ontario Conservation Authorities Act** permitted the creation of local conservation authorities, under the responsibility of one or several municipalities, to address erosion and water issues at the watershed level through integrated planning, demonstration, advisory, and regulation⁷⁹ for water and biodiversity. During and after the Second World War, agricultural policies in Canada focused on market, prices and insurance, with some incentive programs in the early 1940s and late 1960s focused on preventing or reducing oversupply rather than on environmental issues.

While the United States and Canada had originally taken different routes in supporting soil and water conservation, programs developed in the United States influenced Canada, in particular on transboundary issues, including Great Lakes water quality, with the International Joint Commission on shared waters; and migratory waterfowl conservation, through the expansion in Canada of an originally US-based NGO, Duck Unlimited. In the 1970s, while agri-environmental incentive programs were not yet developed in Canada, a

⁷⁹ Conservation authorities regulate development, activities, and channel changes in or adjacent to river or stream valleys, Great Lakes and large inland lakes' shorelines, watercourses, hazardous lands and wetlands (Conservation Ontario, n.d.).

reference group set up by the International Joint Commission already recommended in its final report (based on experience in the US) to review the availability, sufficiency, and conditionality of “*grants, loans, tax incentives, cost-sharing arrangement and other fiscal measures*” to control nonpoint pollution (International Reference Group on Great Lakes Pollution from Land Use Activities [PLUARG], 1978, p. 14). On the private side, Ducks Unlimited Canada (1938), supported by its US counterpart, started delivering habitat conservation programs in Ontario in 1974, including with private landowners.

Institutions set up during this early period are still central to Ontario agri-environmental policies and incentive programs to date. With over 4,000 members in 2021, OSCIA federates 53 local associations and plays a leading role in the administration of agri-environmental self-assessment and incentive programs, including government-funded programs. In 2020, 36 Conservation Authorities organize strategic planning and manage regulatory and incentive programs on a watershed basis in Ontario. In 2017, Ducks Unlimited had completed more than 3,000 habitat projects across Ontario and conserved almost one million acres of wetlands (Ducks Unlimited Canada, n.d.).

3.3.2 The 1980s: the emergence of province-wide cost-share programs in Ontario

In the 1930s to 1970s, agri-environmental policies in Canada and Ontario had set up institutions. Until the mid-1980s, those institutions mainly supported soil health and water quality on private land through extension, demonstrations, and study tours. **Financial agri-environmental incentives on private land** were introduced in the mid-1980s in Ontario through investment **cost-share programs** (Appendix 3). This development coincided with

PES expansion in other OECD countries, including in the United States, with the adoption of the **Conservation Reserve Program** in its current form (1985), and in Europe, where the **European Union Common Agricultural Policy** (EU CAP) first gave the Member States the option to implement agri-environmental incentive schemes in the late 1980s; and made agri-environment incentive programs compulsory in each EU Member State in 1992. In the mid-1980s, the **Ontario Ministry of Agriculture and Food (OMAF)** was at the **forefront** of Ontario agri-environmental programs, with a **broad, integrated approach**, combining research, demonstration, extension, and investment cost-sharing on private land. New ministry staff was hired to strengthen education, extension, and grant administration. A research chair in land stewardship was established at the University of Guelph. Cost-share programs co-financed a large range of on-farm projects, including manure storage, erosion and pollution run-off control structures (on-farm windbreaks, buffer strips, grassed waterways, ditch fencing, alternative watering sources...), machinery, equipment, and on-farm technical advice. The farmer organization OSCIA was mandated to help promote programs and to establish and administer **local stewardship committees** composed of farmers and government representatives in each county. Local committees were responsible for reviewing stewardship action plans, recommending projects for funding, and conducting inspections. Farmers received support from OMAF staff and committee members to complete their applications. They also had ample opportunities to make changes once their applications were reviewed. When the total available budget was reached in a given year, eligible applications were to be carried over to the next program year. Local funding rates were defined per acre for each management practice and varied across agricultural regions in Ontario. Well-maintained tree plantations

financed by a stewardship program could receive a multi-year annual incentive. To facilitate adoption on rented land, three-year minimum **stewardship leases** were supported with an annual grant premium.

Federal policies for soil conservation also emerged in Canada in the mid-1980s (Forge, 1998) and progressively supported provincial programs through **federal-provincial agreements**.

Agricultural economists criticized those early agri-environmental incentive programs for being non-specific. Stonehouse (2000) underlined in particular that the first major agri-environmental program in Ontario - the Land Stewardship Program (LSP, 1987-1990) - was designed in haste to respond to farmer lobbying prior to a provincial election, and pre-specified goals were “extremely general in nature”. “The difference made by LSP was not measured and was not compared against any standard, and therefore it is difficult to assess any measure of success”. “No attempt was made to ensure that available funding was directed to those farm situations encompassing the most severe soil productivity problems, much less those farms causing the most environmental damage”. (Stonehouse 2000, p. 198 and p. 202). Stonehouse even underlined that farmers having already adopted conservation practices benefited the most from program funding. However, Stonehouse also commented on “The successful combination of an NGO [OSCIA] for grassroot program delivery and the OMAFRA for extension advisory” and the “winning combination of financial incentives with conservation technology transfer” (Stonehouse, 2000, p. 201).

“In summary, the politically motivated LSP, with its voluntary compliance, public assistance, nontarget characteristics, represented an inefficient and ineffective application of public money, and a failure to meet with the broad public’s interests. This program, however, was not without its element of success. Highly popular with farmers, it was greatly oversubscribed, it contributed towards improvements in the conservation extension infrastructure serving to encourage greater conservation effort, and it probably, albeit indirectly, boosted Ontario farmers’ awareness for conservation needs and a better stewardship ethic.” (Stonehouse, 2000, p. 206).

While Ontario incentives programs over the next periods became more targeted and specialised, and extension efforts decreased, some of the early features are currently being re-discussed, including the interest for specific incentives or policy measures to support adoption on rented land, multi-year incentives to facilitate long-term stewardship investments, incentive levels tailored to specific sub-provincial conditions and objectives, strong peer-to-peer approaches, and extension support from the project design stage onwards.

3.3.3 The 1990s: Farmer-led organizations at the forefront of policy innovations and implementation

While in the 1980s, OMAF was at the forefront of PES development and implementation in Ontario, **farmer organizations** took a leading role in the 1990s, throughout a second series of environmental cost-share programs financed under federal-provincial agreements. Concomitantly, public extension started to be considerably reduced in Ontario (Milburn et al., 2010). The rise and continued support for PES with more limited government involvement occurred in a period of dominant neo-liberal views internationally, when private-led and voluntary instruments appeared to a wide range of stakeholders as a promising, new and efficient alternative to traditional environmental policies based on regulation and public intervention. Being at least in theory both market-based and voluntary, PES fit particularly well in the *New Environmental Policy Instruments* paradigm⁸⁰, which responded to concerns with regulatory approaches, priority given to

⁸⁰ 'New Environmental Policy Instruments' include market-based instruments and instruments based on voluntary action (voluntary agreements and informational devices) (Jordan, 2001, p. 3).

competitiveness and demands for decentralized governance in the late 1980s and 1990s (Jordan, 2001⁸¹). The 1989 Canada-Ontario Accord on Soil and Water Conservation and Development recognizes this shift and reads in its section 5:

“5.1 Local organizations provide grassroot representation for local producers therefore they are needed in the advocacy, planning, and implementation of effective soil and water conservation and development practices.

5.2 Local organizations will be designated by the Province to receive and administer funds provided by the Province, or the Province in partnership with Canada as appropriate for the purposes of Section 5.1.

5.3 It is recognized that with appropriate support, existing soil and water conservation and development organizations in Ontario can adequately provide conservation management services at the farm level.” (Canada & Ontario, 1989, p. 4)

In 1992, a coalition of farm organizations, the **Ontario Farm Environmental Coalition** (OFEC), took the initiative to develop the **Ontario Environmental Farm Plan** (EFP), a farmer-led voluntary awareness-raising and self-assessment program which remains a cornerstone of Canadian agri-environmental policy to date. This initiative, first piloted in 1993, was largely motivated by farmer organizations’ desire to take the lead on agri-environmental policy design and prevent the regulation of farming practices by offering a credible alternative (Montpetit, 2002⁸²; Morrison & Fitzgibbon, 2014⁸³). This preeminent farmer initiative took place in the context of a decades-long history of struggles led by farm organizations in Canada, which resulted in particular in the adoption of supply management

⁸¹ “The reasons for the increasing popularity of NEPIs range from dissatisfaction with the effectiveness of traditional regulatory instruments, through to concerns about competitiveness and the desire for greater local-level control – i.e. subsidiarity.” (Jordan, 2001, p. 3).

⁸² “the powerful Ontario Federation of Agriculture and the Christian Farmers Federation of Ontario, along with two associations representing commodity groups, organized themselves into the coalition group OFEC in order to control the development of a provincial environmental policy for the agricultural sector.” (Montpetit, 2002, p. 14).

⁸³ Morrison and FitzGibbon (2014, p. 387) analyzed that farmer organizations self-organized EFP was originally “motivated by desire to prevent the regulation of farming practices”.

markets in the 1960s (Winson, 1992). Andrée et al. (2015) present this “history of civil society engagement with the state” as an important feature of the Ontario farming sector to date.

According to Morrison and Fitzgibbon (2014, p. 388), a “widespread social interest in environmental issues (including agroecosystems)” also played a significant part in the development of the EFP. OSCIA was mandated to implement the EFP through workshops where farmers are encouraged and supported to conduct a broad environmental assessment of their operation, identify agri-environmental risks and opportunities on their farm, and develop an action plan to incorporate environmental considerations into business decisions (Agriculture and Agri-Food Canada [AAFC], 2013). In EFP early editions, individual action plans were validated through a confidential review by a group of locally appointed farmers (peer-review). Participation in the EFP was at first limited by trust issues in the farming community towards government intervention, farmers being reluctant to document their environmental practices and self-assessed shortcomings. But acceptability considerably increased over 25 years, as no farmer suffered negative consequences of this documentation, and trust was built. Analyzes on factors that facilitated trust-building pointed out the bottom-up approach and delivery by well-respected local facilitators (Holmes, 2015). In an early survey on the 1993 pilot project, 95% of farmer participants responded that they would recommend the EFP process to their neighbours (OMAFRA, 2021). The Ontario EFP was recognized as a success, with broad farmer participation and satisfaction, and it was expanded to all Canadian provinces with federal funding. To date, participation in EFP remains advertised as a way to build competitiveness and strengthen

the farm industry; and, having an EFP is a prerequisite for several government supports and industries⁸⁴.

In the 1990s, agricultural **stewardship programs and policy frameworks with relatively short lifetimes succeeded one another**. A number of models were tested, with various objectives, eligibility criteria, and funding conditions. The Ontario Ministry of Environment (OME) and local conservation authorities developed their own programs to address water quality issues through investment cost-shares on private farmland. Those programs set up specific local committees to review project proposals based on watershed remedial action plans. While many provincial programs only lasted a few years, **water quality programs managed by conservation authorities** are still active to date.

The importance given to farmer-led collective action in this period led to the development of the **Rural Conservation Club Program (RCCP)** in 1992, which remains apparently the only agricultural stewardship program explicitly supporting collective projects on farmland in Ontario. RCCP was funded by Agriculture and Agri-Food Canada as part of the Canada-Ontario Green Plan. RCCP funded research and demonstration projects in environmentally sustainable agriculture from 36 provincial or local conservation clubs. While support to RCCP was officially open until 1997, new projects were only accepted in 1993 and early 1994. Most conservation clubs have disappeared today⁸⁵.

⁸⁴ In Ontario, for example, having an EFP is a condition to access most government-funded cost-share programs.

⁸⁵ With the notable exception of the Upper Avon River Conservation Club, “neighbours helping neighbours since 1993”, planting treed buffers on farm land, and conducting other stewardship activities, to date.

In 1995, Environment Canada launched the **Ecological Gifts Program**, providing significant tax benefits to landowners who donated their land or donated a covenant or conservation easement to recipients ensuring that the land's biodiversity and environmental heritage are conserved in perpetuity. In 1995, Ontario was the first province to adopt a legislation on **Conservation Easements** (CE), providing a legal basis for long-term stewardship agreements on private land⁸⁶. Donating a CE can enable heirs 'land-rich but cash-poor' to keep a property in the family. But, according to a specialized Ontario lawyer, tax advantages are not donors' first motivations; those are "motivated by the desire to see that piece of land permanently protected."⁸⁷ Land Trusts in Ontario emphasize environmental motivations in their Land Securement Manual: "The grassroots aspect of conservation easements is also a powerful motivation for landowners who have stewarded their lands, sometimes for generations, and wish to see that stewardship continue beyond their ownership." (Ontario Land Trust Alliance, 2003, p. 11). A case study by Miller et al. (2010) confirmed that landowners who entered in Conservation Easements in Wyoming and Colorado "valued the provision of public goods, such as wildlife habitat and open space, to neighboring communities, and generally felt something important would be lost to their communities if their lands were developed" (Miller et al., 2010, p. 65). In line with the popularity of private-led approaches, the number of land trusts in the United States increased dramatically in the 1990s (Merenlender et al., 2004).

⁸⁶ Today, almost all provinces have adopted legal provisions governing conservation easements.

⁸⁷ National Magazine - Legal Insights & Practice Trends, April-May 2012 "To Conserve and Protect", quoting Paul Peterson, a specialized lawyer.

With the adoption and dissemination of the EFP, voluntary cost-share programs, and conservation easements, agri-environmental public policies in Ontario in the 1990s gave an unambiguous preference to voluntary instruments. However, preference given to voluntary instruments rather than regulation was not uncontroversial. While some authors underlined the success of the EFP, others discussed its limits. In 2002, Montpetit (p. 14) noted that “Plans can cover a wide range of practices, but generally lead only to small improvement projects, and the financial incentive of a maximum grant of CAN \$1500 is small.” Despite the adoption of the Ontario Water Resources Act and Ontario Environmental Protection Act, in 1990, Montpetit (2002) analyzed that, in Canada, contrary to the United States, federalism and past policy decisions preserved an agricultural exception with respect to environmental regulations and policies. He denounced that voluntary programs were a poor substitute for the **lack of regulation**, leading to low environmental achievements; considering that “Essentially, Ontario has failed to adopt high environmental regulatory standards for its agricultural sector, preferring to endorse this farmer-controlled program, which imposes few constraints on agricultural practices” (Montpetit, 2002, p. 13-14).

Since the late 1990s, Canadian researchers also criticized cost-share programs with very broad eligibility criteria for their universal availability and **low level of cost-efficiency** (Stonehouse, 2000; Weersink et al., 1998). Weersink et al. analyzed, for example, that:

“The major limitation of these programs is their universal availability and the resulting cost ineffectiveness. Farmers with the greatest contribution to the pollution problem may not apply to a cost-sharing program if they cannot manage the practice or if the financial incentive is insufficient. On the other hand, funding may be granted to polluting firms even though they would have adopted the abatement regardless or to non-polluting firms because the subsidy makes the practice profitable for them.” (Weersink et al., 1998, p. 317).

Having a critical view of broad-based programs, Canadian researchers advocated for more targeted and competitive PES. This analysis was in line with international positions. Since the late 1990s, direct interactions through the market, or a form of management relying on market mechanisms, including market-based competitive approaches, was commonly put forward as the most effective way to conserve nature (Boisvert et al., 2013). On the contrary, some farmer unions and environmental NGOs advocated for the creation of a broad Canadian program similar to the US Conservation Reserve Program, with annual payments based on opportunity costs complementing existing investment cost-share programs. These contradictory positions raised the need for more structured policy studies and debates on PES design under federal-provincial leadership.

3.3.4 2002-2008: a renewed government leadership, through regulation, government-led stewardship programs, and policy debates

While farmers-led voluntary instruments had been preferred to regulations in the 1990s, several factors induced a policy shift in the early 2000s. The Walkerton tragedy, a fatal incident due to the contamination of drinking water by a lethal *Escherichia Coli* strain from manure (2000), triggered a new policy demand for government action in Ontario (Summers et al., 2008)⁸⁸. To improve water quality, the Ontario government adopted the **Nutrient Management Act** in 2002, the **Clean Water Act** for source water protection in 2006, and

⁸⁸ “In Canada, for example, the issue of source water protection was highlighted when contaminants attributed to agricultural waste entered the Town of Walkerton’s water supply causing seven people to die and thousands to take ill” (Summers et al. 2008, quoting O’Connor, 2002). The seven deaths and over 2300 illnesses in the Walkerton incident were linked to *Escherichia coli* O 157:H7 and *Campylobacter jejuni* contamination of municipal drinking water by manure run-off from farmland (O’Connor, 2002).

the **Lake Simcoe Act** in 2007. To protect and restore populations of endangered species and comply with Canada's commitments under the Convention on Biological Diversity (1992), the federal government adopted the **Species at Risk Act** (SARA) in 2002, and the Ontario government **Endangered Species Act** in 2007.

Debates and uncertainties on the regulations under preparation triggered apprehension in part of the farming community and contributed to the **expansion and federation of landowners' rights movements** in Ontario. The origin of the landowners' rights movement in Ontario can be traced back to the 1970s with landowners' opposition to the Niagara Escarpment Planning and Development Act (1972) that established the Niagara Escarpment Commission with the mandate to develop a plan for the escarpment and power to control its development. Work by the Commission led to the 1985 Niagara Escarpment Plan, considered the first large-scale environmental land-use plan in Ontario. Fox⁸⁹ dates the formalization of the landowners' rights movement in the mid-1980s, with the creation of the Grey Association for Development and Growth (Later Grey Association for Democracy and Growth) in reaction to Niagara escarpment planning (Fox, n.d.; Marshall, 2016). The movement expanded in the early 1990s with the creation of the Ontario Property and Environmental Rights Association (OPERA) in 1994, in reaction to the preparation of the Federal Species at Risk Act. In 2003, the emblematic **Lanark Landowners Association** was founded to oppose municipal tree-cutting bylaws. Its experience inspired other local groups. Twelve groups federated in 2005 to create the **Ontario Landowners Association** (OLA) and the magazine *The Landowner* with six issues a year since 2006. In

⁸⁹ Fox (n.d.) relates the history of the Ontario Land Right Movement to Bruce Benson's theory (1981) of the demand for and supply of redistribution of land rights.

2017, the OLA counts 22 chapter organizations. Positions expressed in front of a Senate committee on the preparation of a federal species at risk act help understand landowners' rights movement's views on stewardship programs. While the movement did not oppose stewardship programs (Green, 1992), they expressed a strong vigilance towards program fair access and governance (Ontario Property and Environmental Rights Alliance [OPERA], 2002)⁹⁰. To date, landowners' rights organizations in Ontario express firm defiance towards institutions involved in both regulatory missions and stewardship programs, in particular conservation authorities. Helping landowners charged by conservation authorities is explicitly an objective of OLA (Dolan, 2018).

The growing emphasis on the environment within **federal agricultural policies** continued in the early 2000s (Weersink et al., 1998). While the Ontario government funded substantial cost-share grants to accompany and complement new regulations, in particular the Nutrient Management Act, the federal government provided additional support that farmers were authorized to combine. **Cost-share percentages and funding ceilings increased dramatically** to reach up to 90% of investment costs and \$60,000 per eligible farm in the mid-2000s. Such favourable conditions triggered a large subscription, with programs been highly oversubscribed.

⁹⁰ “We urge this Committee to prevail upon the Minister to: 1. Provide compensation for all losses resulting from any negative impacts on private land that arise from imposition of Bill C-5 as determined by independent appraisers. 2. Offer landowners whose property is reduced in value 40% or more by SARA designation the option of having such property expropriated under Federal expropriation legislation. 3. Keep compensation independent of stewardship programs. No landowner should be compelled to refuse stewardship participation in order to qualify for compensation. 4. Allow only provincial, territorial or federal to establish and deliver stewardship programs under SARA regulations. 5. Revise the Ecological Gifts Program so that only municipal, provincial, territorial or federal government qualify to receive bequests of land designated as Endangered Species Habitat.” (OPERA, 2002)

At the same period, **private sector companies** in the value chains started investing in **quality standards**. Some buyers and banks started, as a condition of business, to require their suppliers or clients to implement EFPs.

“Cross compliance grew to include premiums in quality assurance programs (e.g., for corn fed beef) if the farm has an EFP and having a peer-reviewed action plan became a criterion for some agricultural certification programs and local food programs, such as Local Food +. Financial institutions also started asking for EFPs for insurance and mortgage approvals.” (Morrison & FitzGibbon, 2014, p. 392).

In 2008, according to Statistics Canada’s Farm Financial Survey, one-third of Canadian farms had implemented EFPs due to buyer requirements (AAFC, 2013).

The early 2000s also marked the start of the **sustainable food movement** in Ontario, aspiring to grow food in a sustainable way for local markets (Learmonth, 2010).

Producer associations lost some of their influence in agri-environmental programs, as government intervention increased, other non-governmental institutions emerged, and institutions in the value chains started asking more formally for quality insurance. The coordination between commodity-based farmer organizations and farmer organizations with a broader mandate decreased. OFEC’s voice in the Ontario Environmental Farm Plan weakened (Morrison & FitzGibbon, 2014).

Early PES in Canada had triggered contrasting reactions. As mentioned above, several agricultural economists criticized early agri-environmental incentive programs for being non-targeted and called for more emphasis on cost-efficiency. On the contrary, some farmer unions and environmental NGOs, inspired by large funding schemes in the US, advocated for an annual payment program compensating for the opportunity costs of environmentally beneficial agricultural practices, including land retirement. Diverging

analyzes and policy demands led to the creation of a **Federal-Provincial Working Group on Ecological Goods and Services** (WG-EGS). From 2005 to 2010, WG-EGS coordinated extensive policy exchanges and studies on economic instruments likely to foster EGS preservation and restoration, in particular on agricultural land. Key activities included six pilot projects testing a range of PES models; and numerous policy reports. Canadian federal authorities did not support the idea of a nationwide land retirement program due to potentially high budget requirements and doubts on cost-efficiency associated with recurring payments. However, local initiatives emerged. The Keystone Agricultural Producers, Manitoba's largest farmer union, and Delta Waterfowl Foundation, an environmental NGO originally funded by hunters, conceived and experimented with a community-led PES, the Agricultural Land Use Service program (ALUS), as one of the WG-EGS pilot projects, supporting voluntary retirement of marginal farmland with annual payments. ALUS was adopted at the provincial level in Prince Edward Island (2008). In 2016, ALUS became independent from the Delta Waterfowl Foundation. It has expanded today in a number of communities across Canada, including in various Ontario communities, with **private sector supports**, in particular from the Weston family, and some government support.

3.3.5 2008 to 2013, and 2013 to date: reduced and segmented public funding, experimentation and innovation with new designs

In the 2000s, environmental concerns in the general public increased. In 2011, an AAFC survey established that minimizing the impact of agricultural activities on the environment was one of the Canadians' top three priorities for government action in agriculture

(Environics Research Group, 2011). However, in 2010, the Federal-Provincial WG-EGS concluded its policy learning program by recommending integration of EGS concerns in agricultural policies rather than stand-alone instruments. Moreover, maintaining public support to on-farm environmental measures was largely debated during the preparation of successive rounds of federal agricultural policies.

Cost-share programs were maintained, but **federal funding** for environmental objectives **significantly decreased** after 2008. Program leadership shifted back from federal to **provincial** governments (Morrison & FitzGibbon, 2014). In Ontario, the decrease in cost-share budget led to **a very fast budget disbursement** of the federal-provincial funding program Growing Forward (2008-2013) **on a first-come-first-served basis** (OSCIA, 2014a). Experts report that, in one of the federal funding cycles in Ontario, the entire funding envelop was disbursed in 20 minutes, triggering wide discontent among applicants being denied funding (personal interviews).

“We’ve had examples where those in the queue at 5 a.m. were successful in getting through the doors when they opened at 8 a.m., but those who showed up at 8 a.m. anticipating prompt service were so far back in the line that funds were already committed by the time they got to the door. This scenario played out numerous times across Ontario during the Growing Forward program.” (Rudy, 2018, p. 133)

While EFP continued to receive support, Morisson and FitzGibbon underlined that “the original emphasis on education and capacity building for the farm community became less significant” (Morisson & FitzGibbon, 2014, p. 396), and the sense of EFP being farmer-led decreased. Public agricultural extension continued to be considerably scaled-down in Ontario, and extension largely relies today on private certified crop advisors, most of whom working for input companies. In this context, policy research in the early 2010s called for further collaboration among farmers. Prairie Research Associates (2011, p. viii) concluded:

“the EFP Program should consider further enhancing social interaction among farmers regarding their EFP implementation. This may involve establishing forums for peer discussion, mentorship, or environmental clubs. Enhanced social interactions may result in increased implementation of agri-environmental practices and raise the profile of the EFP Program, which may encourage other producers to participate”.

Despite very high farmers’ demand for cost-share grants (at least in Ontario), the relevance to continue providing federal support to on-farm environmental investment was debated again in the early 2010s. A report by AAFC (2013) concluded that:

“While considerable effort has been made over the past ten years in encouraging the development of EFPs and the adoption of BMPs, the level of continued need for government support in this area is not clear. Many of the EFP and BMP programs across Canada are longstanding, and received significant support under both APF and Growing Forward⁹¹. Some provincial evaluations noted that the level of continued need for government support for this programming in their jurisdictions was being reviewed. An assessment of the remaining gaps in this area, as well as of the relative value and effectiveness of different types of BMPs, would be useful so that future programming can be effectively targeted to identified needs” (AAFC, 2013, p. 13).

Federal and provincial supports were finally extended; and Environmental Farm Plans and BMPs continued to get funding. However, priority in cost-share programs was given to investments aiming to raise competitiveness and food safety. The **environmental budget and list of eligible BMPs were significantly reduced**, and the selection process evolved radically. Under the 2013-2018 federal funding program (Growing Forward 2), some of the most demanded BMPs are only eligible in **limited geographical areas**. **Applications are selected on merit**, using a variety of merit-based assessments, competition processes, and partnerships. This evolution is reflected by several innovative competitive pilot programs in Ontario starting in 2013 (Table 4 below). While conservation authorities have

⁹¹ Two major federal agricultural support programs.

continued to implement incentive programs along with their original principles, farmer organizations innovate, in particular since 2013, with various local or sectorial targeted programs, often limited in scope and short-lived. Those are further described and compared in the next section on comparative designs (Section 3.4).

In 2013, **Linking Environment and Agriculture Research Network (LEARN)**, the research network coordinated by the University of Alberta and funded by Agriculture and Agrifood Canada (AAFC) under Growing Forward since 2009, ceased to receive funding. LEARN had connected research efforts on agri-environmental policies, supporting original research, reports, workshops, and conferences. Both the Federal-Provincial WG-EGS and LEARN had achieved significant results, but their functions as arenas for policy capitalization and transfer had not become redundant. As policy instruments diversify, there remains a strong need to date for a **forum to share experiences and policy insight** on agri-environmental policy instruments. Interviews with program managers in different parts of the country convinced us that there would be great value in reinstalling or increasing funding for knowledge sharing and capitalization networks among PES policy designers and practitioners across the country. During our research, we received constant evidence that local experts and practitioners have accumulated a wealth of experience and lessons learned, but have limited opportunities to share those in a structured way and build on these experiences across jurisdictions and funding sources.

3.3.6 A new era in development? Towards industry-led and demand-led changes

Growing Forward 2 is coming to an end in 2018, and the next federal-provincial agricultural framework was in negotiation in 2017 as we conducted interviews. Intense

discussions were taking place in particular on instruments appropriate to reduce carbon emissions and support carbon storage, including potential carbon offsets through beneficial agricultural practices on private farmland. It was still unclear what scope will be given to environmental concerns in the future policy framework. But independently of the next federal-provincial program, evolutions were already perceptible.

Several key informants mentioned that industry initiatives and consumer demand might lead future evolutions in agri-environmental practices and agri-environmental programs. Private companies, federations, coalitions and multi-stakeholder platforms are developing sustainability assessment systems and performance standards, for example, in the beef sector. Since 2015, the **Canadian Roundtable for Sustainable Beef (CRSB)**, a multi-stakeholder platform, is developing sustainability indicators for beef production in Canada, leading to the definition of a **Verified sustainable beef framework** to assess sustainable practices of individual beef operations (Rocky View County, 2017)⁹². Internationally, this initiative fits into the broader movement of the **Global Conference on Sustainable Beef**, which brings together, since 2012, stakeholders from across the industry to share better management practices, dialogue on science and data, build consensus on key production impacts, and identify the way forward (Global Conference on Sustainable Beef, 2020). The **Verified Beef Production Plus** program⁹³, the **Ontario Livestock Sustainability Working Group**⁹⁴, and McDonalds' **Verified sustainable beef project** are other

⁹² In May 2021, Walmart Canada announced it is now sourcing beef from Canadian certified sustainable farms and ranches through the CRSB Certification process. This initiative is praised by Ducks Unlimited, a conservation non-profit, which insist on the positive message this partnership sends to Canadian farmers and ranchers (Canadian Roundtable for Sustainable Beef, 2021).

⁹³ The Verified Beef Production Plus is an industry driven on-farm food safety program for beef producers reviewed by the Canadian Food Inspection Agency (Verified Beef Production Plus, n.d.).

⁹⁴ Beef Farmers of Ontario (BFO) participates in all three above mentioned initiatives.

examples of industry-led initiatives that may impact the adoption of sustainable practices on-farm in Ontario, and shape accepted references on the concept of sustainable production (Beef Farmers of Ontario, 2015). Similar trends are observed in a larger context. Following consumer, scientific and policy demand, major industries push for changes in agri-food supply chains, with attention to dimensions like **zero-deforestation commitments**⁹⁵. Lambin & Thorkalson (2018, p. 369) consider that “New partnerships between governments, private companies, and nongovernmental organizations are reshaping global environmental governance”, in particular through voluntary sustainability standards.

Since the mid-2010s, green funding sources diversify. At the national level, Export Development Canada issued the first green bond in 2014, and Ontario became the first province to develop and sell green bonds (totalling \$2.05 billion in 2017). Whereas agriculture is an eligible sector, no funding for agricultural projects or sustainable food systems could be identified in 2017 (Stephens, 2017).

With the high price and low availability of agricultural land, funding is a key constraint for the development of sustainable food systems. Since the early 2010s, a number of small funding and technical assistance programs have emerged in the Ontario sustainable food movement to facilitate the development of ecological and local farming. Since 2011, Farms at Work accompanies farmers in East Central Ontario, supporting the installation of new farmers (access to farmland and financing), as well as diversification, training, mentorship, and networking for ‘a healthy and active farmland’. Since 2013, Just Food Ottawa supports

⁹⁵ Zero-deforestation commitments are voluntary sustainability initiatives that signal a company’s intention to eliminate deforestation from its supply chain (Lambin & Thorkalson, 2018).

new ecological farmers' installations in the Ottawa region, facilitating access to land, equipment, training, and connections with local restaurants and retailers. Since 2014, the natural food market The Big Carrot provides grants to sustainable producers through its Nature's Finest Fund program to expand the availability of locally produced food for its market. In 2018, several local food networks⁹⁶ launched the Fair Finance Fund, which provides loans and mentorship services to local food and farm enterprises adhering to sustainable food systems values and objectives. Since 2021, the Fair Finance Fund offers community bonds to investors interested in supporting local food and farm social entrepreneurs across Ontario. Actors in sustainable food systems can find information on grants and other funding opportunities on Sustainable Ontario's Website.⁹⁷ However, initiatives on sustainable food remained spread out and distant from government policies. In 2018, in the context of a large government consultation on food policy, Andrée et al. advocated for a pan-Canadian food strategy and recommended the establishment of a multi-sectoral and inter-governmental National Food Policy Council. In 2019, Canada adopted 'The Food Policy for Canada' - including a \$50 million Local Food Infrastructure Fund - and established a Canadian Food Policy Advisory Council. While organic farming remains marginal in Ontario (with only 1.9% farms and 1% farmland in 2017⁹⁸), the importance of local markets and sustainable food systems is increasingly recognized.

⁹⁶ Including Local Food and Farm Co-ops.

⁹⁷ Sustain Ontario ('The Alliance for Healthy Food and Farming') was launched in 2008 as a cooperative, integrated network with the goal of transforming food and agriculture at a system-wide level. Since 2009, Sustain Ontario has supported networking (conferences, events, platforms...), policy advocacy, and activities on the ground, in particular to connect farms to schools.

⁹⁸ Compared to 7,2% farmland in the European Union in 2017.

Farmer organizations in Ontario are involved in industry-led discussions and put forward propositions to continue playing an important role in shaping agri-environmental policies. A coalition of farmer organizations led the reflection on the future of the EFP, with the discussion on *The Potential Role of the Ontario Environmental Farm Plan in Responding to Sustainability Demands of the Agri-food Supply Chain* (George Morris Centre, 2013). One of the key analyzes in this debate is the broadening of the social concerns – in Canada and abroad for export markets - that may drive consumers demand. “In addition to environmental sustainability, there is a growing trend towards social and economic sustainability measures requested by some downstream customers. Labour, animal welfare and food safety issues are perceived as becoming increasingly important for consumers.” (George Morris Centre, 2013, p. 2). Building on those discussions, EFP may evolve to better serve requirements by the industry and open up markets opportunities to participating farmers, through **traceability** and **certification**. The Comprehensive and Economic Trade Agreement between Canada and the European Union (signed in October 2016) calls in particular for quality standards in production and traceability, including labelling and tracking of food products through the supply chain, with special rules on genetically modified organisms, largely present in Ontario.

Table 4: evolution of agri-environmental policies in Ontario in a national and international context

	1930's-1970's	1980's	1990's	2002-2008	2008-2013 and 2013 to date
International events	1935: US Soil Conservation Act 1936: US Soil Conservation and Domestic Allotment Act 1956: US Conservation Reserve Program (Soil Bank Act) 1972 & 1978: US-Canada Great Lakes Water Quality Agreement	- 1985: US Conservation Reserve Program revised - 1987: Protocol amending the GLWQA of 1978. - Late 1980's: EU opens the option of agri-environmental incentives	- 1992: Agri-environmental incentives become compulsory in national declarations of the EU Common Agricultural Policy		
Federal policies		- 1986: National Agricultural Strategy - 1987: Soil Conservation Council of Canada	- 1989: Env'tal sustainability made a pillar in reform of Can. agricultural policy - 1990-1993: National Soil Conservation Prog. - 1990: Canada Green Plan (CGP) - 1995-date: Environment Canada's EcoGifts Prog. - 1998: National Soil and Water Conservation Prog - Great Lakes Clean Up Fund	- 1997-2004: CanAdapt - 2005-2008: Agricultural Policy Framework (\$1 billion) - 2005-2010: Federal Provincial Working-Group for Ecological Goods and Services (EG&S) - 2006: National EG&S Symposium - 2008: Federal cost/benefit study, <i>Cost-Efficiency Analysis of Possible EG&S Policy Options</i>	- 2008-2013: <i>Growing Forward</i> (\$1.3 billion) - 2013-2018: <i>Growing Forward 2</i> (\$3 billion) - 2018-2023: Canadian Agricultural Partnership (\$3 billion)
Other provinces	1935: Prairie Farm Rehabilitation Administration 1940's to 1971: various programmes to limit wheat overproduction in the prairies	- 1984: First Economic and Regional Development Plans with soil components - 1986: Alberta's Landowner Habitat Prog. - 198X: Saskatchewan Prairie Pothole Proj.	- 1991-1992: Permanent Cover Crop Program (prairies, 2 payments) - Canada-provincial agreements under the CGP with each province	- 2003: First ALUS workshop (Manitoba) - 2006: First ALUS pilot (Manitoba) - 2007-2009: 6 pilot projects for Ecological Goods and Services	- 2009...: conservation auctions tests in the Prairies - 2013: Verified Beef Production Plus prog. - 2014: Canadian Roundtable for Sustainable Beef - 2014: McDonalds' Verified sustainable beef project - 2018: ALUS Canada starts to help fund ALUS P.E.I.
Canada-Ontario		- 1971 (renewed in 1976, 1982 and 1986): Canada-Ontario Agreement on Great Lakes Water Quality - 1986: Ontario-Canada Soil and Water Environmental Enhancement Program (first focused on urban sewage)	- 1989: Canada-Ontario Accord on Soil and Water Conservation and Development - 1992: Canada-Ontario Env'tal Sustainability Accord - 1992: Canada-Ontario Land Management Assistance - 1993-1997: Canada-Ontario Green Plan	- Canada-Ontario Farm Stewardship Programme (APF)	- Successive agreements in the context of Growing Forward, Growing Forward 2 and Canadian Agricultural Partnership
Programmes in Ontario	1939: Ontario Soil and Crop Improvement Association 1946-1948: first Conservation Authorities 1963: Nature Conservancy 1974: Ducks Unlimited Canada starts in Ontario	- 1984-1988: Ontario Soil Conservation & Environmental Protection Assistance Program - 1985-1989: Ontario "Tillage 2000" program - 1987-1990: Ontario Land Stewardship Program - Local Stewardship Committees (LSC) in Ontario to review project proposals (set-up by OSCIA under LSP)	- 1990-1994: Ontario-Canada LSP II (under the Canada Green Plan) - 1990: on-farm Permanent Cover Program (OSCIA) - 1991-1996: Clean Up Rural Beaches Program - 1992-1994 (1997): Rural Conservation Clubs - 1993-date: Environmental Farm Plan - 1993-date: South Nation Clean Water Prog. - 1999-date: Wellington Rural Water Quality Program	- 2005-2008: National Farm Stewardship Prog. - 2003-2009: Greencover Canada Program - Nutrient Management Farm Assistance Programme	- 2013-2014: Water Edge Transformation Prog. - 2013-2015: Grassland Habitat Farm Incentive Prog. - 2013-2017: Ontario Pay-For-Performance - 2015-2018: GLASI - 2016-2018: Grassland Stewardship Programme - 2018-date: LEADS (follows GLASI)
Regulation	1946: Ontario Conservation Authorities Act 1972: Niagara Escarpment Planning and Development Act	- 1990: Ontario Water Resources Act - 1990: Ontario Environmental Protection Act	- 1995: Ontario legislation on conservation easements	- 2002: Nutrient Management Act - 2006: Clean Water Act for source water protection - 2007: Lake Simcoe Act - 2007: Endangered Species Act	
Key groups, reports			- Early 1990's: LSC in each Ontario county/district - 1991: Ontario Farm Environmental Coalition - 1992: "Our Farm Environmental Agenda" (by OFEC) - 1992-1994: Conservation Clubs with joint activities (e.g. Upper Avon River Conservation Club)	2005-2010: Federal Provincial Working-Group on Ecosystem Goods and Services	- Ontario Livestock Sustainability WG - 2009-2013: Linking Environment and Agriculture Research Network - 2013: Report: <i>Potential Role of the Ontario EFP in Responding to Sustainability Demands of the Agri-food Supply Chain</i>
Main feature / Ontario	Institutions are set-up Studies, extension, demonstrations and study tours	First cost-share programmes led & implemented by Ontario govt Govt extension and research capacities are strengthened	Federal mobilisation on agriculture environmental sustainability Farmer-led organizations at the forefront of policy innovations and implementation in Ontario Public agricultural extension decline	Strong decline in Ontario public agricultural extension Increase in federal funding Emergence of the sustainable food movement	Industries lead the demand for change, through quality standards and traceability requirements Diversification of sustainable food funding (crowdfunding, green investors...)

3.3.7 Summary and lessons learned

The evolution of Ontario's agri-environmental policies and programs in a national and international context is summarized in Table 4 above.

Institutions set up in the 1930s to 1940s in Ontario are still central to Ontario agri-environmental programs to date, including the farmer organization OSCIA (1939) and watershed-based Conservation Authorities (1946). **Instruments** developed in the 1990s, including the EFP, beneficial management practices, conservation easements, and conservation authorities' water quality programs, remain key building blocks of agri-environmental action in Ontario to date. However, broad-based agri-environmental incentive programs developed in the 1980s and 1990s were criticized by agricultural economists for being poorly targeted and cost-inefficient. Public authorities have learned from those criticisms and are very reluctant to support non-targeted incentive programs, in particular recurring payments. This has led to the adoption of geographically or thematically targeted merit-based approaches in Ontario PES. However, some of the early features of Ontario PES, which were short-lived and not specifically evaluated, are currently being re-discussed as potentially relevant, including targeted measures on rented land, multi-year contracts, support to collective projects, and stronger peer-to-peer approaches. The decrease in public extension is also described as having reached a critical stage. On the other hand, oversubscription and rejection of many farmer proposals in the 1990s and 2000s had a lasting impact on farmers' perceptions of agri-environmental incentive programs.

Successive periods were marked by evolutions in the level of investment in agri-environmental incentive programs and leading institutions, with the provincial

government, farmer organizations, the federal government, and the provincial government again successively taking the leadership of agri-environmental policies in Ontario. Recent trends show that industry requirements and consumer preferences may be the main drivers of future evolutions, following a growing international focus on sustainability standards in the supply chains and local sustainable food systems.

Finally, while policy attention at the federal level seems to have moved away from PES design, our research shows that there remains a need to date for an active forum to share experiences and policy insight on agri-environmental policy instruments, in particular in view of the multiplication of short-lived programs and experiments.

3.4 Competition and collaboration in Ontario PES and OECD countries: comparing program designs

The historical analysis presented above helped identify major changes in agri-environmental policy design and program governance in Ontario. Debating the design of agri-environmental programs, Dupraz et al. (2007) noted that an iterative process to capitalize lessons learned would lead to the definition of an ‘optimal contract’⁹⁹ on small relevant areas, which could then be proposed to other areas. Describing and comparing current program designs in Ontario, after about 35 years of relevant experience, helps us understand if such convergence has taken place, with a particular interest in comparing

⁹⁹ The contract is optimal when it allows to produce the socially optimal level of environmental services. Identifying and reaching this level is complex in a context of environmental threshold effect and information asymmetry (Dupraz et al., 2007).

design features that foster either competition or collaboration among farmers to feed in the policy debate outlined in the Introduction (Chapter 1).

In the sections below, we examine successively collaborative and competitive features in PES design. We present the theoretical frameworks leading to recommend either competition or collaboration among farmers. Then we propose an original analytical framework to compare levels of collaborative and competitive features in program design. To develop this framework, we reviewed a range of policy options described in the policy literature, including OECD and EU documents (OECD, 2013), and programs we had knowledge of by participating in policy design and evaluation in the French Ministry of environment and OECD expert working groups. We then characterize contrasting OECD and Ontario programs on this basis. We analyze specificities in Ontario programs and attempt some elements of explanation based on semi-structured interviews with key informants and program design trajectories. Finally, based on Ontario, Canadian and international examples, we discuss whether collaborative and competitive features necessarily oppose or could be combined in PES design. We also discuss which innovations could potentially inspire future policies in Ontario.

Ten programs in other OECD countries and Canadian provinces were chosen to represent a broad range of contrasting features in developed countries, including (i) competitive options, (ii) collaborative options, and (iii) pay-for-performance programs where payments are at least partially based on project impact. Those three types of approaches have attracted a lot of research and policy attention in recent years. To illustrate competitive approaches, programs selected included a conservation tender in the Canadian Prairies run by Ducks Unlimited, and a wetland conservation easement acquisition program in a US State where

Ducks Unlimited has moved away from reverse auctions. Programs selected to represent recent collaborative options include emblematic programs run through farmer cooperatives (in the Netherlands), through farmers and conservationists' associations (Landcare associations in Germany), through groups set-up on a project basis (Groups of Common Economic and Environmental Interest in France), or through individual projects with a density bonus (project to restore hamster population in Eastern France). Agri-environmental programs selected in the Netherlands and in Germany are at least partially result-based (with payments adjusted to predicted or actual impacts). Pay-for-performance programs in North-America are illustrated by programs run by Winrock International in Wisconsin and Ohio, with differences in pre-existing collaborations among farmers. In addition, two programs in Prince Edward Island were included to represent a policy mix different from Ontario, where an investment cost-sharing program (Growing Forward 2) is combined with a recurring payment program (ALUS), and restrictive environmental regulations.

Table 5 below compares the ten programs on collaborative features, while Table 6 compares them along competitive design options.

3.4.1 Collaborative designs

Theoretical framework: rationale for collective action in PES. Giving an emphasis to institutional and political economy dimensions, Muradian et al. (2010) insisted that, rather than pure market transactions, landholders' decisions to participate in PES should be analyzed as a collective action issue, i.e. an issue that "requires the coordination of various

actors to avoid undesirable outcomes from a social point of view”¹⁰⁰. According to Ostrom (co-author in Allen et al., 2012), a number of ecosystem services are indeed commons¹⁰¹. Redefining PES as “a transfer of resources between social actors, which aims to create incentives to align individual and/or collective land use decisions with the social interest in the management of natural resources”, Muradian et al. (2010, p. 1205) insisted on the importance of intrinsic motivations, social norms and social relations in PES¹⁰². Building on this analysis, Muradian and Rival (2012) recommended partial incentives through individual or collective cost-sharing schemes, as the most efficient way to trigger sustainable impacts through PES. Other authors also underlined the importance of collective action in PES (e.g. Kuhfuss et al. 2014; Le Coent, 2014; OECD, 2013; Vanni, 2013). In developing countries, community participation in PES is seen as the main way to reduce transaction costs, and thus allow for the participation of smallholders. In OECD countries, collective action is considered both as a way to reduce transaction costs for individual farmers and as a solution to achieve a coherent environmental impact at the landscape level. Being voluntary instruments, PES often fail to trigger the necessary coherency among the commitments of individual ecosystem service providers to reach

¹⁰⁰ The authors argued that: “The services that PES deal with are often environmental public goods (both local and global). Their provision entails a collective action problem insofar as it requires the coordination of various actors to avoid undesirable outcomes from a social point of view. The main goal of PES ought to be the creation of incentives for the provision of such goods, thereby changing individual or collective behavior that otherwise would lead to excessive deterioration of ecosystems and natural resources.” (Muradian et al., 2010, p. 1205).

¹⁰¹ The literature on commons (‘Ostrom’s school’) has developed a theoretical framework identifying the conditions under which community institutions can efficiently manage commons, in particular through rules making and enforcement processes. However, little theoretical literature describes how community management reacts to collective or individual incentives (under which conditions can economic or financial incentives trigger collective management, strengthen it or undermine it?).

¹⁰² “Such transfers (monetary or non-monetary) are embedded in social relations, values and perceptions, which are decisive in conditioning PES design and outcomes” (Muradian et al., 2010, p. 1205).

local environmental targets, especially when environmental improvements rely on reaching environmental thresholds (e.g. to protect species at risk which require a minimal habitat size, or to reach water quality standards), or need to be geographically coordinated (e.g. to form green corridors).

Recent research results also show that incentives for collective action may increase cost-efficiency and participation in PES. The effect of designs fostering collective action in PES has been tested in laboratory experiments and choice experiments with farmers. In a laboratory experiment, Le Coent et al. (2014) tested a **collective action conditionality**. Authors compared the effects on participation and cost-efficiency of two types of payment rules in PES: individual payments proportional to individual environmental efforts (similar to existing agri-environmental schemes), and the same individual payments but conditioned to the attainment of a collective threshold of environmental efforts through individual projects. These two types of payments were compared with a baseline situation without PES¹⁰³. The authors hypothesized that risk aversion and beliefs about others' contributions influenced the effect of the treatments and ran tests prior to the actual experiment to elicit these two characteristics. The results showed that both types of subsidies increased the production of the public good and improved welfare. The subsidy conditional to collective participation was shown to be, on average, more efficient than the unconditional subsidy, mainly due to the fact that subsidies were not spent when the public good was not produced. However, the effects were highly variable depending on individual

¹⁰³ In all treatments, the cumulative environmental effort had to reach a certain threshold to generate benefits; benefits kept increasing after the threshold was attained, which mimics for example the case of many species at risks.

preferences and path-dependent: the successes or failures farmers had in the past influence their current opinion of agri-environmental incentive programs and willingness to apply.

In a choice experiment, Kuhfuss et al. (2014) tested a **collective action bonus** as a potential solution to foster change in local norms while not imposing joint funding for coordinated projects. Wine producers in the French region of Languedoc-Roussillon were enrolled in a choice experiment testing the effect of various levels of payments on the willingness to reduce herbicide use, with or without a collective action bonus triggered above a threshold level of enrollment among farmers willing to participate. Authors showed that a number of wine producers would be ready to accept lower payments for environmental practices if a collective action bonus was included in the payment design. This willingness to participate for a lower price can be interpreted as the perceived fairness, acceptability, or relevance of complying with a more broadly adopted practice. Proponents of collective actions explain increased participation by the impact of social norms in the agricultural sector. Actions supported by a group of peers are often perceived as more feasible (less risky), acceptable, or fair as the effort is shared among the group.

Original analytical framework of collaboration levels in PES. To facilitate broader or more coherent adoption of environmental improvements in the farming sector, some PES have been designed to foster collective action. To analyze the level of collaboration among farmers fostered by a specific program design, we developed an original analytical framework focused on two dimensions.

- First axis: program governance. The horizontal axis considers the level of involvement of farmers or farmer organizations in program governance. Building on designs

implemented in various OECD countries and Ontario, as well as on the Ladder of Citizen Participation (Arnstein, 1969), we identify five potential levels of farmers or farmer organizations involvement in PES governance, from no formal farmer participation (first level) up to farmer-led governance (fifth level) (Figure 9). Farmers or farmer organizations can be involved in decision committees set up under the program (second level of participation in governance, corresponding to either placement of partnership in Arnstein's ladder depending on actual involvement). Farmers or farmer organizations in decision committees can, for example, contribute to the definition of priority funding areas or investments, funding rates and eligibility criteria, or even review individual project proposals. Farmers can also be involved in program delivery on the ground. In Ontario, for example, several programs use farmer field representatives to help disseminate information about funding programs or even help individual farmers prepare project applications. Programs using farmer field representatives in Ontario also have farmers or farmer organizations represented in decision structures. We thus consider that using farmers in field program delivery represents a higher level of farmers' involvement in program design (third level in Figure 9). Since the 1990s, governments have delegated the implementation of agri-environmental programs in Ontario to farmer-led organizations, including OSCIA and the Ontario Farmers Association (OFA), the main farmer organization in Ontario. Programs implemented by farmer organizations represent the fourth level in our analytical framework, corresponding to Arnstein's delegated power (Figure 9). Finally, a few programs are directly defined and led by farmers, with funders and environmental experts only participating marginally in program design or sitting in decision committees as

observers with no or limited voting rights, which represents the fifth level of farmer involvement in Figure 9, close to Arnstein's 'citizen's control' in a more general setting¹⁰⁴.

Figure 9: Level of involvement of farmers or farmer organizations in program governance

The participation of citizens in agri-environmental program governance is not directly considered in our framework. However, it is an important point, as participation of citizen groups (e.g. urban community representatives, environmental NGOs, etc.) may infringe on farmers' sense of ownership. We approach this question in the discussion below.

- **Second axis: project selection and implementation.** Along the vertical axis, we compare program designs based on features fostering collective action between farmers on specific projects on the ground. Several options exist worldwide. Our analysis of program designs led us to identify five levels with a progressive incentive for on-the-ground cooperation among farmers (Figure 10).

¹⁰⁴ Arnstein's Ladder is only used in our research as a way to identify successive levels of increasing participation of farmers and farmer groups in program governance, i.e. successive levels of farmers' self-direction in public policies (or programs). A policies considered specifically target farmers, our ladder does not refer to citizen groups in a broader sense.

Figure 10: Funding conditions fostering collective action between farmers on specific projects

While a number of programs only offer individual payments (level one), others are open to funding group projects as well as individual projects (second level). Some recent designs propose individual agri-environmental contracts but increase the level of payment with the attainment of one or several predefined local participation thresholds. This type of design is often referred to as a collective action bonus or an agglomeration bonus when adoption has to be geographically concentrated or even contiguous (third level). Collective action bonus can also be conditional on projects being presented and supported by a group (fourth level). Finally, eligibility criteria can limit access to stewardship funds to formal organizations (farmer groups, cooperatives, etc.) and not directly finance individual farmers (fifth level).

Contrasting examples. Worldwide, program designs fostering collective action are gaining popularity. Territorial cooperation and community-based approaches to PES are becoming increasingly common. A 2013 OECD report on collective delivery of environmental services offers many interesting examples (OECD, 2013), and many schemes have been set up or significantly evolved since 2013. The increasing focus on ecological corridors in the European Union, particularly critical in the context of climate change, has pleaded in favour of incentive programs fostering coherent adoption across farm boundaries. The 2014 EU Rural Development Regulation introduced the option of group applications for agri-environment-climate measures funded under the EU Common Agricultural Policy framework (EU Regulation EU N°1305/2013, Article 28). While emblematic programs are based on pre-existing bottom-up cooperatives (e.g. in the Netherlands¹⁰⁵), others try to foster cooperation to reach critical environmental targets. Among the ten programs studied outside Ontario, six provide direct or indirect incentives to collective action and could potentially inform Ontario policies (Table 5). Emblematic examples are further developed below. The same analytical framework is used to characterize Ontario agri-environmental PES (Appendix 4).

¹⁰⁵ “Part of farmers’ willingness to pool a proportion of their agri-environment payments through the cooperatives comes from the strong and historic role that the cooperative approach has in Dutch farming.” (European Network for Rural Development, n.d., p. 2).

**Table 5: Characterizing collective features in PES design in a two-dimension analytical framework,
based on ten contrasting examples**

Program	Country; Region/ Province	Dates	Main program administrator	Context	Farmers' participation in prog. governance	Collective action incentive	Trajectory
Agri-environmental cooperatives	Netherlands; National	1992 to date	EU, national & regional gov., Agri-environmental cooperatives	Dependent on farmers capacity to collaborate, or pre-existing cooperative arrangements	FO-led implementation	Only group projects with formal structures are eligible	Generalized at national level; source of inspiration in Europe
Landcare associations in Germany	Germany National	Late 1980s to date	EU, national & regional gov., landscape associations	Dependent on the capacity of farmers, conservationists and local authorities to collaborate	FO in decision committee	Group projects with formal structures are eligible, collective action incentive	Developed in several lands; dominant in Bavaria
Groups of common economic and environmental interest	France; National	2014 to date	Government	Build on a tradition to collaborate, and test innovation among an informal network of farmers with farmer organization's support	No formal farmers participation	Group projects with formal structures are eligible, collective action incentive	Established at national level based on promising cases
Agri-environmental measures to restore hamster population	France; Alsace	2013 to date	National & regional governments, chamber of agriculture	Very specific area with high environmental stakes and explicit environmental aggregation impacts	Farmer field representatives	Collective action incentive, individual (coordinated) projects	Refined and continued across several funding cycles
Pay-for-performance Ohio	United States; Ohio	2011- ? Or 2016-2019	Winrock international	Difficulty associated with the lack of pre-existing collaboration	No formal farmer participation / FFR?	Collective action incentive, individual projects	
Pay-for-performance Wisconsin	United States; Wisconsin	2013-2017	Winrock international	Facilitated by a vivid pre-existing organizational structure	FO in decision committee	No group project, no direct financial incentive (indirect incentive)	
Growing Forward 2, Prince Edward Island	Canada, Prince Edward Island	2013-2018	Provincial government	The limited size of the program brings flexibility to respond to unique priority demands	No formal farmers participation	Group project possible; no collective incentive	Growing interest by farmers informal networks to develop joint projects
ALUS, Prince Edward Island	Canada, Prince Edward Island	2008 to date	Provincial government	ALUS payments only reward efforts additional to strong regulatory requirements	FO in decision committee	No group project, no collective incentive	Long-lasting province-wide program Differs from other ALUS programs
Experimental conservation auctions	Canada, Prairies	Saskatchewan 2009; Alberta 2016	Ducks Unlimited	Research – practitioners partnerships	No formal farmers participation	No group project, no collective incentive	Not continued but useful to set an initial price
Adaptive pricing for wetland conservation easement acquisition	United States, Dakotas	Early 1990s	US Wildlife services	Multi-year program, high local priority	No formal farmers participation	No group project, no collective incentive	Solution developed to reduce transaction costs, and strategic behaviours

Agri-environmental cooperatives in the Netherlands (Ministry of Economic Affairs of the Netherlands, 2016¹⁰⁶). The first agri-environmental (AE) cooperative in the Netherlands was established in 1992 as a self-helped group with voluntary membership (Vanni, 2013). The Dutch government promoted a cooperative approach to agri-environmental schemes since the early 2000s, with an initial focus on grassland bird protection, which significantly benefited from a coordinated habitat approach. Following the new EU regulation and building on a 20-year tradition of bottom-up environmental cooperatives, the Netherlands opted for mainstreaming a cooperative approach to agri-environmental payments. While AE cooperatives only covered about half of the national territory in 2013, new cooperatives were established in 2014 and 2015 to cover the entire countryside, with about 160 cooperatives. As of 2016, individual applications are no longer eligible for EU CAP funding. This corresponds to the most collective approach in the vertical axis of our analytical framework: ‘only group projects with formal structures are eligible’. This reform is supported by both farmers and government. The government expects that a cooperative approach will deliver better value for money, while farmers wish to ensure continued access to agri-environment budgets that would – in case of poor cost-efficiency – be an easy target for budget cuts. The program sets environmental targets with six-year result-based obligations and gives cooperatives a lot of flexibility in fine-tuning local activities and payment levels, based on a broad menu of potential conservation activities. Cooperatives directly contract with individual members (Figure 11). This allows for a coordinated landscape approach with coherent conservation measures adopted at the

¹⁰⁶ Unless cited otherwise, most information in this paragraph was informed by Ministry of Economic Affairs of the Netherlands (2016).

habitat level. In the former system, paperwork had been identified as a barrier to the participation of individual farmers, in particular small farmers. The cooperative model has increased uptake (OECD, 2013). Making cooperatives responsible reduces farmers' transaction costs, as well as government's transaction costs, with only 40 applications to process rather than 13,500. The new approach is also expected to improve compliance, as cooperatives being closer to the ground have a better monitoring capacity. Vanni (2013) also highlighted that AE cooperatives had played a positive role in trust-building and agri-environmental innovation. Finally, some cooperatives involve not only farmers but also citizens and play a role in rural development, including tourism and farm education (OECD, 2013).

Figure 11: Netherlands agri-environmental cooperative scheme
Source: Ministry of Economic Affairs of the Netherlands, 2016

The "front door – back door system" of the Dutch agri-environment scheme with a key role for agri-environment cooperatives as final beneficiaries

Landcare associations in Germany (Bahner, 2010; Bluemlein, 2012; Moore, 2019).

Landcare associations (LCA) were first founded in Germany in the 1980s as local non-profit associations of both farmers and non-farmers. Farmers, conservationists and local authorities join forces to organize the management of ecologically sensitive areas

depending on extensive farming, like wet meadows, poor-soil pastures, hedgerows, and old fruit varieties orchards. LCA contribute to bridging urban-rural and farmers-conservationists divides. LCA provide technical expertise to their members, and apply for agri-environmental funding on their behalf. Participating farmers get a bonus collective action payment in EU CAP funding schemes (level four in our framework: ‘group projects are eligible with a collective action bonus’). LCA adapt projects to specific landscape types, providing scientific and financial expertise. They supervise project implementation by farmers and monitor outcomes. There are above 180 LCA in Germany, federated under the umbrella organization Landcare Germany. LCA mobilize 10,000 farmers (1.6% of German farmers), 2,000 local authorities and 1,200 NGOs, with a turnover of 20 million euros a year of projects on the ground. A multi-disciplinary advisory panel of experts is attached to each LCA (Bluemlein, 2012). 80% of the Bavarian landscape is managed by LCA, which coordinate the implementation of two-thirds of the state-supported conservation measures (Moore, 2019). Since 2011, Landcare Germany has developed an ‘ecopoint system’ to tailor incentive levels to individual farm management measures based on expected environmental benefits, payment is thus based on specific environmental merit anticipated¹⁰⁷. Landcare Germany recommends this system to be used to design eco-schemes in Germany under the post-2020 EU CAP. LCA also help farmers market their products as environmentally friendly ‘nature-conservation-products’ (e.g. ‘species-rich-hay’, ‘route of the ancient fruits’, etc.), and organize marketing communication campaigns.

¹⁰⁷ See, for example Deutscher Verband für Landschaftspflege (2019).

Groups of common economic and environmental interest in France. In France, the importance of collective action in PES has been locally recognized and sometimes built as a conditionality for funding eligibility since the early 2000s (Latouche et al., 2005)¹⁰⁸. An agricultural law adopted in 2014 created a new cooperative status (*Groupements d'intérêt économique et écologique*, GIEE) to facilitate collective agri-environmental projects. In 2021, about 12,000 farms participate in above 750 GIEE (3% of French farms). To be recognized as a GIEE, groups should submit a multi-year agro-ecological project through an administrative approval process. Eligible groups should include several farmers, with lands located in an environmentally coherent area. Groups can also include non-farming members involved in the proposed project (e.g. farm advisors, researchers, local governments, private companies in the value chain, environmental NGOs, etc.). The status of GIEE is attributed for the duration of the project, which should aim at performing economically, socially and environmentally, and develop synergies among farmers. Projects can protect existing practices or introduce new ones. If the project is approved, farmers can benefit from agri-environmental extension funding, and a premium on existing incentive schemes (Ministère de l'agriculture et de l'agroalimentaire, n.d.). This example also corresponds to level four in our framework ('group projects are eligible with a collective action bonus'), but contrary to German LCA, GIEE are project-based groups rather than permanent associations. Most early GIEE projects are exploratory and technically innovative. Besides reducing transaction costs, the GIEE approach allows for

¹⁰⁸ "In the Ille-et-Vilaine Province, France, the local administration has promoted the use of grass strips along river banks to improve water quality. A first experience of individual AES-like contracts had led to a very scattered and ineffective adoption of this practice. Public authorities therefore imposed a minimum enrollment threshold of 60% of the targeted streams' riverbanks to initiate payments to farmers." (Le Coent et al., 2014, citing Latouche et al., 2005).

projects to be customized locally and evaluated on a case-by-case basis. Since 2016, specific farmer groups can also be supported in France to collectively adopt more ambitious measures to reduce pesticide use (*'Groupes Ecophyto 30 000'*).

Restoring a viable Hamster population in Eastern France through collective action incentives (*Chambre d'Agriculture de la Région Alsace and Office National de la Chasse et de la Faune Sauvage*, 2015). Since 2009, incentives have fostered the cultivation of crops favourable to Hamsters (*Cricetus cricetus*), a protected species in Eastern France. But individual contracts with farmers did not succeed in increasing Hamster populations, as favourable crops remained too scattered to provide a viable habitat. In 2011, France was condemned by the EU Court of Justice for the likely disappearance of this protected species. Stakeholders representing local governments, national environmental services, and the regional chamber of agriculture¹⁰⁹ agreed on an innovative approach fostering collective action among farmers. Under the new scheme, the chamber of agriculture provides technical and organizational support to farmers in areas critical for Hamster survival. The chamber helps voluntary groups of farmers to coordinate crop rotations, and ensure broad cultivation of crops favourable to Hamsters in critical target areas. In those areas, incentive levels vary with the density of adoption of favourable crops, from 435 euros per ha in 2015 for a density of 24% of favourable crops (minimum) to 520 euros for 40% of favourable crops. These density thresholds provide both conditionality and a bonus to collective action, as payment is conditional to a minimum density and increases with higher density levels. While farmers continue to receive incentives individually,

¹⁰⁹ Industry association delivering services to farmer groups and networks, including extension.

coordination by the chamber of agriculture ensures that threshold levels of favourable crops are reached, and each farmer can benefit from a collective action bonus. The chamber also helps farmers with the administrative process. This model corresponds to the third level in our framework ('collective action bonus for individual projects'), with the nuance that there is active coordination among farmers.

Pay-for-performance conservation programs in Ohio and Wisconsin. Since 2006, pay-for-performance programs have been developed in the United States (Wisconsin, Michigan, Ohio, Iowa, and Vermont) with support from Winrock International to increase the cost-efficiency of funding given out to support the reduction of phosphorus run-offs in the Great Lakes area. Programs are designed with a two-fold payment. Voluntary farmers can choose among a list of locally relevant nutrient run-off reduction measures. Based on farm characteristics and chosen measures, phosphorus models help estimate phosphorus reductions. A first payment is calibrated on this estimated impact. A second payment relies on actual performance and is only triggered by reductions observed in phosphorus levels downstream of the program. While estimated benefits can be assessed on an individual basis, actual impacts can only be cost-efficiently observed at the level of a small watershed or part of a watershed. To obtain a performance-based bonus payment, farmers in the same watershed should collaborate to reach a phosphorus reduction threshold that can be observed with a reasonable level of confidence. In Wisconsin, pre-existing cooperation in the farming sector allowed for coordinated participation in the program. In Ohio, where no such organized social structure pre-existed the program, collective financial incentive

bonuses have been added to the program to foster collective action (which corresponds to the ‘collective action bonus for individual projects’ level in our framework).

The experiences presented above share some similarities. Collective action does not only rely on farmers spontaneously joining forces. Local intermediary organizations, either pre-existing or forming around a dedicated agri-environmental project, play a key role in program implementation. They help increase cost-efficiency by adapting standard practices and sometimes payment levels to landscape characteristics and place-based potential for environmental benefits; while reducing transaction costs for individual farmers and funding agencies. Those organizations often provide technical and administrative support to farmers or help them access such support. The important role of intermediary organizations was also highlighted in some of the most famous private PES (e.g. Perrot-Maitre, 2006, on the Vittel case). While intermediary organizations are not costless, and financing them could even take a significant part of the PES resources, their cost should be balanced with multiple benefits in engagement, targeting, tailored design, extension, monitoring, reporting...

Intermediary organizations differ in their origin. Some organizations form, in a bottom-up approach, around a dedicated project. Others are or derive from pre-existing farmer organizations. In some cases, pre-existing informal collaborative groups are formalized to access funding. This was, for example, the case of early GIEEs in France. A number of studies highlight the importance of pre-existing collaborations among farmers and trust, as key facilitating factors for a collaborative approach. A strong pre-existing cooperative tradition is, for example, an important element of success in the Netherlands’ experience.

Intermediary organizations also differ in their composition. Some, like LCA in Germany, bridge the gap between farmers and conservationists. Others only gather farmers.

The two-dimensional analytical framework on collective action, presented above, is used to characterize the 10 PES outside Ontario and 22 Ontario PES (Figure 12 and Appendix 4). Figure 12 shows the dispersion of programs in Ontario and beyond along the two proposed axes, focusing respectively on Program Governance and Project Funding Conditions. Results 1 and 2 below build on Figure 12.

Result 1: In Ontario, farmers and farmer organizations participate explicitly in program governance - and often in program implementation - across models. Farmers and farmer organizations play a key role in the governance of most agri-environmental schemes identified in Ontario (Figure 12). With few exceptions, either farmer organizations participate in decision committees, farmers are responsible for all or part of the outreach, farmer organizations implement funding schemes (OSCIA, OFA), or programs are led by farmers (ALUS). As outlined in the historical analysis, farmer organizations' participation in PES has been an important characteristic of Ontario PES from their inception. Farmers can engage in PES governance and implementation either as members in steering committees (ALUS, conservation authorities' water quality schemes...) or as part of the program implementation staff responsible for program outreach or management. Many emblematic Ontario programs rely on local farmer champions. Champions often participate on a voluntary basis. They share their experience in newsletters, program pamphlets, study tours, or conferences. Program promotion and peer-to-peer training tend to repeatedly mobilize a few emblematic farmers and may surpass their capacity to spare time from productive activities.

Figure 12: Collective action in agri-environmental incentives in a two-dimension framework

Netherlands	Agri-environmental cooperatives in the Netherlands
Germany LCA	Landcare associations in Germany
GIEE France	Groups of common economic and environmental interest
Alsace	Agri-environmental measures to restore hamster population
PFP Ohio / Wisconsin / ON	Pay-for-performance Ohio / Wisconsin / Ontario
PFP Wisconsin	Pay-for-performance Wisconsin
GF2 PEI	Growing Forward 2, Prince Edward Island
ALUS PEI / ALUS ON	ALUS, Prince Edward Island / ALUS Eastern Ontario
Auctions Prairies	Experimental conservation auctions in the Canadian Prairies
US Adaptive pricing	Adaptive pricing for wetland acquisition in the US
RCCP	Rural Conservation Club Program
GF1 // GF2	Growing Forward 1 / Growing Forward 2
WET	Water's Edge Transformation Project
GHFIP	Grassland Habitat Farm Incentive Program
GLASI	Great Lakes Agricultural Stewardship Initiative
SN CWP	South Nation Clean Water Program
Ottawa	Ottawa Rural Clean Water Program
GR WR	Grand-River, Wellington Rural Water Quality Project
Peel	Peel Rural Water Quality Project
Credit Valley Rural Land.	Credit Valley CA Clean Water Fund for rural landowners
Huron	Huron County Clean Water Project
DU LWRP	Ducks Unlimited Canada - Landowners' Wetland Restoration Program
SARFIP	Ontario Species at Risk Farm Incentive Program
Essex	Essex Region Clean Water Green Spaces
Lake Simcoe	Lake Simcoe/ Southeastern Georgian Bay Clean-up Fund
LEAP	Ontario Landowner Environmental Assistance Program (Lake Simcoe)
NVCA	Nottawasaga Valley Conservation Authority – Healthy Waters Program
UTRCA	Upper Thames River CA

In this context, creating part-time positions associated with farmer-to-farmer outreach appears a promising solution. Programs such as the South-Nation-Conservation water quality program and ALUS already compensate farmers for outreach activities and farmer-to-farmer support. The EFP is also implemented by OSCIA through local farmer representatives. Other programs consider compensating farmer champions for their time.

Result 2: While features fostering collaborative or coordinated projects on the ground gain popularity in Europe and the US, such designs are not present in Ontario. With a unique exception in the 1990s, group projects are not eligible for agri-environmental funding in Ontario, and no specific design has been developed to foster a dense adoption in priority areas through aggregation or collective action bonus (Figure 12)¹¹⁰. Participants in the Rural Conservation Club Program (RCCP) in the 1990s mentioned, in interviews, that it was too short-lived to really give a chance to collective action. A farmer interviewed blames the short-lived application window for not giving the opportunity for more solid, innovative projects based on lessons learned to emerge, rather than the lack of farmer interest. With only a two-year window to apply, participants did not have the time to see the first projects through, get used to the application process, and build on lessons learned in successive applications. Similar comments were made by interviewees on other programs with applications only open for one or two successive years.

A number of non-agricultural Ontario stewardship programs target local conservation groups or aboriginal communities. Some farmer groups have benefited from community

¹¹⁰ Some programs concentrate funding on limited priority sub-watersheds, such as GLASI PSP.

funding through private grants (e.g. from the Trillium Foundation) or community grants from the Ontario Ministry of Environment, sometimes with a conservation authority helping with project design and application process. However, such cases remain exceptions and rely on individual goodwill rather than purposeful design. They remain sparsely distributed in Ontario and concentrated on a few emblematic longstanding groups. Informal farmer networks also gather, in particular through local soil and crop associations or shared interest in ecological practices, to test similar farming practices or share experiences, but these initiatives are not associated with coordinated project design or collective funding.

The literature shows that cooperative approaches are very promising for biodiversity conservation and water quality (OECD, 2012; Sieberg, 2006). Sieberg (2006, p. 334) cites Canada as an early example of cooperative approaches in agri-environmental biodiversity conservation policies. However, as demonstrated in Figure 12 above, very strong farmer cooperation in program governance contrasts in Ontario with very limited cooperation among farmers on specific agri-environmental projects on their farms.

Some of the designs presented above, in particular in France and the Netherlands, build on a strong historical experience of cooperative organization in the farming sector; such experience does not exist in Ontario. The Ontario Local Food and Farm Co-ops network (LFFC), founded in 2009, supports a cooperative movement, but its members mainly gather alternative farmers, with alternative marketing models (e.g. organic and local), rather than mainstream farmers. Equipment cooperatives were mentioned by an interviewee as instrumental in first introducing no-till equipment, but short-lived in Ontario, where

custom farming¹¹¹ seems to be the preferred solution for farmers who do not have the capacity or required acreage to purchase and profitably use specialized equipment. Out of the 1790 cooperatives listed in Ontario, only 22 are farming and supply cooperatives (computed from Ontario, 2021).

3.4.2 Competitive designs

Theoretical framework. A number of environmental scientists, environmental and political economists - scholars or practitioners - have championed the utilization of market-based approaches to conservation since the late 1990s (Andersson & Leal, 2001; Bishop & Landell-Mills, 2002; Daily, 1997; Heal et al., 2001; Nicholls, 2004; Pagiola et al., 2002; Wunder, 2005). Most economic research on PES is developed in a Coasean theoretical framework. Coase proposed, in the late 1950s, that if trade in an externality is possible and there are sufficiently low transaction costs, bargaining - between actors causing the externality and those affected by it - will lead to a Pareto efficient outcome¹¹² regardless of the initial allocation of property rights. Based on this theoretical framework, economic research on PES has focused on three shortcomings limiting PES cost-efficiency: incomplete property rights, asymmetric information, and transaction costs. The research literature developed on this basis recommends using competitive designs, such as reverse auctions (conservation tenders), to maximize PES cost-efficiency in a context of asymmetric information on the opportunity costs of alternative land-uses between ES

¹¹¹ A custom operator performs specialized machine operations on the landholder's land in exchange for a set fee or rate.

¹¹² A Pareto efficient outcome is a situation where no individual can be better off without making at least one individual worse off.

providers and ES buyers (Ferraro, 2008). Ideally, the agency purchasing environmental services would want to pay landowners their exact minimum willingness to accept to provide that service (Vickery, 1961). Competitive designs intend to minimize windfall effects associated with PES: ES service providers, competing against each other, have an incentive to make an offer close to their actual cost of adopting environmentally beneficial practices (including opportunity costs) - or willingness to accept - rather than take advantage of funding made broadly available in a context where ES buyers have limited information on their actual cost (Whitten et al., 2013). Conservation tenders, based on a reverse auction principle, have been the mode of project selection in mainstream PES since the late 1980s or early 1990s in the United States (Hellerstein, 2017¹¹³; Veeman et al., 1989) and since 2001 with Bush Tender in Australia. In the early 2000s, auctions were used at a large scale in the US Conservation Reserve Program and Environmental Quality Incentive program¹¹⁴. More than 100 conservation tenders have been implemented to date in Australia (Rolfe et al., 2017).

In Canada, potential reverse auction programs for conservation were already discussed in the late 1980s during the preparation of the National Soil Conservation Program (Veeman et al., 1989). The cost-efficiency of broad cost-share stewardship programs with uniform payments was questioned in Canada in the late 1990s (Stonehouse, 2000; Weersink, 1998). A cost-efficiency analysis undertaken by ÉcoRessources Consultants (ÉcoRessources Consultants, 2008) for the Federal-Provincial Working Group on Ecological Goods and

¹¹³ While Hellerstein date the introduction of auction in mainstream programs to 1990 (Hellerstein, 2017), Veeman et al. (1989), already mentioned competitive bidding being used in the US CRP in 1987.

¹¹⁴ With a respective budget in 2004 of US\$ 1.9 billion and 0.9 billion (Johansson, 2006).

Services (WG-EGS) found that water quality and habitat improvements worth about \$3.3 billion could be created at a national scale with a total public expenditure estimated at \$2.8 billion if delivered through an **annual payment** policy; \$1.5 billion if delivered through a **one-time payment** policy; \$1.2 billion for an **optimal mix of one-time and annual payments**; and \$1 billion if delivered through an **auction**-based policy tool. The study extrapolated from two representative watersheds in Québec and Manitoba to quantify the costs to producers of BMPs designed to achieve phosphorus reduction and habitat enhancement targets, proposed a payment schedule to offset these costs, and estimated public administrative costs for each option tested. Benefits of BMPs adoption were assessed through a benefit transfer methodology, considering improved recreation, drinking water, flood protection, aesthetics and other public benefits. The analysis found that a **tradable permit** policy for water quality would even be more efficient but could not be used for habitat improvement. While this study was referred to us during interviews to discard annual payments - as performing poorly with regards to auctions - the original source had more balanced conclusions, with an optimal combination of one-time and annual payments performing – in theory – almost as cost-efficiently as the auction-based model. The superiority of conservation auctions in terms of cost-efficiency remains controversial. Cost-efficiency is design and context-dependent. In a case study in Steinburg county in Germany, Groth (2011) estimated, for example, cost-efficiency gains of payment-by-results conservation procurement auctions - compared to current fixed flat-rate payment schemes - of up to 50%, with a relatively high number of participants¹¹⁵.

¹¹⁵ Comparisons were established for conservation schemes for grassland plant biodiversity, where actual results are relatively easy to assess, including on an individual basis.

BushTender in Australia was analyzed to be seven times more cost-effective than comparable fixed price schemes (Latacz-Lohmann & Schilizzi, 2005; Stoneham et al., 2003). On the other hand, Schilizzi evaluated, in controlled laboratory experiments in Australia and Germany, that auctions outperformed fixed-price programs only in a one-shot setting, with target-constraint auctions quickly losing cost-efficiency, while the budget-constraint auction was more robust to repetition. On the ground, insufficient participation in conservation auctions can result in a lack of competitive behaviour (Whitten et al., 2013), participants can bid on factors other than their own costs (Latacz-Lohmann & Schilizzi, 2005; Rolfe et al., 2009), or bidders learn to manipulate the auction (Latacz-Lohmann & Schilizzi, 2005; Riechelderfer & Boggess, 1988). In particular, bidder collusion can be an issue in multi-round auctions (Cummings et al., 2004; Hartwell & Aylward, 2007). In addition, uncertainty may cause some landowners not to participate (Comerford, 2013 & 2014), or to bid above their true willingness to accept.

Research and experimentation on conservation auctions in Canada. Competitive systems have been researched and tested in Saskatchewan, Manitoba, Ontario, and Alberta (Boxal et al., 2013; Brown et al., 2011; Hill et al., 2011; Novak, 2017; OSCIA, 2014a; Packman & Boxall, 2010; Packman et al., 2013; Wilson & Boxall, 2013). Research in experimental economics conducted in Manitoba (Boxall et al., 2013) tested several options to support the adoption of a BMP aiming at reducing phosphorus run-offs from cattle farms, based on reverse auctions. Three **bid-selection methods** and two **pricing rules** were tested through **laboratory experiments** mimicking twelve local farms. Each experiment included fifteen **rounds** of auctions. Offers were either ranked to maximize environmental impact under a specific budget, to maximize cattle coverage, or to maximize the number of

participant farmers. Two pricing rules were tested: farmers whose offers had been selected either received the price they asked for (**discriminative-pricing**) or a uniform amount based on the first rejected offer (**uniform-pricing**). These two options are known to trigger different rent-seeking behaviours. Analyzing the impact of these behaviours was part of the experiment. The uniform-price rule appeared to be superior (i.e. to lead to a more cost-efficient result) than the discriminative-pricing rule for all three selection methods¹¹⁶. The bid selection based on cattle coverage appeared to be almost as efficient as the selection based on environmental impact (i.e. cost per kg of phosphorus run-off avoided). On the contrary, the bid-selection method aiming at maximizing the number of participant farmers appeared to be largely less efficient than the other two. In conclusion, Boxall et al. discussed the relevance of PES impact evaluations in Canada, largely based on the number of participating farmers. Wilson and Boxall (2013) also studied the incorporation of variable costs of adoption into conservation auctions and concluded that risk-averse individuals bid closer to their costs.

In the Prairies, conservation auctions were **piloted on the ground** since 2002 by Ducks Unlimited Canada (DUC) in close cooperation with the research community (Universities of Alberta and Manitoba) to optimize designs (Boxall et al., 2013; Brown et al., 2011; Hill et al., 2011; Novak, 2017). In 2002, DUC conducted a single round, uniform price auction with a hidden reserve price, aimed at discovering landowners' willingness to accept compensation for placing **conservation easements** on their lands (to protect native grasslands and wetlands), in four sites of the Canadian prairies. About 1% of landowners

¹¹⁶ There is no general finding across studies on this aspect.

in eligible sites participated. Reverse auctions were expensive, but information from the auction was successful in guiding a long-term easement procurement program (Brown et al., 2011). Other conservation auctions, led by DUC, focused on wetland restoration in Assiniboine River Watershed (Saskatchewan, 2008-2009)¹¹⁷ and Wintering Hills in Wheatland County (Alberta, 2015). The Assiniboine River Watershed auction was a two-round, discriminatory price auction for 12-year wetland restoration contracts (Hill et al., 2011). The Wheatland County auction was a uniform price, single-round auction with a hidden reserve price, for 10-year contracts¹¹⁸. “Uniform pricing was selected for two reasons; first because landowners perceived it to be more fair, and second to establish an accurate per acre price for securement of drained basins for wetland restoration activities.” (Novak, 2017, p. 31). Reverse auctions were found to be time consuming and potentially expensive. In Wheatland County, the auction secured land at a price comparable to average value of agricultural land, and researchers noted the presence of rent seeking behaviour (Novak, 2017). In the Assiniboine River Watershed, securement cost per acre reached almost 1.7-time average land value. Novak noted that while land could have been purchased for an equivalent (or lower) price, auctions were still useful, as:

“Using reverse auctions means that conservation agencies can do restoration work on land that’s not for sale, which could potentially allow for more restoration to take place. Additionally, even if auctions pay out the price of land, they only pay for land where conservation takes place as opposed to paying for the entire parcel of land.” (Novak, 2017, p. 43)

¹¹⁷ This auction is detailed in Appendix 3, Box 9.

¹¹⁸ Half of the payment up front and the other half in annual payments, with interest, over the term of the lease.

However, wetland restoration was only secured for a limited period (10 or 12 years), while purchasing the land could have secured it permanently. The **Revolving Land Conservation Program**, developed in the early 2010s¹¹⁹ and offered by DUC in Alberta, Saskatchewan, Manitoba and Ontario, responds to this concern. Through this program, DUC purchases land, restores its wetlands and grasslands, and then sells it back to farmers with a permanent conservation easement on the title, thus ensuring wetlands and grasslands preservation permanently. Financial institutions have opened a line of credit to allow for the original acquisition of the land. Donors fund the interest rate and decreased land value corresponding to the easement. DUC has observed that acceptability increased in the farming community with regards to former permanent acquisition programs, as land is not permanently acquired by DUC but returns ultimately to farmers' ownership. The integration of this program in local markets has increased over the year. Partnerships have developed with local real estate agents identifying suitable lands and involved in reselling them. DUC has also narrowed its targeting to only restore grasslands when a local cattle raising activity guarantees a market for grasslands. Online debates among Ontario farmers on the purchase of lands with conservation easements on them show caution and interest (Anonymous, 2017¹²⁰).

In Ontario, conservation auctions have been tested by OSCIA, with several environmental objectives. The first conservation tender in Ontario, the **Water's Edge Transformation Program** (WET), a stewardship program for agricultural riparian systems in Lake Simcoe,

¹¹⁹ Following a model developed by Ducks Unlimited in the Dakotas in the late 1990s.

¹²⁰ See details and link in the bibliography.

Severn Sound and Nottawasaga Watersheds, was implemented by OSCIA in 2014 with OMAF funding, and technical support from local conservation authorities. WET aimed to reduce nutrient risks to freshwater resources through various on-farm BMPs¹²¹. Three stewardship groups, including conservation authorities¹²², mobilized technical specialists to visit the farm properties and provide ideas and recommendations for improved performance of the riparian area through BMP adoption. Farmers were then responsible for preparing project files and competitive bids through an online process. They could include multiple BMPs in a single application. To be eligible, properties needed to be actively farmed, located alongside a watercourse and having completed a recent EFP (OSCIA, 2014c). Bids were selected based on their environmental score, estimating a project's contribution to water quality improvement (Environmental Benefit Index) and funding requested (Box 1). The environmental score aggregated three criteria: the sub-watershed sensitivity, a riparian assessment score, and on-farm improvements. Bonus points could be added for enhanced features. Sub-watershed sensitivity, riparian score and bonus points were assessed by the local watershed specialist who visited the farm and provided advice. Bids were, in principle, selected to maximize environmental impact: bids with the highest environmental score per dollar were ranked first (bid-selection method). Successful applicants received the actual cost-share requested (discriminatory payment). In practice, the program was undersubscribed (see Result 4 below). In 2014, 20 applicants were allocated funding representing a total of 30 projects (OSCIA, 2014d). There was a

¹²¹ Eligible BMPs included installing eaves troughs on barns to divert clean water away from livestock areas, fencing off watercourses to prevent livestock access, planting trees and shrubs to form a riparian buffer...

¹²² Lake Simcoe Region CA, Nottawasaga Valley CA, and Severn Sound Environmental Association.

single round of auction, with an implicit, hidden reserve price, as ‘unreasonably high’ bids were rejected.

Box 1: Water’s Edge Transformation Program Scoring explained to applicants

The Grassland Habitat Farm Incentive Program (GHFIP; 2013-2015), funded by the Habitat Stewardship Program of Environment Canada and implemented by OSCIA, offered funding to farm projects that strengthen farming operations while supporting grassland birds. Under GHFIP, farmers could decide how to best combine several BMPs. GHFIP relied on a **competitive bid system and an Environmental Benefit Index** to select among proposed projects. Bids were ranked according to their environmental merit per government dollar requested. Successful applicants received prices they asked for (discriminatory prices). The program was open over two successive years. While a limited number of applications were received in the first round, the second round was more encouraging, with some level of rivalry among eligible applications. Design and development work was much heavier than with traditional first-come-first-served

programs. However, according to program administrators, the application review process was much easier. In addition, contrary to other programs administered by OSCIA, participants in GHFIP did not have to provide proof of payment. This led to saving cost in delivery, as producers often have to go back and forth with OSCIA to justify project implementation on the ground through bills, photos and sometimes site visits. Regarding cost-efficiency, “*the jury is still out*” (personal interview with a program administrator), as cost-share applicants requested were not necessarily lower than in anterior fixed cost-share programs. While GHFIP was thereafter interrupted, OSCIA built on lessons learned to develop a subsequent conservation tender for Ontario grassland habitats: The Grassland Stewardship Program (2016-2018), with more explicit bidding recommendations (Box 2). Proofs of payment (invoices) were made mandatory again, as some former projects appeared to be largely overestimated, leading to very large actual cost-shares.

Original analytical framework of competition levels in PES. To analyze how competitive principles are built in a program design, we consider two dimensions: (1) the selection process; and (2) the principle used to calculate payments. A competitive process can either select the most cost-efficient projects only or select a broader range of projects but reward higher environmental benefits with a higher grant or cost-share. We used a broad diversity of programs in OECD countries to define potential levels along these two dimensions. Programs move towards the right in the horizontal axis (Figure 13) when their selection is based on a growing number of criteria. On the left of the axis, all eligible projects are funded. As we move towards the right, more criteria assess the value of the project. In a first-come-first-served approach, evaluation is only based on the timing of the

application¹²³. A merit-based approach selects projects on their expected environmental performance. Conservation tenders select projects both on environmental merit and price.

Figure 13: Process of project selection for funding, by increasing level of project-based competition

Programs move up in the vertical axis (Figure 14) as their funding level becomes more project-specific.

Figure 14: Payment calculation method, by increasing level of project-based payment

¹²³ Timing could be considered a weak signal of motivation to access funding and implement an environmental project.

Examining OECD programs led us to define six possible options on our vertical axis: uniform payment (i.e. for a certain type of environmental practice, all selected projects receive the same level of funding¹²⁴); geographic bonus (projects in priority areas receive a higher payment); innovation bonus (innovative projects receive higher funding); collective action bonus (or aggregation bonus, triggered by a certain level of project density or connectivity in a target area); project-specific environmental merit (payment increase with expected environmental benefit); and conservation tender (payment is based on the applicant's bid or a reference bid, depending on the type of auction mechanism).

The classification of our ten reference programs outside Ontario is presented in Table 6.

Table 6: Characterizing competitive features in PES design based on ten contrasting examples

Program	Country Region/Province	Competitive selection	Competitive pricing
Agri-environmental cooperatives	Netherlands; National	Merit-based (result-based)	Specific environmental merit (result-based)
Landcare associations in Germany	Germany National	Merit-based ("public goods bonus")	Specific environmental merit (funding sources have different modalities)
Groups of common economic and environmental interest	France; National	Merit-based	Uniform payment / Collective action bonus
Agri-environmental measures to restore hamster population	France; Alsace	All eligible projects	Collective action bonus
Pay-for-performance Ohio	United States; Ohio	All eligible projects	Specific environmental merit & Collective action bonus
Pay-for-performance Wisconsin	United States; Wisconsin	All eligible projects	Specific environmental merit
Growing Forward 2, Prince Edward Island	Canada, Prince Edward Island	All eligible projects	Uniform payment
ALUS, Prince Edward Island	Canada, Prince Edward Island	All eligible projects	Uniform payment
Experimental conservation auctions	Prairies, Canada	Conservation tender	Bid-based
Adaptive pricing for wetland acquisition	United States, Dakotas	First-come-first-served	Uniform payment a specific year

¹²⁴ Same amount per acre or same cost-share.

Result 3: Incentive programs in Ontario have covered a broad diversity of competitive approaches. The review of Ontario programs summarized in Figure 15 shows that most of the potential diversity of competitive approaches defined along our two analytical axes is represented in Ontario, a significant exception being the absence of collective action or agglomeration bonus, already underlined above. This finding confirms that Ontario is an interesting case to learn from its experience on competitive approaches.

Figure 15: Analyzing competition in PES design in a two-dimensional approach¹²⁵

¹²⁵ Results are presented at the time we conducted the interviews. Program designs and applications evolve over time. E.g. in 2020, Huron County Clean Water project received about 290 applications and approved 260, <https://www.huroncitizen.ca/farm-21-huron-clean-water-project-marks-15-years-of-projects>. Peel rural clean water program also notes, on its website (2021), some competition between projects: “Those projects with the higher potential for improving environmental quality will be considered first.” <https://trca.ca/get-involved/private-land-grants/rural-clean-water/rural-water-quality-program-peel-region/>

Result 4: The mechanisms designed to be the most competitive and maximize cost-efficiency (reverse auctions) have not been associated with the highest level of rivalry among applicants¹²⁶, nor with the lowest cost-share. In Figure 15, we colour-coded the actual level of rivalry among applicants under each program, i.e. the proportion of applications that were granted funding. While some Ontario programs were affected by an extremely high level of rivalry, which led to rejecting many applications and required adjusting enrollment mechanisms to adopt merit-based rather than first-come-first-served approaches, other programs remained undersubscribed or funding matched subscription levels with no significant rivalry among projects. Conservation tenders, intended to build competition among individual projects and increase cost-efficiency, seem to have at least partially missed the objective, both in Ontario and in other provinces (cf. above). The Water's Edge Transformation Program was undersubscribed, despite the important support of local conservation authorities and a stewardship group, in partnership with OSCIA, in dissemination, outreach and on-farm technical advice. An experienced program officer recalls that "bidding caused a lot of anxiety and frustration"; "I received a lot of phone calls asking *"how much should I ask for?"*"; and "most farmers asked for more than typical cost-shares". In conclusion: "farmers applied anyways but they are more comfortable with a fixed cost-share"; even though "the pilot lasted only one year, so, if continued, the model might have developed" (interview). Technical innovations (online applications under farmers' responsibility) were also an issue: "30% of my farmers did not have access to the

¹²⁶ The term 'rivalry' is used here to compare funding farmers apply for with funding availability. There is rivalry among farmers when applications exceed funding availability.

Internet, so I filled out applications on my computer”. Not all program officers can be expected to show the same level of dedication.

The GHFIP, intended to conserve grassland birds, was also undersubscribed in its first year but applications in the second year exceeded budget and there was some level of competition between bids. Yet, price bids did not significantly differ from payment levels in previous flat-rate programs, and an increase in cost-efficiency was not observed. Interviews with key informants, including Ontario farmers having participated in GHFIP, bring some light to this apparent contradiction. The first conservation tenders in Ontario were short-term programs introduced together with new application requirements (online bidding). With the limited possibility to hear about the program from previous participants and learn the application process, applications were highly dependent on local technical support. Flexible cost-shares were not necessarily interpreted by farmers as a competitive process but rather seen as a way to release cost-share thresholds set under previous funding schemes; thus, farmers felt inclined to bid higher rather than lower than previous cost-share flat rates. A farmer interviewed mentioned that he tried to guess how high he could price his offer without discouraging government support, rather than adjust to the opportunity cost of his intended conservation practices or his own willingness to accept. Others mentioned that they had difficulties understanding the best way to set a price or had no recollection of even trying to figure out a price. Support technicians mentioned that they were often asked by farmers what level of cost-share to apply for. In the absence of alternative reference, cost-share levels of previous or parallel programs were often used in farmers’ bids. Building on this result, OSCIA developed a new conservation tender

mechanism for farmland birds, with more explicit bidding recommendations: the Grassland Stewardship Program (2016-2018; Species at Risk Partnerships on Agricultural Lands [SARPAL], 2018). However, those recommendations tend to suggest farmers should adjust their bids to expected environmental benefits and traditional cost-shares rather than their minimum willingness to accept alone (Box 2). In addition, similarly to WET, applicants highlighted barriers associated with transactions costs “I have experience in applying to programs, but it was a real pain, very difficult. I almost gave up (...). I found it too complex, with a lot of questions. Some of them I did not understand. I had to go out in the farm to get the information.” (Ontario farmer)

Box 2: Grassland Stewardship Program bidding recommendations (SARPAL, 2018)

HOW TO DETERMINE YOUR FUNDING BID

Consider the following when determining the funding bid for your project(s):

1. **What are your financial needs to complete the project(s)?** First determine the total project costs, and then consider how much funding support you require to complete the project. Ensure your funding bid reflects the bottom line needs of your farm.
2. **What cost-share percentages are typically offered?** A good starting point when creating your bid is the cost-share percentage you are requesting. Traditionally, cost-share programs fund anywhere from 35 to 75% of project costs. Consider how beneficial your project is to bobolink and other grassland birds. If the benefit is high, a funding bid with a cost-share percentage on the higher end of the traditional range may be justified. If the benefit to grassland birds is not as direct, a more conservative funding bid may be appropriate.
3. **GSP is a competitive program.** You will be evaluated against other applications, and projects that offer the most conservation benefit to bobolink and other grassland birds for a fair cost will be prioritized for funding. Applications will be evaluated based on the total funding bid, but also the percentage of total project costs requested (i.e. the cost-share percentage).
4. **You will not be funded higher than your requested bid.** OSCIA sets aside funding for approved projects until all available funding has been allocated. OSCIA will not provide funding over and above the approved amount at the claim stage. Do your research and ensure your estimated project costs are accurate, and your funding bid reflects your needs to complete the project. Please be very clear in your cost descriptions.
5. **Delayed haying projects may have multi-year costs.** When applying for a multi-year delayed haying project, be sure to consider project costs for the length of the Conservation Agreement. Funding for multi-year costs are not eligible under BMPs 1 through 3.

Perceived complexity and transaction costs were also a deterrent to applying. Similar findings were shared by other conservation auction programs. In an article entitled *Too*

burdensome to bid: Transaction costs and pay-for-performance conservation, Palm-Forster et al. (2016, p. 1314) reported that:

“A 2014 conservation auction to allocate payments for practices that reduce phosphorus runoff in Northwest Ohio experienced very thin bidding. According to a follow-up survey, auction participation was deterred by the perceived complexity of the bidding process and the need to negotiate with renters. Due to low participation, the actual conservation auction made payments for phosphorus reduction that were surprisingly costly at the margin. Applying a farmer behavioural model to the Western Lake Erie Basin, we simulate participation choice and cost-efficiency of environmental outcomes in reverse auctions and uniform payment conservation programs. Results reveal that when perceived transaction costs of bid preparation are high, reverse auctions can be less cost-effective than spatially targeted, uniform payment programs that attract higher participation.”

Result 5: The apparent diversity in program design in the competition framework aggregates two contrasting models. A closer analysis of current Ontario designs reveals that two contrasting models coexist (Figure 16 and Figure 17). Conservation authorities and ALUS use uniform pricing strategies and introduce no or limited competition among projects. Programs run by farmer organizations with federal or provincial funding use a range of competitive approaches with variations on both selection modes and pricing. While the type of sustainable practices funded overlap, these two models correspond to radically different strategies, with a number of distinct features. The first model (inclusive, hands-on, and governed locally) has been the dominant approach in Ontario until the early 2010s. While conservation authorities and ALUS have preserved the principles of this original model, farmer organizations implementing federal-provincial funded programs have transitioned towards competitive and hands-off approaches, trying out a broad diversity of options and building on a pre-existing capital of trust.

Figure 16: PES managed by Conservation Authorities or ALUS in Ontario

Figure 17: PES implemented by Farmer Organizations in Ontario

Initial inclusive model. The historical analysis of Ontario agri-environmental PES (section 3.3 above) reveals that both current models have a similar origin. Agri-environmental PES introduced in the 1980s and 1990s were based on a number of common principles. Programs were:

- **Inclusive**¹²⁷. Programs funded a broad scope of beneficial practices with limited competition among project proposals. Budgets available to provide agri-environmental grants were originally very limited, but schemes offered a similar (low) level of funding to all eligible farmers (funding based on the EFP was originally limited at \$1,500 per farm).
- **Hands-on**¹²⁸. Farmers were provided with direct assistance, including technical advice and administrative support to prepare applications¹²⁹. Changes in applications were often possible after feedback was received.
- **Local**. Programs were represented locally and relied on advisors on the ground. Some farmers refer to program staff with a long-term presence on the ground - or even hired among local farmers - as their ‘go-to person’.
- **Consistent**. While funding levels and eligible practices varied over time, the approach and governance structure remained fairly constant over the years, including local stakeholder committees.

¹²⁷ A program is defined as inclusive when it aims to fund as many eligible applications as possible.

¹²⁸ A program is defined as “hands-on” when program staff supports farmers in project design and application paperwork.

¹²⁹ Support was provided either by conservation authority technicians or soil and crop local field representatives.

- **Trust building.** In the early days, PES invested significant efforts in building trust in the farming community, with local farmers as their intermediary on the ground and farmer organizations or farmers represented in program steering committees.

To date, conservation authorities and ALUS still largely rely on an inclusive model, with principles of **equity** (across municipalities under the same program, and across constituents) and attention to preserving **motivation** in the long-term preceding cost-efficiency objectives. Rather than building competition among projects, conservation authorities often aim at serving conservation demand as broadly as possible. With few exceptions, conservation authorities have dimensioned their funding ceilings, rates and eligibility criteria to be able to fund most if not all eligible projects. When budgets are insufficient or intended projects not eligible, conservation authorities tend to manage expectations, delaying projects for a year or offering alternative options, rather than discouraging voluntary farmers. Ducks Unlimited and ALUS have adopted a similar strategy. When necessary to select projects based on merit, **environmental ranking indexes** are set with local **stakeholder's committees**, and available in detail to potential applicants (e.g. South Nation Clean Water Program). Figure 16 above shows only one outlier with differentiated payment levels. This scheme, the Credit Valley Conservation Authority Clean Water Funding program for rural landowners, mainly targets non-farmers. Program specialists in conservation authorities have also analyzed that - to facilitate participation - programs need to be consistent across the years, and, if possible, aggregated under a single funding window or a limited number of windows. For example, the Essex Conservation Authority decided to merge its different landholder incentive programs under

a single window, funding both water quality beneficial projects and tree planting¹³⁰. To make application simple for the farmer, South Nation Conservation Authority (SNC) implements its water quality offset program under the broader umbrella of its Clean Water Program. All farmers participating in the Clean Water Program sign an agreement that transfers to SNC all potential offsets derived from the projects funded. SNC takes the responsibility to identify the projects best suited to serve as offsets, thus managing the requirements of its offset program without complicating the application process for the farmers.

Competitive model. With research and government doubts on large-scope uniform cost-share grants, and reduction in agri-environmental funding budgets, programs funded under a federal-provincial agreement framework evolved to reduce costs associated with extension, outreach and support to individual projects design, and introduce more merit-based approaches. This second model, often implemented by Ontario farmer organizations such as OSCIA and OFA, with federal-provincial funding (Figure 17), has the following characteristics:

- **Competitive.** Farmer enrollment and payment levels are generally based on merit (i.e. expected environmental benefits). Programs concentrate on priority geographical areas and projects with the highest environmental rankings. Under competitive models, individual grant thresholds are generally higher than with more inclusive programs, as they concentrate funding on priority projects.

¹³⁰ In most conservation authorities, these objectives are served under several funding windows (at least two).

- **Hands-off.** Farmers are expected to prepare their applications with no or limited support from program managers. While local soil and crop representatives are still present on the ground, their mandate has shrunk. In particular, they do not provide support anymore to project technical and administrative preparation. A few farmers mentioned in interviews that they had received much-appreciated help by phone from the central farmer organization office - to understand the application process - but such support is not embedded in the program design on a systematic basis.
- **Provincial.** Funding schemes under this category are often administered at the provincial level, even if some practices may only be eligible in priority areas.
- **Innovative.** Due to short funding cycles, many programs under this model have a short life, and farmers have short-term visibility on future funding. These short funding cycles have the advantage of allowing for innovation. At the provincial level, program specialists have the capacity to research and propose innovative program designs. New approaches are tested and either built on in a successive funding cycle (if they are considered successful or promising) or abandoned. While this approach is beneficial for policy learning and improvements, it also induces high transaction costs for both farmers and implementing agencies. In addition, there is not necessarily sufficient time to assess impact, with participation and bidding levels (under conservation auctions) being some of the only factors that can be monitored during the project time frame.
- **Building on a pre-existing capital of trust.** Implemented by long-standing and positively recognized farmer organizations, those programs build on their capital of trust - rather than dedicated trust-building efforts - to foster participation. Program information is actively disseminated, but no or limited efforts are invested in trust-

building as such, as programs build on the reputation of farmer organizations administrating the program, such as OSCIA and OFA.

Figure 18 below summarizes major differences across these two models.

Figure 18: From one to two types of mainstream models in agri-environmental Ontario schemes

3.5 Competitive and collaborative features, comparing participation barriers

Result 6: Trust is key in participation decisions in Ontario. Programs either build on an existing trust capital or invest in trust-building. The importance of trust justifies the high level of farmers' and farmer organizations' participation in program governance across models. While farmer organizations can build on their long-standing presence and involvement in stewardship programs, conservation authorities cannot rely on such pre-existing capital of trust among farmers. Having both regulatory and stewardship missions, conservation authorities are feared by a number of farmers, in particular in Eastern Ontario, where a vivid landowners' rights movement is reluctant to participate in any government intervention. Some farmers mention negative experiences with conservation authorities in

the past, in particular if they were refused a development permit¹³¹. Others are suspicious that conservation authorities may – in cooperation with government institutions – use visits or investments on their lands to enforce restrictive regulations, immediately or in the future, for example on species at risk. While not aware of being breaking rules, some farmers seem unclear if specific regulations, existing or to be adopted, could apply to their farm (OSCIA, 2014b) and are concerned by what detailed visits could reveal. They are also concerned that environmentally beneficial investment could make them more liable, for example if species at risk were discovered on or colonized their land. Because their motives are questioned by some farmers, Conservation Authorities take extra steps to build trust. To provide farmers with relevant technical advice and build trust, a growing number of conservation authorities hire farmers (often locally respected community-minded farmers; e.g. in South Nation Clean Water program) or certified crop advisors with a farming background to ensure program outreach. According to key informants, trusted ‘faces of the program’ have a significant impact in removing barriers to participation. Conservation authorities also rely on local stakeholder committees with a strong farmer presence. They open committee meetings to interested audience and allocate funding through a ‘democratic process’ and build trust¹³². Using similar approaches to build long-term trust, conservation authorities have also successfully implemented conservation programs with Mennonite and first nation communities in Ontario, who rarely participate in government-funded programs.

¹³¹ Conservation authorities are empowered to regulate development and activities in or adjacent to river or stream valleys, Great Lakes and inland lakes shorelines, watercourses, hazardous lands and wetlands. Development taking place on these lands may require permission from the conservation authority.

¹³² While conservation authorities’ mandates are defined by law, or local bills, some farmers consider conservation authorities as supra-municipal organizations with large powers and limited democratic mandate.

Result 7: The introduction of competitive hands-off approaches has been possible as some farmers acquired experience and trust with previous hands-on funding schemes (path dependency). But participation in competitive programs remains limited by farmers' individual experience and transaction costs. Technical and administrative supports during project preparation remain a priority for a majority of farmers. While administrative support has not been provided to farmers applying to competitive PES in Ontario in recent years, the number of applications remains high and exceeds available funding in most merit-based programs. In interviews, participating farmers mentioned having completed several EFP rounds and having acquired the capacity to fill out complex documents. However, several informants, including farmers, mentioned paperwork as a major barrier to increased participation in competitive funding programs. Participating farmers mentioned that others had difficulties with the paperwork and application process. Some farmers hire consultants to help with the application; others ask neighbours¹³³ or relatives to help them identify funding programs and apply, but interviewees also suspect that a majority of farmers just decide not to participate. Paperwork in competitive programs was not only described as technically complicated but as a major transaction cost. Even highly educated, well-informed farmers mentioned weighing out potential funding level, paperwork, and likelihood to be selected, before applying to a competitive program. There is a high demand for technical support in project design and help with paperwork, in particular by farmers starting new operations and interested in designing multi-year plans. Farmers participating in the choice experiment described in Chapter 4 confirmed a large

¹³³ Several interviewees have provided support to their peers on a voluntary basis.

interest for on-farm support with project identification and design, and support with paperwork, as priority choices if technical support was made available to accompany a cost-share program. This result aligns with previous research. According to Milburn (2007, 2010), reducing extension staff and replacing one-on-one contact with rural landowners is a recipe for decline, as rural landowners value personal interactions and are most likely to innovate or change behaviours as a result of in-person training and discussions.

Result 8: Competitive approaches raise concerns associated with perceived fairness (uneven capacity to apply, fairness in selection...), but merit-based selection is accepted as the fairest system. A number of farmers raised concerns about selection processes. Under Growing Forward, extremely fast disbursement rates on a first-come-first-served basis have affected program credibility. More recent merit-based approaches are criticized for their lack of transparency, and eligibility criteria targeting laggards rather than innovative farmers. But it is not clear if these concerns affect participation. As confirmed by the survey accompanying the choice experiment - described in Chapter 4 - selection based on merit is globally considered fairer than selection on a first-come-first-served basis. Because competition has been a reality in Ontario for a number of years, the fact that applicants compete on both environmental merit and price does not seem to raise additional fairness issues.

Result 9: Not being selected in a competitive process negatively impacts farmers' willingness to participate in the future. As detailed above, conservation authorities have put emphasis on managing farmers' motivations. Such emphasis is largely absent from competitive approaches. Interviews with farmers whose project proposals were not

selected (unsuccessful applicants) confirmed the importance of managing motivations. When applications require detailed merit-based proposals or conservation bids, disappointment seems to be even more critical than when projects are rejected on a first-come-first-served basis. In merit-based approaches and conservation tenders, farmers invest in project design, sometimes spend considerable amounts of time on the application, and build ownership of the proposed project. Besides having spent time in vain, some farmers mention feeling personally affected (“why do they prefer my neighbour?”, “what do they have against me?”). Unless they had previously successfully applied multiple times, interviewees who saw their project proposal rejected decided not to reapply. Uncertainty on the rejection factors increases resentment and further affects motivation to reapply to the same funding scheme or another. Results of the choice experiment (Chapter 4) confirm the negative impact of rejected applications on farmers’ motivation. In addition, some affected farmers tend to spread a negative word on funding schemes in their personal or professional networks. Some practitioners have learned from experience and recommend maintaining a relatively low rejection rate in conservation auctions (e.g. Ducks Unlimited, personal communication). However, long-term negative consequences of competitive approaches on individual or even collective motivations seem to be underestimated in policy and research papers on PES design.

Result 10: New approaches are emerging that recognize the importance of technical support (Result 7) and the need to account for farmer motivations (Result 9). Most recent programs in Ontario seem to acknowledge two of the main limits to competitive approaches outlined above. An important feature of these recent models is to be more

inclusive while remaining competitive. Instead of refusing a large proportion of applications, the competition process establishes a gradation in the level of funding. Projects which are not ranked highest in the selection may still get funding at a lower rate. In our review of Ontario agri-environmental PES we identified three examples of such evolutions: the GLASI program¹³⁴, Ducks Unlimited wetland restoration funding scheme, and Ontario Species at Risk Farm Incentive Program (SARFIP). The GLASI program, a phosphorus reduction program targeting sensitive sub-watersheds in Southern Ontario administered by OSCIA, introduces three innovations. These innovations address some of the shortcomings we identified with competitive approaches. Farmers do not bid for funding; rather, the funding level is determined by the expected level of environmental benefits, which is based on several complementary criteria. Criteria can be transparent, as their assessment is either straightforward or conducted by an external technical expert (certified crop adviser). In conservation auctions, on the contrary, selection criteria cannot always be fully transparent, as some criteria could trigger strategic behaviours with limited means of verification or because complex criteria can send mixed signals¹³⁵. To help farmers identify and design priority projects on their farms, GLASI provides support for a professional soil health diagnosis by a certified crop advisor. Besides reducing entry costs for farmers not experienced with funding schemes, technical support also helps improve the technical relevance of the proposed project, and independent assessment of its expected benefits. Finally, investments are explicitly targeted in limited geographical areas (priority

¹³⁴ GLASI is emblematic of the learning process in the farming community. In its first year, the program was undersubscribed, while in the second year GLASI funds were sold out in 36 hours (personal communication).

¹³⁵ Species at risk, for example, appreciate different environments; thus certain environmental features can be positively valued under a specific program and negatively under another, which can be confusing or counterproductive to highlight.

Great Lakes watersheds), which helps manage expectations as the selection is explicit upfront. GLASI was developed under Growing Forward 2, and it ended with the termination of Growing Forward 2 in 2018. However, similar principles were applied to its successor (LEADS). Financial support to farmland health check-ups was maintained.

Under SARFIP¹³⁶, cost-share financed by the program depends on the project's direct or indirect impact on species at risk. Eligible beneficial management practices can receive a standard (low) cost-share. The cost-share rate is raised when species at risk are present on or nearby the farm, and the project focuses on the specific conservation needs of the SAR (e.g. installing bat boxes, creating nesting sites for SAR turtles, etc.). In this second case, farmers can benefit from even higher cost-shares if they commit to actively monitor species at risk. Both GLASI/LEADS and SARFIP have been renewed over several programming periods, thus also applying a principle of continuity/consistency over time.

Ducks Unlimited is an NGO with a longstanding presence in Ontario, supporting wetland restoration and preservation. Recent evolutions in Ducks Unlimited funding schemes move away from a competitive merit-based approach towards an inclusive approach with gradual cost-share funding rates, depending on the project environmental priority. This evolution was justified by the observation that former competitive approaches had a detrimental impact on farmers' motivations. Figure 19 below schematize the evolution towards this third model.

¹³⁶ SARFIP was originally introduced in 2012 as a traditional cost-share program, but evolved over time.

Figure 19: Towards a combined model

Result 11: Limited economies of scale, coordination costs, and tensions in the farming community restrict collaboration between farmers. However, several key informants mentioned a scope for testing collaborative approaches.

Besides barriers with competitive approaches, our research also helped identify collaboration barriers. Various factors may explain why none of the current agri-environmental cost-share programs in Ontario supports coordination between project holders. Interviews with key informants, including farmers, and answers to open-ended questions in the survey accompanying the choice experiment (Chapter 4) allowed us to narrow down five main justifications.

- **Limited benefits of scale.** Farmers and program managers mentioned a limited need for collective action as farms are generally large and individual measures sufficient to generate significant environmental improvements. Coordination may even be

mentioned as irrelevant when neighbours have very different farming systems (e.g. with one grazing cattle while the others keep cattle indoor or exclusively produce crops). Farms are generally smaller in Europe, which may justify a stronger need for coordination. However, coordination may also be important in Canadian environments. Interviewees mentioned, for example, wetland restoration¹³⁷, tree planting along roads, controlled tile drainage, creek and stream fencing, integration of livestock and crop activities across farms¹³⁸, and coordinated BMP adoption in a sub-watershed for measurable impacts on water quality in pay-for-performance schemes, as situations justifying collective action. Collective action already exists in several Ontario communities for tree planting (e.g. Avon Conservation Club), but remains concentrated in emblematic locations (a number of interviewees denounce a strong tree cutting rather than tree planting trend in Ontario, in a context of high commodity prices).

- **Coordination costs.** A number of key informants, including farmers, also cited high coordination costs as a reason to apply on an individual basis with limited regard for their neighbours' decisions.
- **Rivalry and tensions among neighbours.** Holmes (2015) noted that Ontario farming communities have a strong 'culture of cooperation'. However, this culture rarely translates into joint projects at the farm level. Independence is also a strong characteristic of Ontario farmers. In our survey (Chapter 4), 60% of respondents agreed with the statement: "I do not want anybody to tell me what to do on my farm". In

¹³⁷ When several farms share, or border, the same wetland.

¹³⁸ E.g. fencing for rotational grazing on crop and hay farms, benefiting neighbouring livestock farmers, under a joint agreement.

addition, with the expansion of pluriactivity in the farming sector, community-mindedness may be losing ground in Ontario. Several program managers mentioned having difficulties finding new and younger farmer representatives to join program steering committees or relying on the same committed individuals across multiple programs. Local tensions in the farming community over rented land or over windmills installation raise additional barriers to collective action. After a number of years of high grain prices, tensions are exacerbated by land tenure conflicts. As grain prices increase, access to buying or renting land becomes a conflictual issue in the farming sector. Extremely precarious rental agreements – often based on simple annual handshakes – facilitate rapid land turnover at the detriment of stewardship investments on rented land¹³⁹.

- Collaborative approaches have never really been tested in Ontario agri-environmental programs.
- **The overall legal and institutional framework does not foster cooperation.** In Ontario, tensions among neighbours are triggered or exacerbated by rivalry over accessing land. In Europe, strong regulations on farming have limited these factors of tension. In France, for example, farmland rental agreements and rental rates have been strictly regulated since 1945. Rental leases cannot be concluded for less than nine years,

¹³⁹ The percentage of farmland under tenancy in Canada has been steadily rising for the last two decades and tenants now operate approximately 43% of Canadian farmland (Nadella et al. 2014; Statistics Canada, 2017). In Ontario, about 30% of farmland is rented or share-cropped.

and regulated rates are at the advantage of the farmer. Since 2006, ‘green leases’ allow landowners with an environmental mandate to lease land under environmental conditions (clauses). Any landowner can use green loans in environmentally sensitive areas, or to protect environmental assets. In addition, agricultural land does not freely change hands. Since 1960, specific organisations¹⁴⁰ have been created in rural areas to allocate lands among several candidate buyers. Finally, fiscal measures and governance agreements favour the agricultural cooperative movement. In France, for example, cooperatives, farmers’ unions, and chambers of agriculture have been delegated powers by the government for decades¹⁴¹. In 2014, ¾ of French farmers are members in a cooperative, and cooperatives generate 40% of the agri-food sector income.

All these factors might play a role, and collective approaches will not be a silver bullet in Ontario. However, several key informants identified a potential scope for collaborative approaches that would deserve further attention. In addition, in the survey accompanying the choice experiment (Chapter 4), most farmers (90%) responded that they would be ready to test some form of collaboration if additional incentives were attached to it. Finally, emerging result-based PES approaches (pay-for-performance) would require collective action to reach the levels of concentrated adoption required to measure impact.

Agri-environmental programs could explicitly support group projects among farmers that currently rely on non-agricultural funding alone (e.g. from the Trillium Foundation). Opening agri-environmental programs to funding groups could emulate other farmers more

¹⁴⁰ Safer : Société d’aménagement foncier et d’établissement rural.

¹⁴¹ The cooperative movement in agriculture emerged in the 1880s in France, long before being recognized by the government.

efficiently that relying on grants for ‘community action’. Linear on-farm investments were mentioned as an important area to further collaboration (e.g. tree planting along a road, run-off protection along a ditch, restoration of river or wetland banks, etc.). Finally, collective action bonuses could help disseminate species at risk incentives in the farming community as acceptability is an important factor.

3.6 Discussion and policy insight

3.6.1 Combining competition and collective action in PES research

Competition and collective action are not necessarily at odds in PES programs, but economic research combining both continues to lack important interdisciplinary and long-term perspectives. Previous research in North America and Australia has opposed stewardship programs, drawing on personal and social norms, and auction-based PES, drawing on financial motives (Holmes et al., 2011; Morrison et al., 2012). Our research leads us to argue that there is a diversity rather than a dichotomy of approaches. Rather than a clear distinction between collaborative and competitive options, we observed that hybrid designs with both collaborative and competitive features have emerged. In particular, programs designed and implemented by or with farmer organizations in Ontario (a collaborative feature) have tested competitive approaches. Collective action incentives have never been tested in Ontario to our knowledge, but economic and policy research worldwide tested many collective action incentives, including in competitive designs. Research on conservation auctions tested agglomeration bonuses (Parkhurst et al., 2002; Parkhurst & Shogren, 2007; etc.), spatial-connection incentives (Banerjee et al., 2015; Fooks et al., 2016; Krawczyk et al., 2016; Liu et al., 2019; Windle et al., 2009); and joint

bidding (Banerjee et al., 2021; Calel, 2012; Iftekhhar & Tisdell, 2017; Rondeau et al., 2016; Smith & Day, 2018). Various research methods were used, including agent-based simulation models (Iftekhhar & Tisdell, 2017); laboratory experiments (Banerjee et al., 2021; Krawczyk et al., 2016; Rondeau et al. 2016); and framed field experiments (Liu et al., 2019¹⁴²). Opportunities for producers to submit joint bids in conservation auctions were also implemented on the ground in the “Auction for Landscape Recovery” in Australia (Latacz-Lohmann & Schilizzi, 2005), and an auction to reduce nutrient runoff into Lake Erie in the United States (Palm-Forster et al., 2016a). Conclusions can be insightful. Banerjee et al. (2021) concluded, for example, that joint bidding improves cost-efficiency and environmental benefits when no individual agglomeration bonus is offered, but not otherwise. Liu et al. (2019, p. 843) concluded that “in a PES auction that provides agglomeration bonuses, subjects tend to bid less in anticipation of receiving bonus payments when their neighbours are also successful in the auction”.

Those papers testify of increasing recognition of the importance of coordination to reach ecological thresholds, in economic research, including by researchers promoting competitive approaches to PES as a solution to improve cost-efficiency. However, those experimental designs fall short of considering some of the key benefits of collective action in agri-environmental programs:

1. Getting a slightly higher grant may not be enough to increase motivation. Having technical assistance and joint access to expert support - from a trusted farmer-led

¹⁴² Liu et al. (2019, p. 843) conducted “a framed field experimental auction allocating PES contracts with and without agglomeration bonus payments using actual forest land owners in rural China as subjects”.

organization - may be a stronger incentive for participation by farmers. Farmer organizations or multi-stakeholder associations coordinating joint agri-environmental projects in the Netherlands, France, Germany, the United Kingdom, or the United States, for example (see above), do more than just aggregate individual farmer bids. They can significantly increase environmental benefits and reduce farmers' and governments' transactions costs in a 'hands-on' approach, by helping to design scientifically and financially sound projects tailored to individual conditions; explaining funding mechanisms to farmers; organizing coordination among farmers; preparing and following applications; monitoring projects; and reporting on achievements. They have a prior territorially relevant knowledge of local stakeholders, farming practices and/or conservation issues. They have the capacity to help adapt on-going projects and coordinate performance-based programs. They also benefit from a strong capital of trust from both farmers and ES buyers. Whether such designs improve cost-efficiency depends on the costs associated with intermediary institutions or bottom-up farmer coordination; but needs to be evaluated taking into account medium and long-term benefits, and spill-over effects. Collaboration among neighbouring producers can lead to an increase in local social capital, which can, in turn, lead to higher levels of pro-environmental behaviour (Zabel, 2019). Collaboration with non-farmers can help bridge gaps across rural-urban communities or across farmers and conservationists. Collaborative approaches can help change local agricultural norms, create new network connections, and develop new value chains for sustainable products. OSCIA, in Ontario, plays some of the functions of those intermediary institutions but with an approach that has largely moved away from the ground towards

provincial or sub-provincial levels, with no intervention on specific project design or farmer to farmer coordination.

2. In addition, those experiments seem to disregard an important drawback of competitive approaches we highlighted in this dissertation: competitive approaches can negatively impact unsuccessful farmers' motivations in the long-term. As several interviewees highlighted, this negative experience can not only discourage unsuccessful farmers themselves, but also create harmful negative publicity in the farming community.

3. Finally, these approaches take the nature of the farm sector as given. They do not raise legal or institutional questions. They do not debate if we need to consider ways to reorganize the farm sector to make it easier to accomplish collective ends. In other contexts, strong transformational changes happened through legal or fiscal measures supporting cooperation or regulated leases.

There is no one-size fit all solution, and imposing collective action through intermediary organizations - or bottom-up groups - can increase transaction costs and reduce farmer buy-in, if there is no prior interest to collaborate, limited environmental benefits of coordinated projects, no demand for technical and administrative support, or no legal or fiscal incentive to cooperate. However, our research highlighted that, while economic research on PES is increasingly recognizing the importance of collective action, this research often continues to fall short of strong partnerships with social, social-psychology and institutional scientists, and a broader perspective on farmers' motivations, including medium to long-term path dependency. As outlined by an Ontario farmer in our choice experiment survey (Chapter 4): "You cannot "purchase" environmentalism, it can only be learned."

3.6.2 External validity

While South-Western and Eastern Ontario are representative of other agro-ecological environments (see Section 3.2), distinctive Ontario features may have impacted our findings. Landowners' rights movements and defiance towards government regulation are particularly pronounced in the Ontario farming sector in particular in Eastern Ontario. High farmland prices in the context of unsecure land agreements also impact BMP adoption and PES participation in Ontario, in particular on rented land (Nadella et al. 2014¹⁴³), as well as relationships among neighbours. Situations can be very different in other regions of the world. In France, for example, farmland tenants' rights are strongly protected. Cooperative movement in the farming industry is historically very low in Ontario, whereas, in several European countries and Quebec, policies favoured the cooperative movement for decades. Other factors may have affected external validity. However, issues observed in Ontario are likely to be representative of broader situations. Ontario has been a source of inspiration for agri-environmental policies in Canada and abroad, in particular on the participation of farmer organizations in program governance and implementation, and on-farm self-diagnosis of environmental issues. While maybe not as pronounced elsewhere, issues associated with rivalry over land, and defiance towards government programs are common in many countries' farming sectors.

¹⁴³ Nadella et al. (2014, p. 3) found that Ontario farmers whose rental tenure is not secure for more than five years are less likely to plant cover crops on the land that they rent compared to the land that they own. This is not the case for conservation tillage.

Research in Ontario confirmed that the province is a relevant revelatory case study, with an embedded unit of comparison. The broad diversity of programs allowed for first-hand comparisons and could inspire research in other regions. Future research ought to consider how contextual factors (including factors above mentioned) matter for the kinds of PES designs that will strike an appropriate balance between competition and collaboration.

3.6.3 Policy implications

Fostering trust and nurturing motivations. Trust in organizations managing programs has been widely documented as a critical factor to increase participation in PES. Our research in Ontario confirms this analysis, and most programs have already taken into account this factor. Government-funded programs largely rely on trusted farmer organizations to implement incentive schemes. Conservation organizations mobilize dedicated efforts to build trust, including by hiring inside the farming community. However, the importance of trust in a specific program, or type of incentive program design, is rarely described in policy research. Our research in Ontario showed that being denied funding can affect farmers' perception of the funding program in the long-term, and farmers' motivations to participate in any similar agri-environmental program. It might also affect farmers' perceptions of environmentally beneficial practices promoted under those programs (Chapter 4). On the other hand, as developed in Chapter 2, being funded and recognized for the environmental benefits of the actions funded (through awards, on-site visits, being invited to give speeches...) can crowd-in motivations by developing a sense of pride and self-identification as a strong environmental steward. Agri-environmental funding can also help build recognition for environmentally beneficial

products in the value chain, thus increasing motivations to sustain, enhance, or scale up the practices. As already outlined by Sieberg et al. in 2006, the task of influencing and changing farmers' behaviour and willingness to act needs to be conceived of as a medium- to long-term process.

Those results lead to recommend to give further importance in program design to preserving or nurturing motivations, including with non-participants. This implies that it is key to avoid motivation loss by managing expectations, preventing failure through technical advice and constructive feedback, adopting schemes that build competition on price (level of funding) rather than binary in or out options; transparent selection criteria; and explaining why applications were unsuccessful. This also implies that it is important to support motivations crowding-in, by including in program design, or in a broader policy mix, features to build self-esteem and recognition, or markets for environmentally beneficial products. Features that bring recognition to 'environmental farmers' or 'good stewards' already exist, but they tend to concentrate on a limited number of emblematic farmers, whereas nurturing motivation would call for the recognition of a broader number of farmers.

Minimizing transaction costs. The importance of transaction costs is widely recognized in PES research, and our research shows once again that transaction costs are a major barrier to participation. However, policy designs do not always factor in this criterion. In particular, it is not straightforward to weigh out selecting environmental projects on merit (which often requires detailed information and paperwork), on the one hand, and minimizing transaction costs on the other hand. Research on conservation auctions, in

particular, shows that auctions can be expensive to set up and run for the institution organizing them and expensive for participants to join. Limited government support in preparing suitable applications, and relying on competition alone to select the most cost-efficient projects, can effectively offload costs to the farmers in the form of administrative and transaction costs. Unless those costs are limited, they can ultimately undermine trust in the system and make the program's longer-term success less likely. Providing specialized support in identifying and designing the 'best projects' on-farm has a cost for the institution running a program, but long-term benefits may outweigh this cost, in particular for environmentally ambitious projects, farmers who are newcomers to agri-environmental issues, or farmers ready to engage in a multi-year transition.

Recent projects, such as GLASI in Ontario, provide farmers **free expert advice at the early diagnosis and project identification stages**. This support reduces farmers' transactions costs while allowing program managers to rank projects based on an expert appraisal of environmental merit. Our interviews in Ontario, and the survey accompanying the choice experiment (Chapter 4), confirm that such an approach responds to a vivid farmer demand. For some farmers, expert advice may even be the main benefit of participating in a PES.

Other leads to reduce transaction costs include: (i) differentiating support to applicants depending on their level of experience with PES; (ii) allowing for multi-year projects with gradual investment plans; (iii) gradually adapting programs rather radically changing approach; and (iv) aggregating all funding opportunities available in a specific area under the same umbrella.

(1) Differentiating support to applicants depending on their level of experience with PES. While experienced cost-share applicants have mastered application processes and may be able to figure out new program requirements relatively easily, tentative and new applicants could greatly benefit from additional support in identifying relevant projects on their farms (through expert on-site visits) and figuring out application processes.

(2) Allowing for multi-year projects with gradual investment plans. Several interviewees explained that they have medium to long-term stewardship investment plans. They do not have the investment capacity to realize their entire project in the first year, but plan to progressively invest over the years, as they mobilize the required time and financial resources or as their cattle expands. This is in particular (but not only) the case for farmers who newly acquired a farm or are developing a new activity. Those interviewees have to re-apply annually to stewardship programs, with constant uncertainty on whether their project will be selected, and repeated transaction costs. In such context, it would be worth considering funding multi-year projects, with successive installments dependent on the successful implementation of each project stage.

(3) Gradually adapting programs rather than radically changing approach; testing over several years. Numerous program designs have been piloted in Ontario, in particular since 2013. Some programs only lasted a year, with a very limited window for potential beneficiaries to learn and adapt to the program design. Transaction costs are particularly high with new designs, as those require an intense communication and learning process. Rather than a succession of contrasting programs, Ontario could benefit from programs evolving incrementally, based on strong evaluations and program adjustments, to continue innovating while minimizing transactions costs associated with new designs. If radically

new designs are tested, those will benefit from running over several years and several intake periods before conclusions can be drawn.

(4) Aggregating all funding opportunities available in a specific area under the same umbrella. Potential applicants spend time to find relevant funding opportunities or to combine them to benefit from higher funding rates or larger projects. Initiatives such as the East Central Farm Stewardship Collaborative (ECFSC) could be further developed in Ontario. The ECFSC operates in Northumberland, Peterborough and Hastings Counties, the City of Kawartha Lakes and Durham Region. The Collaborative stands out for its streamlined initial application and coordination of stacked funding. ECFSC does the leg work of helping producers in East Central Ontario access multiple sources of funding from its 11 member organizations, including several conservation authorities and Ducks Unlimited Canada (DUC). It helps applicants identify and access relevant funding. It also helps mobilize external funds for on-farm investment and technical support by applying directly to incentive programs and administering cascade funds (e.g. under the ‘on-farm clean water projects’ in 2019 and 2020). In 2011, the ECFSC was awarded the Ontario Minister's Award for Environmental Excellence. It provides an insightful example other sub-regions could replicate or build on.

Opening options for collaboration. Our research led to recommend developing opportunities for collaboration among farmers in Ontario PES, at least on a pilot basis. Collaboration does not necessarily need to be broad scale. In the context of an increasing farming systems specialization, and tensions in the farming community over precarious land agreements, **even bilateral agreements could bring significant improvements.** PES

could, for example, support contracts between crop and livestock farmers for grazing cover crops and extending the grazing season into the fall (OSCIA, n.d.); or organize rotational grazing through shared investments in temporary fences (Canada & OMAFRA, 2012). Agri-environmental programs could also support rental agreements, as promoted by Farm & Food Care in Ontario, to improve stewardship on rented land. Bilateral agreements could be supported with legal advice or monetary bonus in cost-share programs. Several interviewees even suggested exploring making stewardship rental agreements mandatory for landowners to receive tax breaks eligible on Ontario farmland. Collective action bonuses for individual projects in sensitive areas, or group projects, could also be considered on a pilot basis. Those could first benefit collective farmer initiatives, which are currently funded by environmental foundations or NGOs. Being funded by mainstream agri-environmental programs could increase their visibility and trigger a ripple effect.

Broadening the perspective on economic instruments. Cost-share funds for environmentally beneficial practices on farms were more largely available in the early 2000s. But dedicated federal and provincial funding has significantly shrunk. In this context, several interviewees, including farmers, recommended exploring other forms of incentives associated with on-farm environmental practices, including tax exemptions, tax credits, cross-compliance measures¹⁴⁴, BMP insurance, certification price premium. Recent research by Palm-Forster explored similar options using experimental procurement auctions to reduce phosphorus runoff in Lake Erie. Payments and tax credits that target high-impact areas of the watershed were found more cost-effective than untargeted price

¹⁴⁴ Accessing other funds conditional to environmental practices or stewardship agreements.

premiums for product certification. Farmers demanded higher payments for contracts offering BMP insurance (i.e. protection against yield loss from BMP use) due to uncertainty about how the program will be implemented and the reliability of indemnities and anticipated transaction costs associated with the program (Palm-Forster, 2017, p. 493). Joint measures were not assessed, e.g. tax incentives conditional on securing rental agreements with environmental provisions. In the context of limited funds, cross-compliance or environmental conditionality could be interesting avenues to explore.

3.6.4 Perspective for further research

While a retrospective of agri-environmental policies in Ontario was not planned in the research proposal, it appeared most interesting to revisit past programs and understand that most of the current questions were already debated in the past, and potential policy innovations already tested either with mixed success or no recorded lessons learned. This finding should encourage to restore a more active policy learning process with policy-makers, researchers and practitioners involved. An active federal-provincial working group could play this role, in line with efforts undertaken from 2005 to 2010 in the Working Group on Ecological Goods and Services (WG-EGS). Research efforts could be encouraged and regularly presented in this forum.

We did not assess the level of cost-efficiency corresponding to the various models we studied. However, our approach highlighted some of the factors that could significantly impact a cost-efficiency analysis and are rarely taken into account. In particular, we brought into light long-term impacts of program design features and impacts on non-participants. While quantifying these impacts may be a challenge, ignoring them could be

misleading. Recent research on PES evaluation draws interesting methodological insight in this regard. Based on a systematic review of the literature, Le Velly and Dutilly (2016) propose a framework for designing an impact evaluation of PES schemes, with a particular focus on estimating PES additionality by isolating a causal effect of the scheme on the outcome(s) of interest. Authors use the theory of change and point out three factors, which – based on our findings in Ontario - we also consider critical in PES evaluation: endogeneity of the reception, spatially lagged effect, and temporally lagged effects. While the authors sketch methodological elements for a quantitative impact evaluation, they also insist on the importance of qualitative work, in particular to identify motivational changes induced by the PES in participants and non-participants. In Ontario, agri-environmental incentive programs may have been too spread out, diverse or short-lived to allow for a full quantitative impact evaluation with a solid counterfactual. However, similar reasoning could at least be used to map out and qualify impacts with a semi-quantitative approach. Focus groups with first-hand knowledge of farmers' motivations and incentive programs, including farmers themselves, could help draw such analysis while taking into account the key elements we outlined in our research to apprehend impacts broadly.

Finally, future research could analyze how contextual factors matter for the kinds of PES designs that will strike an appropriate balance between competition and collaboration. Such research could, for example, be based on comparative case studies. It could consider factors such as pre-existing cooperative movement, defiance towards government, and legal-fiscal framework regulating the farming sector. The concept of agri-environmental policy-mix helps consider, in a systems approach, the combination of regulations, technical assistance

programs, funding, and labelling instruments intending to support an environmental transition in agriculture. But the research we recommend should adopt an even broader perspective to identify instruments that may facilitate or prevent cooperative or competitive approaches, while not directly related to environmental policies, in particular aspects that may impact farmers' motivations or attitudes.

Chapter 4: Ontario farmers' preferences for agri-environmental programs, a choice experiment

“A major advantage of this latent segment approach may be its ability to enrich the traditional economic choice model by including psychological factors. This integrated modeling strategy also offers an opportunity to merge various social psychological and economic theories in explaining behavior.” (Boxall & Adamowicz, 2002, p. 441)

4.1 Introduction

Using theoretical and empirical literature and semi-structured interviews in Ontario, previous chapters analyzed farmers' **motivations** for participating or not participating in agri-environmental incentive programs. We also identified program **design features** affecting Ontario farmers' willingness to participate (Chapters 2 and 3). Interviews in Ontario helped comprehend a diversity of viewpoints, personal experiences, and hopes for the future. We were also able to identify positions and analyses shared across a range of stakeholders. We concluded that, while some motivations and participation barriers are of overarching relevance for most Ontario farmers, others vary. However, our qualitative research did not provide sufficient information to confidently segment groups of Ontario farmers with heterogeneous preferences with regards to agri-environmental incentive programs. The present chapter aims at filling this gap. Using a quantitative research method, this chapter investigates how do various PES design features associated with key decision factors impact farmers' willingness to participate. In particular, it targets the following research questions: What characteristics can help segment Ontario farmers in groups of heterogeneous preferences with regards to agri-environmental incentive programs? Which design features matter most to each group of farmers? These questions

are of direct policy relevance for the design of Ontario agri-environmental programs, as discussed with the Ontario Ministry of Agriculture and Rural Affairs (OMAFRA) at various critical stages of the research.

The literature on landholders' preferences for agri-environmental programs converges with the broader behavioural economics literature in concluding that **preferences are heterogeneous**. Fehr and Fischbacher (2003) established, for example, that altruism (i.e. benefits that a specific choice would have for others) weighs on the decision of some people but not others. Public good experiments helped **segment groups** with different preferences for altruism and perceived fairness (Gunnthorsdottir et al., 2007). Research on landholders' conservation behaviours also identified segmented groups of preferences (Broch & Vedel, 2012; Chouinard et al., 2008; Greiner, 2015; Jaeck & Lifran, 2014; Kuhfuss et al., 2014; Maybery et al., 2005; Mzoughi, 2011; Ruto & Garrod, 2009; Schulz et al., 2014; Sheeder & Lynne, 2011; Villanueva, 2015; etc.). Schaiblea et al. (2015) noted, for example, that:

“For some farmers, adopting conserving land and pest management practices just makes good business sense (Hopkins & Johansson, 2004; Smith & Weinberg, 2004); for others, moral and social values help to guide their decisions, and yet for others, conservation incentives (financial and/or technical) are required to encourage adoption (Chouinard et al., 2008; Mzoughi, 2011; and Sheeder & Lynne, 2011). Ultimately, however, the environmental effectiveness and cost-efficiency of these programs are likely to improve when their implementation recognizes farm heterogeneity.” (Schaiblea et al., 2015, p. 139).

Various variables and methods have been used to identify and characterize groups of farmers with heterogeneous preferences for agri-environmental policy designs. Twelve studies using various research methods are summarized in Appendix 5 (Table 32). Some studies assume a segmentation up-front based on observable behaviours (Chouinard et al., 2008; Mgouzhi, 2011). Others use a principal component analysis to identify groups with

different farming objectives (Maybery et al., 2005). In this case, segmentation focuses on the sub-cultures of farming systems in order to better understand how to target programs to increase uptake (DEFRA, 2008). “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” (Weber, 2017, p. 5). Since 2009, **choice experiments** and **latent class models** have been used in agricultural policy research to reveal underlying factors weighing on farmers’ decisions (Broch & Vedel, 2012; Greiner, 2015; Kuhfuss et al., 2015; Ruto & Garrod, 2009; Schultz et al., 2014; Vaissière et al., 2018; Villanueva, 2015).

Several of those studies took into account indicators of **psychological constructs** (psychometric indicators) in their models (Greiner, 2015; Ruto & Garrod, 2009; Schultz, 2014; Villanueva, 2015). **Pro-environmental** or **altruistic motives** are for example accounted for in research on agri-environmental behaviours by Chouinard et al. (2008), Greiner (2015), Jaeck and Lifran (2014), Kuhfuss et al. (2014), Mzoughi (2011), and Ruto and Garrod (2009), among others. Ruto and Garrod used a composite indicator of environmental consciousness. Schultz et al. tested the impact of five attitudinal questions on conservation and greening. Greiner built a three-factorial motivation model and a five-factorial attitudinal model and considered all eight dimensions as covariates in her models. Villanueva took into account the perception by farmers of cover crops to be environmentally or economically beneficial.

Indicators of pro-environmental **attitudinal traits** are used as covariates to explain participation and choices under specific program designs, with various levels of

environmental ambition. But limited research has analyzed how attributes specifically associated with attitudinal traits may impact farmers' preferences for different program designs. Broch and Vedel (2012) considered the purpose of afforestation as one of the contract variables, acknowledging the potential importance of personal norms (pro-environmental motives) in the preference for a specific environmental program target. Kuhfuss et al. (2014) used a choice experiment to test the effect of introducing a **collective action bonus** in contracts limiting the use of herbicides on a French vineyard, studying the potential importance of **social norms** and **reciprocity** in explaining participation. In their experiment, numerous farmers declared that they would accept lower compensation when a collective bonus was built into the program, showing a net preference for **collective action**. Villanueva et al. (2015), on the other hand, found that farmers in a Spanish region had limited interest in incentives supporting **group projects** and would prefer individual incentive schemes, seemingly contradicting Kuhfuss' results on collective action. However, papers differed in the options proposed: while Kuhfuss et al. tested a collective action bonus associated with individual projects, Villanueva tested the hypothesis of collective projects and attributed farmers' reluctance to participate in group projects to their perception of **transaction costs** (coordination costs) associated with joint participation.

The present chapter adds to the literature by including - in the different program designs tested - features that intend to directly appeal to farmers with **heterogeneous social preferences**, rather than using attitudinal factors only as control variables to explain participation (Greiner, 2015; Schultz et al., 2014). Because social preferences are known

to be fairly recurrent across cultures, as shown in public goods experiments, we expect some of our findings to be relevant beyond the scope of this Ontario case study.

In the first section, we present our methodology, starting with the decision to rely on a choice experiment with latent class models. We then discuss precautions taken to address the main shortcomings of choice experiment methods; and justify specific design choices.

In the second section, we present and discuss our data and results. Finally, we discuss how these results fill in some of the gaps in our qualitative research and draw conclusions on policy design.

4.2 Method

4.2.1 Choosing a choice experiment

We considered several methods of quantitative research to complete our qualitative findings and identify groups with heterogeneous preferences with regards to agri-environmental program designs, including laboratory experiments. **Laboratory experiments** are often conducted with a population different from the population of interest (usually students) with a large control over experimental treatment variables. Laboratory experiments have been used in agri-environmental policy design to evaluate behavioural responses to specific design features. Laboratory experiments helped, for example, compare pricing strategies in reverse conservation auctions (Schilizzi, 2017) or study the effect of aggregation bonuses in conservation incentives (Liu et al., 2019). However, laboratory settings can lack external validity in complex policy environments. Landholders, in general, and farmers, in particular, evolve in environments difficult to replicate in laboratory experiments. Multiple objectives and technical and economic factors

impact their land-use decisions. **Choice experiments** (CE) have been used when the options to be compared vary on multiple dimensions. CE are traditionally used in non-market valuation to inform health, environment, and transport policies. In particular, CE have helped understand environmental preferences (Adamowicz et al., 1998; Kits et al., 2015). CE can test a range of policy designs, varying on several dimensions. In CE, subjects are asked to compare scenarios based on a combination of variables (**‘attributes’**). CE usually include a hypothetical monetary attribute to determine stakeholders’ willingness to pay or willingness to accept for specific policy features. Choice experiments are conducted with representatives of the population of interest. As researchers lose some control over experimental treatment variables, CE can be affected by unexplained heterogeneity factors. They can also suffer from potential biases discussed below. Laboratory experiments and CE can both account for heterogeneous preferences.

We chose to conduct a choice experiment with Ontario farmers. Losing some control over experimental treatment variables is not an acute issue in our case. Policy options we consider closely mimic existing and potential policy designs, and are better tested with representatives of the population of interest. CE have been used to provide insights ex-ante in the design of agri-environmental contracts and payments for ecosystem services programs (PES) since 2009. Previous studies were mainly conducted in European countries, but the methodology was also used for PES design in Australia, Canada, Mexico, and Tanzania (Figure 20 and Table 33 in Appendix 6¹⁴⁵).

¹⁴⁵ Table 33 in Appendix 6 lists 16 studies worldwide, with the distribution presented in Figure 20.

Figure 20: Choice experiments on PES, by region

4.2.1.1 Random Utility and Latent Class Modelling

The **Choice Experiment method** (CE) is based on Lancaster's theory (1966), that the utility of a good is derived from the sum of the utility of all its attributes. In a CE, this is combined with the random utility theory (McFadden, 1973), where an individual i 's utility (U) of a good j is assumed to consist of a deterministic element (V) and a stochastic element (e):

$$(1) \quad U_{ij} = V_{ij}(x_j, z_i, \rho_j) + e_{ij}$$

V is a vector of individual and alternative specific attributes that are observable. V depends on the characteristics of the good x_j and price ρ_j , and individual-specific characteristics z_i . z_i is a vector of socioeconomic characteristics and psychometric constructs. Psychometric constructs are used to take into account psychological characteristics in quantitative analyzes, including social preferences. Attitudes towards the environment, for example, have been studied extensively using psychometric constructs¹⁴⁶.

$$(2) \quad V_{ij} = \sum_{k=1}^K \beta_{ik} x_{ik} + \sum_{a=1}^A \alpha_{aj} z_{aj} + \gamma \rho_j$$

¹⁴⁶ A common method in the measurement of attitudes is the use of the Likert scale (see below).

e_{ij} in equation (1) is a random error term that consists of factors affecting the choice but not observable by the researcher (Louviere et al., 2000).

The random utility theory states that an individual i chooses an alternative j from the choice set C_i , if the indirect utility of j is greater than that of any other choice k .

$$(3) \quad U_{ij} > U_{ik} \Rightarrow V_{ji} + e_{ji} > V_{ki} + e_{ki} \quad \forall k \neq j; j, k \in C_i$$

The probability of individual i choosing an alternative j is the same as the probability that the utility of alternative j is greater than the utility of any other alternative of the choice set:

$$(4) \quad P(j) = P(V_{ji} + e_{ji} > V_{ki} + e_{ki}) \quad \forall k \neq j; j, k \in C_i$$

Where P is the probability, and $P(j)$ the probability to choose j .

The conditional logit model is the most commonly used method in the analysis of multi-attribute choices. Assuming that the error components are identically and independently distributed (iid) across alternatives and across observations/individuals, and that the error components are extreme-value (or Gumbel) distributed, the probability of choosing j is:

$$(5) \quad P(j) = \frac{\exp^{V_{ji}}}{\sum \exp^{V_{ki}}}$$

with $k \neq j; j, k \in C_i$

The model is estimated using maximum likelihood estimation procedures and assumes a linear-in-parameters functional form for the systematic portion of the conditional indirect utility function (Horne 2006, quoting Ben-Akiva & Lerman, 1985).

[adapted from Broch and Vedel, 2012, and Horne, 2006]

More complex models help understand heterogeneities in preferences among respondents. Most choice experiments on agri-environmental practices use methods capturing heterogeneities¹⁴⁷. Ruto and Garrod (2009) used two models to account for preference heterogeneity: a **mixed logit model**, which allows utility parameters to vary randomly and continuously over individuals; and a **latent class model**, which postulates a discrete distribution of tastes in which individuals are intrinsically sorted into a class, each characterized by a homogenous segment. The latent class model is particularly relevant to our research as, following research on social preferences and farmers' conservation behaviour, we assume that social preferences are segmented in the population of interest and could explain segmented preferences with regards to PES designs. Since 2009, latent class models have often been used in agri-environmental research (Broch & Vedel, 2012; Greiner, 2015; Jaeck & Lifran, 2014; Kuhfuss et al., 2015; Ruto & Garrod, 2009; Vaissière et al., 2018; Villanueva, 2015). Latent class modelling was used to illustrate the various influences of motivations, attitudes and preferences on stated contract participation (Greiner, 2015; Kuhfuss et al., 2014; Schultz et al., 2014). Several authors (Broch & Vedel; Jaeck et al. 2014; Ruto & Garrod, 2009) used both a random logit and a latent class model; and confirmed that latent class models are well suited to reveal important segmentation in farmers' preferences. Broch and Vedel, for example, concluded that: "Latent class models

¹⁴⁷ "The increasing use of random parameter logit (RPL) and latent class (LC) models for the analysis of choice experiments in farming contexts has been underpinned by a recognition of the heterogeneity in farm conditions and farmer preferences, and the desire to make this heterogeneity relevant for policy formulation" (Greiner 2015b, p. 9, based on Jaeck & Lifran 2014; Schulz et al. 2014, among others).

with class probability variables reveal discrete heterogeneity and support a division into (...) groups with divergent preferences” (Broch & Vedel, 2012, p. 561). Latent classes are also important to account for attribute non-attendance, which is poorly accounted for in random logit models (Campbell et al., 2011; Collins, 2012; Lagarde, 2013¹⁴⁸).

Under a latent class model, the probability that a respondent i chooses a specific alternative j in a choice-task n (of the sequence $n = 1 \dots N$) from the alternatives ($k = 1 \dots K$) can be written as (adapted from Broch & Vedel, 2012; quoting Train, 2009):

$$(6) \quad P(jin) = \sum_{m=1}^M s_m \prod_{n=1}^N \frac{\exp(b'_m x_{jnin})}{\sum_{k=1}^K \exp(b'_m x_{kin})}$$

Where b is a vector of class-specific parameters; β with probability s_m takes the value b_m , $m = 1 \dots M$; and $f(\beta) = s_m$ for $\beta = b_m$.

s_{im} is the probability of membership of i in segment m , and can be written as:

$$(7) \quad s_{im} = \frac{\exp(\lambda_s Z_i)}{\sum_{s=1}^S \exp(\lambda_s Z_i)}$$

z_i is a vector of “psychometric constructs” and socioeconomic characteristics, and λ a vector of parameters.

The parameters of the LC choice model are estimated by means of the Maximum Log-Likelihood method. The likelihood function is derived from the probability density function defined in equation (6) (Vermunt & Magidson, 2005). The LC model mixes characteristics of the individual, in the form of, e.g., measurable terms such as some

¹⁴⁸ To account for attribute non attendance, Lagarde (2013) proposes for example to use a latent class model, where each class represents a specific non-attendance decision rule, where the attributes ignored have a parameter set to zero.

socioeconomic characteristics, and less measurable terms such as psychometric constructs, with the stated behaviour in the choice sets (Broch & Vedel, 2012).

4.2.2 Designing the choice experiment

4.2.2.1 Informing the choice experiment focus with qualitative research

Our research design was based on a sequential approach. A detailed qualitative analysis informed the design of our quantitative research. Between June 2016 and January 2017, we **interviewed** 70 farmers, farmer organizations and program managers in Ontario and 11 key informants in other Canadian provinces and countries, on PES program designs and farmers' motivations to participate or not to participate in programs associated with specific designs features. We also used a range of written information sources, including **project documents** (reports, factsheets, booklets, etc.) and **local media** (online farm news, Twitter messages on farmers' accounts, etc.), to identify policy tensions and negotiations in Ontario, helping us understand the context in which individual decisions are formed. These qualitative research methods helped identify differences in PES design significant to Ontario farmers and policy challenges in Ontario. More specifically, we identified four critical policy research areas on PES design in Ontario: (1) Hierarchizing the relative importance of various program design features in farmers' decisions; (2) Assessing the relevance of collective approaches; (3) Choosing a selection process; and (4) Securing stewardship on rented land.

(1) Hierarchizing the importance of various design features. Agri-environmental policies rely on a complex set of instruments, including financial incentives. Our

qualitative analysis singled out design features impacting Ontario farmers' decisions whether or not to participate in incentive programs (Chapters 2 and 3). Further research is required to understand which design features matter most, identify and characterize groups of farmers that value program features differently, and adapt designs accordingly.

(2) Assessing the relevance of collective approaches. Ontario PES involve farmer organizations in their governance or implementation, but projects on the ground are rarely collective or even collaborative among farmers, with only a single short-lived experience targeting collective projects among Ontario farmers identified (Chapter 3). Internationally, collective approaches are gaining traction. Program managers wonder about the potential scope for further collaborative approaches in Ontario PES, including support for collective projects, bonuses for dense adoption ('aggregation bonuses'), and further peer-to-peer outreach, including further reliance on farmer champions.

(3) Choosing a selection process. Various project selection processes have been tested in Ontario agri-environmental incentive programs. Projects to be financed are either selected on eligibility criteria alone (all eligible projects are funded), selected on a first-come-first-served basis (first eligible projects are funded up to the exhaustion of the funding envelope), using merit-based selection criteria (the most environmentally beneficial projects are funded), or conservation auctions (projects compete on both environmental merit and proposed price). Selection processes are at the centre of (sometimes heated) debates in the farming community. Based on the qualitative research, we wonder if the type of selection process actually impacts Ontario farmers' willingness to participate in agri-environmental incentive programs.

(4) **Securing stewardship on rented land.** In the context of high commodity prices, interviews revealed tensions related to land tenure access in Ontario and constraints on the adoption of environmentally beneficial management practices (BMPs) on **rented lands**. Can a policy mix with both financial incentives and legal instruments, or legal advice securing tenure, increase BMPs adoption on rented land in Ontario?

While all four policy areas listed above would be relevant for quantitative research, our work could not target all four. In December 2016, we presented and discussed these questions with policy-makers, farmer organizations and conservation authorities through our **informal field advisory committee** (see Introduction, Chapter 1). We organized a stakeholders meeting and one on one conversations with field advisors who could not be present at the meeting. Advisors were interested in all four policy research areas. Following a very insightful discussion, experts agreed that a choice experiment aimed at the first and third areas of questioning (relative importance of specific program features and selection process) could be particularly informative in Ontario. Experts' views differed on the scope for further collaborative approaches in Ontario and consequently on the interest for further research on the subject. Experts agreed on the importance of researching ways to increase BMPs adoption on rented land. However, they considered this subject to deserve standalone research. This consultation guided our choices in the design of the quantitative research component of this dissertation, with a focus on comparing the relative importance of various program features in farmers' decisions, including the selection process.

4.2.2.2 Building the choice experiment: contexts, attributes, levels

Choice experiment contexts: Choice experiments present one (or several) contexts to participants to frame their choices. During our qualitative research, we noted that farmers' motivations vary with the **type of environmentally beneficial management practices** (BMPs) considered. In particular, farmers' motivations to adopt BMPs requiring to **take land out of production** seemed to differ from motivations to adopt more **sustainable cropping practices benefiting soil health**. In this sense, our qualitative research confirmed Brick's (2013) conclusion that the type of BMP considered for adoption is an important factor to take into account when attempting to predict farmers' conservation behaviour in Ontario (Brick, 2013). Prokopy et al. derived similar conclusions in the United States (Prokopy et al., 2008). Understanding how preferences differ across BMPs is relevant to our research, but asking farmers to choose between alternatives with radically different BMPs in the same choice set or a series of consecutive choice sets would be a source of complexity, and a factor of unexplained heterogeneities, as motivations to prefer one type of BMP rather than another are of complex nature, and can be highly context dependant (i.e. dependant on the farm and land characteristics). To account for differences across groups of environmental practices, we defined **two treatments**. Each treatment was associated with a specific homogeneous group of BMPs. Respondents were randomly allocated to one of the treatments. Treatment 1 focused on BMPs requiring taking farmland out of production (to set up buffer strips, windbreaks, fencerows, grassed waterways, or wetlands). Treatment 2 focused on adopting cropping practices beneficial to soil health (cover crop, longer rotations, no-till, strip-till, or organic amendments). Consulting field experts allowed us to define contextual scripts and scenarios that are **ubiquitous** (the

change in farming practices could apply to a range of production systems); **locally relevant** (respond to recognized environmental priorities); **well-known** to target participants, and sufficiently **environmentally ambitious** to avoid measuring windfall effects (Box 3)¹⁴⁹.

Box 3: Choice experiment contexts

The context of the choice experiment was presented to participants under two modalities to test if the type of BMPs impacts preferences. Treatment 1 focused on environmentally beneficial areas on-farm, while Treatment 2 focused on cropping practices beneficial to soil health. The choice experiment context was presented as follows:

Treatment 1: “**Suppose that a stewardship program helps farmers invest to increase environmentally beneficial areas on their farms.** This includes vegetated buffer strips, windbreaks, fencerows, grassed waterways, and wetlands creation or restoration. Assume that the **total** project cost is about \$3000 **per acre.**”

Treatment 2: “**Suppose that a stewardship program helps farmers try cropping methods to improve soil health on their farms.** The program would not finance new equipment, but it would give a lump sum per acre to try practices with equipment you already have or through custom farming. Those practices could include a new cover crop, a new crop for a longer & more diverse rotation, no-till, strip-till, or organic amendments. You could test a practice that other farmers have already been successful with, or try cutting-edge innovations. But, the program would only finance technical improvements that are beneficial to soil health and new to this part of your farm.”

Precise modalities presented to the participants, including assumed project costs in Treatment 1, are based on detailed exchanges and reviews by field practitioners. An important objective of those exchanges was to ensure that the presentation of the context was ubiquitous to all BMPs within one treatment, and results in both treatments would be fully comparable. Fixing a realistic project cost in Treatment 1, and mentioning it explicitly to participants, was necessary to convert cost-shares in prices. The \$3000 per acre amount was judged realistic based on these consultations with practitioners.

Attributes: Our choice of attributes was based on the qualitative research and priorities identified by the informal field advisory committee. To limit the complexity of the choice experiment, we concentrated all attributes on program design features that can affect landholders’ decisions (Table 7) rather than mixing attributes on program design and on the level of environmental ambition, or type of environmental practices, as commonly done

¹⁴⁹ In Ontario, limited environmental additionality is one of the motivations to evolve from PES with large coverage towards competitive approaches (OSCIA, 2014a).

in previous choice experiments on agri-environmental programs (Figure 21 below). Table 34 in Appendix 6 summarizes twelve choice experiments on agricultural contracts and PES in industrialized countries¹⁵⁰.

Figure 21 presents the most common attributes in 11 choice experiments on agri-environmental incentive programs in industrialized countries. In addition to payment levels, the most common attributes include various levels of environmental ambition (approached through the percentage of area converted to environmentally beneficial practices, input restrictions, a constraint on location, etc.); applicant's flexibility to adapt her/his project or make changes during the course of the commitment; contract duration; type and intensity of monitoring, control or sanctions; and technical assistance (Figure 21). Greiner (2015) included all five types of attributes. Most studies focus on the level of environmental ambition and type of environmental commitments farmers or landowners would be ready to adopt. The type of environmental commitment(s) and their level of ambition is often approached through multiple attributes (up to four attributes in Schulz et al., 2014).

Contrary to previous research, we elected to keep the level of environmental ambition constant in our choice experiment, to focus on program design and delivery. The characteristics of the proposed programs were defined with regard to the main decision factors identified in our analytical framework (Chapter 2), and exchanges with Ontario

¹⁵⁰ Allo (2013 and 2015, Spain), Broch (2012, Denmark), Christensen (2011, Denmark), Greiner (2015 and 2016, Australia), Kuhfuss et al. (2014, France), Ruto and Garrod (2009, various European countries), Schulz et al. (2014, Germany), Villanueva et al. (2015, Spain).

policy advisors. While some attributes are in line with previous studies (Figure 21), others are original to our research.

Figure 21: Attributes included in 11 previous choice experiments on PES in industrialized countries

Table 7: Attributes and attribute levels

Attributes	Attribute levels Treatment 1 (ecological areas on farm)	Attribute levels Treatment 2 (soil health practices)
Selection and funding	- First-come-first-served - Merit-based - Conservation tender	Identical to Treatment 1
Technical and administrative support	- Not included - Technical assistance to groups - One-on-one technical assistance - One-on-one technical and administrative support	Identical to Treatment 1
Contact person with the program	- Conservation specialist - Experienced farmer	Identical to Treatment 1
Commitment (multi-year contract), with potential inspections	- Yes: 5 years - No	- Yes: 3 years - No
Payment level	- 35% cost share / 55% / 75% / 90% / 80% + \$350 per acre per year for 3 years / 100% + \$350 acre per year for 3 years	Per acre, per year committed: \$20 / \$40 / \$60 / \$80 / \$100 / \$120

Level of payment: The level of payment attribute is included in various forms in previous choice experiments on agri-environmental programs. This attribute appeals to financial motivations in our five-dimension motivation framework (Chapter 2). For BMPs associated with on-farm investments in ecologically beneficial areas (Treatment 1), financial incentives were defined as a cost-share instead of a fixed amount per acre, eventually associated with a 3-year annual grant to align with existing practices in Ontario. The explicit assumption that projects in Treatment 1 cost \$3,000 per acre allowed us to translate cost-shares in grants per acre and compare Treatments. This amount was identified with agronomists and program managers in Ontario as a realistic cost for the type of projects and farming practices included in the experiment. In Treatment 2, financial incentives were defined as a fixed amount per acre per year of participation, in line with existing practices. While levels varied across treatments on the price attribute, successive price levels were adjusted using the same premises and in close interactions with program managers, to ensure that they would represent similar levels of financial incentives for the respondents (Figure 22).

Figure 22: Comparing levels progression in the price attribute (Treatment 1 and 2)

In addition, pricing had to be coherent with the selection process. In conservation tenders, price levels were defined as price ceilings. Mimicking reverse auctions, farmers had the opportunity to bid below this price.

Contractual commitment: The question of a multi-year contractual commitment, with associated control and potential sanctions, appeared controversial in our qualitative research, with some stakeholders and farmers promoting more stringent commitments, while other farmers expressed fear that contracts and inspections would infringe on their prerogatives as independent decision-makers. While previous research has focused on the duration of the commitment, or the stringency of monitoring, control and sanctions (Figure 21), we elected to only test the presence of a mandatory commitment with associated controls, under the hypothesis that farmers with strong preferences for ownership and self-direction would have a negative utility associated with such binding commitment, which is often not required in Ontario environmental programs. Thus, the corresponding attribute can take two levels: (1) incentives are associated with a contractual commitment and potential inspections, or (2) no contractual commitment. Duration of the commitment is adapted to BMPs in the treatment (3 or 5 years).

Technical and administrative supports were an important subject of concern in our qualitative interviews, with technical assistance sometimes described as a major motivation for participating in Ontario agri-environmental programs. We concluded that the relative importance and potential interactions between technical assistance and funding were an important area of research. Previous CE have already explored the importance of free technical assistance in agri-environmental incentive programs (Christensen et al., 2011;

Kuhfuss et al., 2014; Trenholm et al., 2013). Attribute levels in our choice experiment include: (1) no technical or administrative support; (2) technical assistance to groups; (3) one-on-one technical assistance; and (4) one-on-one technical and administrative support. We originally assumed that those levels would raise increasing interest from respondents from levels (1) to (4) (ordinal variable).

Selection and funding: Coherent with the current trend to evolve towards more competitive PES, and interest expressed by the informal field advisory committee, we included, in our CE, an original attribute on the selection process. This attribute can impact multiple decision factors associated with transactions costs, perceived risk and perceived fairness. To limit CE complexity, we considered only three selection modalities as attribute levels: (1) first-come-first-served; (2) merit-based approach; (3) conservation tender. In the first case, the selection is not project dependant. In the second case, the selection is only based on the project environmental merit with fixed payment rates for a certain type of BMP. In the third case, projects compete on their environmental merit and price.

Contact person with the program: Given the importance of ownership and self-direction, revealed in our qualitative research, we deemed it important to consider a second attribute associated with these motivation factors. While this attribute is original to agri-environmental experiments in industrialized countries, to our knowledge, Kaczan et al. (2013) considered the profile of the person in charge of inspecting sites under PES contracts as one of their CE attributes in Tanzania¹⁵¹. In our CE, we considered two levels

¹⁵¹ With either no inspection (low conditionality), a local villager (moderate conditionality), or a forestry officer (high conditionality) in charge of site inspections.

of attribute, depending on whether the program contact person is (1) a conservation specialist; or (2) an experienced farmer.

In line with previous research (Figure 23), we chose to consider a total of five attributes. To limit the cognitive burden and attribute non-attendance, certain key factors in our analytical framework (Chapter 2) were integrated into the choice experiment as differences in **treatments** or **follow-up questions** (Table 8), rather than additional attributes.

Figure 23: Number of attributes in 12 CE with farmers in industrialized countries

Table 8: Programs characteristics in the CE and corresponding hypothesized decision factors

Decision factor	Behavioural traits	Characteristic of the good	Indirect targeting in the choice experiment
Financial impact	Self-interest	Financial incentive level	Attribute: Level of financial incentive (as a cost-share or fixed amount per acre, as most relevant to a specific treatment). Attitudinal questions in the survey.
Feasibility / risk	Risk aversion	Change in risk exposure	Attribute: Technical and/or administrative assistance.
Ownership / self-direction	Endowment effect	Commitment versus flexibility	Attribute: Multi-year contractual commitment or not. Attribute: Experienced farmer or conservation specialist as a contact person Attitudinal questions in the survey.
Personal norms	Altruism; pro-environmental attitude	BMP perceived opportunity costs & public benefits	Treatment: The choice experiment compares two treatments. Scenarios in the treatments correspond to BMP types identified in the qualitative research as relying differently on personal norms. Attitudinal questions in the survey.
Social norms	Conformism	Peer adoption	Follow-up question: When CE participants elected the opt-out option in a choice set (participation in none of the two programs proposed), a follow-up question asked if they would participate if most of their neighbours did so. Direct questioning also included a question on the importance of what peers do.

Attribute levels. Attribute levels keep the **level of environmental ambition constant**, and correspond to **realistic policy options**, most of which are **already known** to Ontario farmers. To define attribute levels, we mimicked existing programs as closely as possible. Realism was ensured through the extensive phase of qualitative analysis and verified with key informants involved in policy design and implementation. To ensure realism, some of the attribute levels had to be adjusted across treatments: the duration of the contractual commitment and the financial incentive structure (see above). Attribute levels are reported in Table 7, and corresponding visuals are in Appendix 8. We verified with informal field advisors that the level of complexity in the choice sets was compatible with decisions by Ontario farmers. The very limited proportion of respondents who dropped out during the choice experiment (see below) tends to confirm this appreciation.

4.2.2.3 Experimental plan

We defined an experimental plan using NGene, a specialized software developed by Choice Metrics. We elected a D-efficient design. A fractional factorial D-efficient design requires a much smaller sample size than a random orthogonal design, or a full factorial design (Rose & Bliemer, 2013; Greiner et al., 2014). We used priors positive or negative but close to zero when we could derive information on a parameter's sign from our qualitative research but had no information on the potential magnitude of the variable's impact. When we had no pre-existing knowledge of the potential impact of an attribute level, we used zero priors for the parameters in the design. Each choice set presented three alternatives: two unlabelled alternatives corresponding to different program designs with

the same set of attributes and an opt-out alternative (non-participation) to account for the voluntary nature of PES. Respondents were asked to choose their preferred option in each choice set. Our design was organized in 24 choice sets divided into four blocks (Appendix 9). Each respondent was thus presented with six successive choice sets.

Two **constraints** were built in the design. In alternatives with conservation tenders, prices were defined as price ceilings rather than fixed prices; and **conservation tenders could not be associated with the two lowest levels of the price attribute**. But farmers could bid as low as they wanted, with multiple choices offered down to the lowest level of price attribute. They could also enter their preferred price level in an open field. To limit the risk of price dominance overshadowing the effects of other attributes, we also **limited differences in prices across alternatives** in the same choice set. Specifically, we prevented comparisons between alternatives with the highest and lowest price levels.

Based on our qualitative research and in consultation with Ontario experts, we also assumed that **some of the attributes could interact** in our experimental design. We specified these potential interactions in our NGene models. We suspected interactions between:

- the **preferred mode of project selection** and the **level of technical and administrative support** (farmers may be more willing to engage in a selection process requiring complex applications if they receive support in preparing them);
- the level of technical or administrative support, and the program contact-person providing it.

Because of the conditions imposed, the attributes in our efficient design were not level balanced (i.e. the different levels of an attribute do not necessarily appear the same number of times in the experimental plan), which is not required to maximize D-efficiency¹⁵².

4.2.2.4 Questionnaire structure

The online choice experiment was organized into four sections. An introduction collected information on farmer's experience and preferred designs. Choice tasks were then introduced. A third section focussed on attributes attendance and attitude. Finally, respondents were asked socio-economic information. In the last section, an open question allowed respondents to express comments and ideas on stewardship programs. The rationale and content of the four sections are further detailed below.

Introduction: farmer's experience and preferred designs: Multiple choice questions in the first section of the survey were designed to introduce the notions later used in the choice experiment, with a double intention: ensuring that all respondents had in mind a **common definition** of the notions used in the choice experiment, and allowing each respondent to **think about her/his former experiences and preferred options on individual program features**, before having to make multidimensional choices in the experiment (Table 9).

¹⁵² Level balance and orthogonality is only one way to maximize D-efficiency. Design with neither balance nor orthogonality may have higher D- efficiency than design with exactly one of these two properties (Lemmens, 2018).

Table 9: Environmental perception and direct preferences

Environmental perception and direct preferences	Precise question
Perception of environmental benefits	Do you think that having buffer strips, windbreaks, fencerows, grassed waterways, or wetlands on your farm has a positive impact on... (Your farm, Your neighbours' farms, Your community, Soil health, Water quality, Biodiversity, Climate change, Other)
Preferred project selection method	Given that funding is limited, what do you think is the best way for environmental and soil health programs to select individual projects for funding? ¹⁵³
Preferred project implementation	Do you have a preference regarding who runs the program and selects projects for funding? (No; Yes Conservation Authority; Yes Farmer Organization; Yes OMAFRA; Other)
Preferred Technical Assistance	If the program could provide support to help you with your project, which type of technical or administrative assistance would you prefer? ¹⁵⁴

In the introductory section, notions later used in the choice experiment were accompanied **by explicit definitions**. Multiple choice questions presented farmers with **more options in program design** to choose from than in the successive choice experiment. Open answers were also made possible when relevant. Thus, farmer responses in this first section bring additional information on farmers' preferences for specific design features. This section also allows us to analyze if direct questioning and choice experiment results converge. Preferences directly stated are presented in Section 4.3.5. below. Previous experience with agri-environmental programs was approached through three indicators, to account for participation in EFP, success in applying for a grant, and applications rejected (Table 10).

Table 10: Previous experience with agri-environmental programs

Experience	Precise question
Participation in EFP	Have you prepared an Environmental Farm Plan? (No/Yes Once/Yes several)
Projects approved	Have you received a grant to improve soil health or the environment on your farm? (From any program: Environmental Farm Plan, Growing Forward 0 & 1, Conservation Authorities, ALUS, Ducks Unlimited, industry program,...)
Applications rejected	Have some of your applications to a grant program been unsuccessful?

¹⁵³ For options proposed, see Table 22.

¹⁵⁴ For options proposed, see Figure 37.

Choice tasks: The second section of the survey presented the actual choice tasks. Each respondent was asked to make **six successive choices**. Each choice set presented **two alternative programs and the option not to participate**. As per the experimental plan, choice tasks were organized into **four groups** of six choice sets. Respondents were also divided into **two treatments**, corresponding to different groups of BMPs (Box 3). Thus, participants were randomly allocated to one of eight groups of choice sets (four groups per treatment and two treatments). Choice sets are presented in Appendix 9.

Attributes attendance and attitude: The third survey section aimed at understanding attribute attendance and respondent's attitudinal profile. To identify **attribute non-attendance**, respondents were asked to what extent various attributes impacted choices made in the previous survey choice tasks (Greiner, 2014). We added two dimensions to the list of attributes: environmental impact and practices adopted by their peers to account for differences among the two treatments and options given in the CE to non-participants to follow the choices of their peers.

In addition, respondents were presented with **nine value/objective survey items** (attitudinal statements), and asked to state their position on a five-point Likert scale. This section intended to understand farmers' attitudes towards environmental practices and incentive programs. It allowed us to test the impact of individual attitudes on choices. The value/objective survey items were derived from three studies: Maybery et al. (2005), Trenholm et al. (2013), and our own qualitative research (Table 11). Maybery et al.'s article published in the Journal of Economic Psychology (2005) under the title 'Categorizing

farming values as economic, conservation and lifestyle’ is a well-recognized reference in the literature analyzing farmers’ preferences, with above 260 citations (Google Scholar, 2021). Trenholm et al. (2013)¹⁵⁵ surveyed farmers and rural landowners on their conservation behaviour in and adjacent to the Credit River watersheds (Ontario). Farmers were asked their opinion on 15 statements in Maybery et al. (2015) and 26 statements in Trenholm et al. (2013). To limit respondents’ fatigue, we selected three questions with the highest discriminative power in each original study¹⁵⁶. Finally, we added three statements we heard recurrently during our qualitative research, which were not covered in the other two surveys.

Table 11: Survey value / objective items (attitudinal statements) used to identify attitudinal traits

Source	Value/objective survey items ¹⁵⁷	Attitudinal traits
Maybery et al., 2005	When planning future farming activities, I only focus on how profitable they would be.	Economic
	The lifestyle that comes with being on the farm is very important to me.	Lifestyle
	Managing environmental problems on my farm is a very high priority.	Conservation
Trenholm et al., 2013	As a landowner, I have the responsibility to take into account the values and interests of society at large when making decisions about my land.	Conservation (other-regarding)
	There is too much government regulation on private land use.	Ownership
	Environmentally sensitive areas on private land should be protected from being altered or damaged.	Conservation (low ownership)
Derived from our qualitative analysis	I do not want anybody to tell me what to do on my farm.	Self-direction
	I like to show my children or my community that I can have a positive impact on the environment.	Conservation (other-regarding)
	Investing in the environment will help secure and develop my market access.	Conservation (economic)

¹⁵⁵ This study explored the following research question: “Are there factors that explain why some farmers convert conservation lands to agricultural production while some farmers establish conservation lands on their property?” The data for this study was obtained from a survey of rural landowners in, or near, the Upper Thames River and Grand River watersheds. The survey was developed by a team from the University of New Brunswick and Simon Fraser University.

¹⁵⁶ We only excluded the statement: “Land stewardship by farmers is more important than anything else about farming” from Maybery et al. (2005) to acknowledge that Ontario farmers have different conceptions of what stewardship entails (Brick, 2013).

¹⁵⁷ The sample size of 280 respondents in our survey comfortably meets the minimum ratio of five individuals per survey item (Maybery et al., 2005).

Respondents in our choice experiment survey were asked to state their position on the nine statements on a five-point Likert scale, ranging from ‘Strongly disagree’, to ‘Strongly agree’. Examining farmers’ responses helped us identify attitudinal traits.

Socio-economic data: In line with previous research on farmers’ agri-environmental preferences, we collected information on individual and farm-specific characteristics, including farm size, farm size owned, respondent’s age, membership in an environmental association, membership in a producer association, education, gender, dependency on farm income, and having a successor or not (Table 12). The list of socio-economic data collected was based on the research literature on farmer environmental preferences, including previous choice experiments (Chapter 2, Table 2), with further emphasis on membership in agricultural and environmental organizations, as we explore the importance of social networks.

Table 12: Socio-economic questions

Characteristic	Precise question
Farm size	How many acres do you farm?
Farm size owned	How many acres of farmland do you own?
Commodity	“What is your primary commodity?”
Agricultural region	“In which agricultural region is your farm located?”
Respondent’s age	“How old are you?”
Membership in an environmental / hunting association	“Are you a member of a stewardship group, an environmental association, a fishing or hunting association?”
Leadership in a farmer organization	“Are you on the board of directors of a farmers' organization?”
Education	“What is the highest level of education you received?”
Gender	“What is your gender?”
Dependency on farm income	“Is farming the main source of income in your household?”
Having a successor or not	“Do you have a successor on your farm? (for example a child who plans to keep the farm after you)”

Data on farmers' socio-economic profile, preferences, environmental perceptions, attitudes, and past experience with agri-environmental programs helped us analyze our sample and interpret heterogeneities in preferences across groups of farmers revealed by the choice experiment.

4.2.2.5 Survey administration and bias mitigation

Survey administration: With a limited timeframe and budget, using exclusively face-to-face interviews to administer the choice experiment was not an option. The 2011 Census of agriculture identified that a majority of farmers in Ontario used the Internet for farm business, with a proportion of 50 to 65% in agricultural regions of Eastern and South-Western Ontario. Online choice experiments are relatively cheap and offer additional flexibility in the organization of the choice tasks and follow-up questions. Using an online survey allowed us to tailor follow-up questions to the respondents' choices. However, as with any online survey, ours may be prone to a bias associated with Internet access and proficiency. Using an online method can result in an overrepresentation of young farmers and large farms. We discuss our sample's representativeness in the next section.

We collected data through an online survey from March to May 2017, using the survey platform Qualtrics available through Carleton University. A consulting firm provided support and training in developing the online survey. In particular, two functionalities needed programming in HTML: the insertion of choice sets with multiple attributes and the possibility offered to withdraw from participation at any stage of the survey (as planned in our ethics application). To facilitate participants having to make successive choices, we included a visual with each attribute level. Consultation with field experts confirmed the

usefulness of the visuals (Appendix 8). Participation in the survey was only open after prior informed consent. Prior informed consent text is presented in Appendix 7.

Recruitment strategy and self-selection bias: Ontario experts informed us that, given the high number of surveys and time constraints in the farming community, we should expect low response rates to an online survey. In this context, we acknowledge that our choice experiment could be affected by significant self-selection bias. Two potential strategies were thus considered. We could extensively advertise the survey within a limited group of farmers to aim for a 10% or 20% response rate as achieved by similar studies in other jurisdictions (Kuhfuss, 2014)¹⁵⁸. However, even a 20% response rate is not sufficient to avoid self-selection bias, and we would not know if our selected group (or micro-region) fairly represents Ontario. Instead, we decided to broadcast the survey widely. Measures were taken: (i) to ensure that farmers in diverse networks had the possibility to participate and (ii) to appeal to a range of motivations.

We used four complementary strategies to recruit participants. Firstly, invitations were relayed electronically by farmers' networks representing a diversity of socio-economic profiles and viewpoints in the Ontario farming sector. The magazine *Better Farming* – which targets commercial farmers in Ontario – invited those in its electronic mailing list to participate in the survey, advertised the survey in its weekly newsletter, and included an article on the survey in its online version. OSCIA - a farmer organization responsible for implementing major agri-environmental programs in Ontario - sent an invitation to its

¹⁵⁸ Similar rates were also achieved in Ontario in postal surveys. Brick (2013) reported an 18% response rate to a farmer survey by postal mail.

mailing list, followed by a reminder, and included an insert in its newsletter. The Ecological Farmers of Ontario advertised the survey in their newsletter and on social media. Several experts - connected to networks of innovative farmers and farmers interested in soil health and environmentally beneficial projects (including pollinators) - relayed the information on their Twitter accounts.

Three complementary methods, focused on Eastern Ontario for feasibility reasons, were tested to control for selection biases. We sent a postcard invitation to 5,426 farms in Eastern Ontario, using the Canada Post neighbourhood mail service. Bilingual postcards were sent to municipalities with a significant proportion of Francophone inhabitants (above 30%). Our objective was to extend our outreach to farmers not regularly connected by email to farmer organizations. Two Masters students at Carleton University, with personal knowledge of farming and farming communities in Eastern Ontario, also recruited a small sample of farmers (35 respondents, i.e. 12% of our final sample) using direct recruitment methods based on snowball sampling. These students had no connection with environmental programs. Our objective with this third recruitment method was to control for self-selection bias, and Internet access and proficiency biases. Farmers contacted by the Masters students were interviewed face-to-face using computer-assisted personal interviewing. Students brought their own computers and Internet connections to the farms. They introduced the choice experiment and responded to farmers' questions as needed. To minimize social desirability bias, farmers completed the survey themselves, and students did not look at the farmers' responses unless asked for help. Finally, we also tried recruiting at a major farm show to reach a diverse group of farmers. But this type of venue was ill-suited to attempting a full survey (absence of dedicated space and time).

Our survey did not include a question asking how the respondent was informed of the survey. However, the peaks in the daily number of responses following specific dissemination methods were explicit, whereas others dissemination methods did not trigger particularly high response levels in the following days. In particular, we observed peaks in response numbers after direct emails were sent by Better Farming and OSCIA. The impact of postcard invitations was less explicit. Students were successful in recruiting participants who do not usually participate in surveys.

Survey respondents were given the opportunity to enter a draw to win one of thirty gift cards valued between \$20 and \$200. Financial incentives for participation have been used in surveys with a similar target audience (Rahelizatovo & Gillespie, 2004; Paudel et al., 2008; Brick, 2013). The survey was confidential. Farmers' contact information was only collected if they wished to participate in the draw and was not connected with survey responses. The survey used Qualtrics, a software with multiple layers of protection subject to US privacy and confidentiality laws. Contacts were collected in SimpleSurvey, stayed on Canadian Servers, and were erased once the draw was over and gift cards mailed out. As respondents completed the survey, they were offered the option of withdrawing. When they chose to withdraw, all the information provided was erased. The ethics protocol was reviewed by the Carleton University Research Ethics Board, which gave clearance to carry out the research.

We cannot claim that the responses we obtained accurately reflect the viewpoint of all Ontario farmers, but a diversity of farmers potentially interested in stewardship programs were given the opportunity to participate in the choice experiment. Having used a diversity

of advertisement channels and incentives, we allowed for our sample to represent a diversity of farmers interested in stewardship programs for various motives.

Hypothetical bias and strategic responses¹⁵⁹. Choice experiments share some of the shortcomings of laboratory experiments. As subjects know that they participate in a hypothetical choice, their responses may be biased. In particular, in stated preference methods, hypothetical bias and social desirability bias affect the estimation of the stated willingness to accept (Harrison & Rutström, 1999). Because the contract is fictitious, landholders can ‘afford’ to accept minimal compensations to adopt environmentally friendly and socially desirable practices, while those levels of compensation might be insufficient if the situation was real. Previous research has shown that such biases can be minimized if participants are convinced that the results of the research will influence policy decisions (Champ et al., 2009). To minimize hypothetical bias, we made explicit in all survey advertisements and introduction materials (consent form) that survey results will be presented to policy-makers and farmer organizations and may impact policy design¹⁶⁰. The survey being advertised by well-recognized farmer organizations supported this claim. Researchers using stated-preferences methods for policy design also fear that participants may respond strategically to influence program design in their favour. To reduce this source of hypothetical bias, Cummings and Taylor (1999) proposed to use ‘cheap talks’ in an introductory statement. In contingent valuation methods, cheap talk entails including a

¹⁵⁹ The two sources of hypothetical bias have opposite effects, as social desirability would reduce the stated ‘willingness to accept’ socially desirable environmental practices, and strategic answers increase it.

¹⁶⁰ The introductory sentence reads as follows: “We will ask your preference between various program scenarios. Project results will be presented to farm organizations and policy-makers in Ontario. Your experience and viewpoint may thus inform future programs for Ontario farmers.”

script that explicitly highlights the hypothetical bias problem before participants make any decisions (Murphy et al., 2005), through a straightforward message at the beginning of the survey, encouraging respondents to provide realistic answers. Murphy et al. (2005) and Carlsson et al. (2005), among others, found that introductory ‘cheap talk’ was effective in reducing hypothetical bias. Utilizing a large national survey and split-sample experimental design, Tonsor and Shupp (2011) also found ‘cheap talk’ scripts led to more reliable estimates of consumers’ willingness to pay in online choice experiment. Following those recommendations, we used cheap talk to introduce the choice tasks. In our study, the choice experiment was introduced by the following ‘cheap talk’ sentences:

“Now, we will ask you to choose between potential programs. Please answer even if you are not willing to participate in any of the proposed programs. Please consider the options carefully - as if you were participating in a real program - since the program would have a limited budget and could only fund a limited number of projects. If you are not sure of the exact answer, please put your best estimate.”

Social desirability bias: Survey respondents tend to respond so as to be viewed favourably by others. To reduce social desirability bias, Lusk and Norwood (2009) recommended using an inferred valuation, i.e. a questioning approach in which respondents are asked to predict other people’s choices. In a recent study on landholders’ preferences for PES in Tanzania, Kaczan et al. (2013) found social desirability bias to be minimal, as direct answers and inferred valuation provided similar results. In our case, the inferred valuation would not be appropriate to minimize bias. Our research aims at detecting and accounting for heterogeneous preferences. Members of groups with minority preferences may well be aware that they do not represent the most common behaviour, so asking what others would do could misrepresent minority preferences.

Attribute non-attendance: As underlined by Greiner et al. (2014), attribute non-attendance (i.e. the fact that certain respondents do not give any significant weight to some of the attributes) can be an important source of non-observed heterogeneity. To estimate and account for attribute non-attendance, researchers can either directly question respondents on the importance given to specific attributes, or draw inferences from the responses. Scarpa et al. (2009) suggest, for example, using a panel mixed logit model based on a latent class structure to detect respondents who belong to latent classes with zero utility weights for selected attributes. Following Greiner et al. (2014), we used both methods. Using both a latent class model and direct questioning helped us identify respondents with limited or no utility for specific attributes.

Protest answers: Some respondents may react negatively to the format of the survey or choice tasks. Those respondents may be interested in participating in real programs but find the survey intrusive, incomprehensible, or useless. To identify protest answers, we questioned respondents who systematically chose not to participate (Greiner et al., 2014). Among the proposed motives for non-participation, we included “I don’t like this type of survey”, and considered the respondents who elected this option as protest answers. We also considered comments in open-ended fields. Three responses were deemed protest answers. The actual number of protests might be higher, as respondents were offered the choice to withdraw during the completion of the survey, and respondents unhappy with the survey format might have chosen this option. One respondent considered a protest answer had no farmland either owned or rented; two mentioned a strong dislike for the survey format in their open responses. Out of six respondents who chose never to participate in

the choice sets, only one was considered a protest answer. Others explained they were not willing to participate because they had a negative experience with agri-environmental funding programs in the past, have a negative perception of government-funded programs, or do not want anybody to tell them what to do on their farm. We decided not to eliminate respondents who expressed negative opinions of governments or government-funded programs, as those positions are in line with some of the motives for non-participation identified during the qualitative research. In particular, keeping respondents with negative opinions of agri-environmental incentive programs in the survey helped us understand the reasons that motivate this perception and the conditions under which those respondents might be willing to participate.

Sample size: After removing protest answers, we have a sample size of 286 respondents, representing 1716 choices. Greiner (2015) considered that a much smaller sample of 104 responses was sufficient¹⁶¹:

“The sample size is sufficiently large to estimate all attribute coefficients at the level of $P < 0.01$ statistical significance because of the D-efficient choice experimental design, which requires a much smaller sample size than a random orthogonal design (Rose & Bliemer, 2013). A systematic review of discrete choice experiments based on design features and sample size by Bliemer & Rose (2011) supports the assertion.” (Greiner, 2015, p. 17)

¹⁶¹ Greiner only eliminated 4 protest answers. Our approach is coherent with her choices. Other researchers tend to remove a larger number of protest answers, assuming a large range of potential protest answers and conservatively reducing the number of respondents (Trenholm et al., 2013, removed for example 34% of their respondents, considering them protest answers or strategic answers). This conservative approach may hinder the researcher’s capacity to understand why some farmers are actually unwilling to participate in PES, rather than unwilling to participate in the survey.

4.3 Results

The results of the choice experiment and associated survey are presented below. The upcoming section discusses the socio-economic characteristics of the respondents and their representativeness. A second section focuses on the psychosocial characteristics of the respondents, which may significantly impact their choices. A third section presents the results of the choice experiment and latent class models. Finally, a fourth section puts in perspective the result of the choice experiment, using answers to direct and open-ended questions in the survey associated with the choice experiment.

4.3.1 Respondents socio-economic characteristics and representativeness

Participation. Three hundred and twenty-four (324) Ontario farmers agreed to participate in the survey¹⁶². Three hundred and fifteen (315) provided usable answers in at least one of the survey sections. Two hundred and eighty-nine (289) respondents started the choice experiment, and two hundred and eighty-four (284) completed it, corresponding to a total of 1721 choices. Two-hundred-and-eighty (280) Ontario farmers completed the entire survey. With only 1.7% of respondents dropping out during the choice experiment, the length or complexity of the choice task (six successive choices) was unlikely to be a barrier to participation¹⁶³. We elected to keep the survey as concise as possible to account for

¹⁶² Out of 49,600 farms in Ontario (Statistics Canada, 2016). Respondents who chose to withdraw have been removed from these numbers.

¹⁶³ Another 1.7% stopped just before starting the choice experiment. Once again, this number is an indication that the choice experiment format was not a barrier to participation.

Ontario farmers' busy schedule, mentioned repeatedly as a constraint to participation in the qualitative research. Respondents took a minimum of 6.5 minutes and a median of 19 minutes to complete the survey¹⁶⁴. Only 8% of the respondents retained in our choice experiment took less than 10 minutes to complete the survey¹⁶⁵. The distribution of respondents by response time is presented in Appendix 16 (Figure 49 and Figure 50). 106 respondents chose to also share ideas and opinions on stewardship programs using the general open-ended question at the end of the survey¹⁶⁶ (i.e. about 38% of those who completed the entire survey).

Only sixteen respondents (6%) mentioned they were uncertain of their decisions in the choice experiment¹⁶⁷, 163 (57%) were somewhat certain, and 105 (37%) very certain.

Withdrawal: Some respondents decided to withdraw part-way through the survey. We cannot assess the proportion of Ontario farmers who chose to withdraw. Several non-farmers (experts, consultants, and researchers) expressed interest in the research. Some of them, knowing that they could withdraw, started to complete the survey. This prevents us from assessing the proportion of actual withdrawals. Out of the 36 farmers who completed the survey through computer-assisted personal interviewing, one chose to withdraw.

¹⁶⁴ We had indicated in the advertisement material and consent form that the survey should take from 15 to 20 minutes. Most respondents who used 17 minutes or more to complete the survey took the time to answer facultative open-ended questions.

¹⁶⁵ The survey was rapid to complete by design, and almost one in four respondents who spent less than 10 minutes completing the survey filled at least one of the open fields, showing that they took the time to read the questions and answer precisely. Only one of the respondents retained in the CE who used less than 10 minutes to complete the survey mentioned that she was uncertain of her choices.

¹⁶⁶ Responding to the open-ended question "Do you have any other idea or thought on stewardship programs that you want to share?".

¹⁶⁷ Two of which were later identified as protest answers.

The socio-economic profile of participants having completed the whole choice experiment and follow-up socio-economic questions is presented in Table 13 below.

Table 13: Socio-economic characteristics of respondents
(n=280 respondents having completed the entire survey)

Characteristic	Options (# of respondents)
Farm size (acres)	Continuous, Responses from 1.4 acres to 5100 acres
Farm size owned (acres)	Continuous, Responses from 1.2 acres to 4800 acres
Commodity	Beef (26) / Dairy (55) / Field crops (148) / Fruits or vegetables (6) / Greenhouses (1) / Poultry (8) / Sheep, goats, or horses (14) / Swine (8) / Other (14)
Agricultural region	Central Ontario (36) / Eastern Ontario (141) / Northern Ontario (5) / South-Western Ontario (96) / Other [East-Central] (2)
Respondent's age	18 – 30 (36) / 31 – 45 (52) / 46 – 60 (118) / 61 or more (74)
Member in an envtal / hunting association	Yes (97) / No (183)
On the board of a FO	Yes (104) / No (176)
Education	High school (48) / College (131) / Bachelor (74) / Masters (23) / PhD (3) ¹⁶⁸
Gender	Male (226) / Female (50) / Prefer not to answer (4)
Farming is the main household income	Yes (177) / No (102) / No answer (1)
Having a successor or not	Yes (163) / No (113) / No answer (4)

With the 2016 Census of Agriculture just published, we had recent socio-economic data to adjust our sample. However, ample research has shown that attitudes and preferences – which are at the center of our research – are not necessarily connected with socio-economic variables, so we cannot ensure that the adjustment factors we would use would help with representativeness on the variables of interest. In addition, we do not claim that the survey represents the position of all Ontario farmers but rather the position of farmers interested in stewardship programs. We chose, therefore, not to adjust our data using socio-economic data in the 2016 Census of Agriculture. However, we used Census data to analyze how our

¹⁶⁸ Master and PhD levels were grouped in the analysis.

respondents' profiles compare with the Ontario farming community. Statistical tests of significance are presented in Appendix 10.

As suspected, using the Internet to deliver the choice experiment introduced a significant bias towards **large farms** (above 400 acres) and **young farmers** (below 35 years). A similar response bias is common in previous online CE with farmers (Broch & Vedel, 2012; Kuhfuss et al., 2014; Schultz et al., 2014), and is not necessarily an issue, as larger farms and younger farmers are representative of future situations.

Agricultural region: To control for selection bias associated with the online method, we decided to broadcast the survey more intensively in Eastern Ontario (through postcards and direct recruitment), and relied on partner organizations to distribute the survey across Ontario. Subsequently, Eastern Ontario farmers are significantly overrepresented in the sample (Figure 24).

Figure 24: Distribution of Ontario farmers and respondents by agricultural region (n=280)

However, farmers from other agricultural regions of the province also participated in the survey¹⁶⁹. The respondent's region is not a significant factor in our models.

¹⁶⁹ Two farmers responded that their farms were located in Central Eastern Ontario. We interpreted this location as in Central Ontario.

Gender: Male respondents are significantly overrepresented if we consider the average profile of Ontario farm operators (Figure 25). However, women are more frequent among the respondents than in Ontario farms with one operator. We thus cannot conclude on gender representation as we do not know the proportion of multi-operators' farms who participated in the survey.

Figure 25: Distribution by gender of farm operators in Ontario and survey respondents

Commodity. Field crops and dairy producers are significantly overrepresented in our sample, while 'other', beef, and fruit or vegetable producers are significantly underrepresented (Figure 26). This is not surprising as agri-environmental stewardship programs largely target field crops and dairy or cattle farmers, who are thus more likely to be interested in our experiment. Dairy is more represented than beef cattle, which is also not surprising as dairy is particularly frequent in Eastern Ontario (oversampled region).

Figure 26: Distribution by commodity

Former experience with agri-environmental programs: 83% of survey respondents have prepared an Environmental Farm Plan; 53% have received one or several grants to improve soil health or the environment on their farm, and 36% have already had at least one of their applications denied (Figure 27). Unsurprisingly, our respondents have probably more experience with stewardship programs than Ontario farmers on average. However, the gap may not be very large. In 2014, Morrison and FitzGibbon established that 70 to 75% of all Ontario farmers had already completed an Environmental Farm Plan.

Figure 27: Former experience with agri-environmental programs (% of respondents)

Language community. Another significant representation bias needs to be acknowledged. In an effort to sample both Anglophone and Francophone farmers, we developed a French version of the online survey and choice experiment. But the Francophone farmer association identified for its importance in Ontario did not follow up with our proposal to disseminate the survey in the proposed time period. While we disseminated French versions of the advertisement postcard in Eastern Ontario, only one farmer took the survey in French. Other Francophone farmers might have completed the survey in English, a default survey version, but the Francophone farming community in Ontario is likely underrepresented.

4.3.2 Respondents psychosocial characteristics

Following previous research on farmers' conservation behaviour referenced above, and building on our qualitative research, we intend to test if attitudinal traits and social connectedness have an impact on Ontario farmers' preferences for specific PES design; if they influence their choices in the CE, and help segment groups of farmers with heterogeneous preferences. To test for such contribution, we built aggregate indicators of attitudinal traits and social connectedness, as described below.

4.3.2.1 Respondents attitudinal traits

The distribution of respondents' positions towards objective / value items is presented in Table 14 below.

Table 14: Respondents' positions on objective / value items

Objective / value item	Strongly disagree	Dis-agree	Neither agree nor disagree	Agree	Strongly agree
S1: When planning future farming activities, I only focus on how profitable they would be	17	46	76	102	36
S2: The lifestyle that comes with being on the farm is very important to me	5	5	13	124	130
S3: Managing environmental problems on my farm is a very high priority	3	4	17	168	86
S4: As a landowner, I have the responsibility to take into account the values and interests of society at large when making a decision on my land	18	30	65	129	36
S5: There is too much government regulation on private land use	8	20	82	86	81
S6: Environmentally sensitive areas on private land should be protected from being altered or damaged	23	45	83	99	27
S7: I do not want anybody to tell me what to do on my farm	6	27	77	109	57
S8: I like to show my children or my community that I can have a positive impact on the envt.	3	0	23	156	93
S9: Investing in the environment will help secure and develop my market access	11	33	85	109	39

Attitudinal segmentation is used in marketing for crafting strategies that appeal to customers with diverse attitudes regarding products or services. Attitudinal segmentation provides insight into the attitudes and beliefs that drive consumers' decision-making and behaviour. Attitude segmentation is also relevant to policy and program design. Indicators of environmental or pro-social attitudes have been used in research on environmental policies (Sheeder & Lynne, 2011; Greiner, 2015...). To develop aggregate indicators of attitudinal traits, we proceeded as recommended by Fishbein and Ajzen (2010), and analyzed correlations among respondents' reactions to value or objective survey items (Table 15 and Figure 48 in Appendix 11).¹⁷⁰

Table 15: Correlations among objective / value items

Objective/ value item	S2	S3	S4	S5	S6	S7	S8	S9
S1	0.05	-0.18 ⁻	-0.17 ⁺	0.22 ⁺	-0.15 ⁻	0.06	-0.19 ⁻	-0.16 ⁻
S2	1	0.19 ⁺	0.22 ⁺	0.01	0.13 ⁺	0.08	0.12 ⁺	0.13 ⁺
S3	0.19 ⁺	1	0.48 ⁺⁺	-0.15 ⁻	0.34 ⁺⁺	-0.14 ⁻	0.5	0.41 ⁺⁺
S4	0.22 ⁺	0.48 ⁺⁺	1	-0.18 ⁻	0.44 ⁺⁺	-0.22 ⁻	0.34 ⁺⁺	0.47 ⁺⁺
S5	0.01	-0.15 ⁺	-0.18 ⁻	1	-0.26 ⁻	0.43 ⁺⁺	0.03	-0.13 ⁻
S6	0.13 ⁺	0.34 ⁺⁺	0.44 ⁺⁺	-0.26 ⁻	1	-0.26 ⁻	0.14 ⁺	0.43 ⁺⁺
S7	0.08	-0.14 ⁺	-0.22 ⁻	0.43 ⁺⁺	-0.26 ⁻	1	0.02	-0.14 ⁻
S8	0.12 ⁺	0.50 ⁺⁺	0.34 ⁺⁺	0.03	0.14 ⁺	0.02	1	0.41 ⁺⁺
S9	0.13 ⁺	0.41 ⁺⁺	0.47 ⁺⁺	-0.13 ⁻	0.43 ⁺⁺	-0.14 ⁻	0.41 ⁺⁺	1

Note: ++Correlations larger than 0.30 considered positive correlations. +Correlations between 0.10 and 0.3: weak positive correlations. -Correlations between -0.10 and -0.30: weak negative correlations.

¹⁷⁰ "Responses to each item in the original item pool are scored from 1 to 5. Strong agreements (...) are given a score of 5, and strong disagreements (...) are given a score of 1. (...) Preliminary attitude scores are obtained by summing across all item scores. (...) the higher the score, the more favorable the attitude. In practice, an item is said to meet the criterion of internal consistency if the item score correlates strongly with the total (preliminary) attitude score. The final Likert scale is composed of the most discriminating items (i.e., of the items that have the highest correlations with the total score)" (Fishbein & Ajzen, 2010, p.88).

To confirm this identification, we also analyzed correlations with preferences directly stated by the respondents after the choice experiments (factors that respondents mentioned as impacting their choices or not). On this basis, we identified three attitudinal traits.

Pro-environmental attitude. A group of farmers expressed environmental preferences unambiguously. Half (49%) of respondents either agreed or strongly agreed with at least four of the five attitudinal statements reflecting pro-environmental attitude (S3, S4, S6, S8 and S9). Unsurprisingly, responses to all those statements are correlated (with correlations from 0.35 to 0.5). Farmers expressing a strong pro-environmental attitude are also more likely to declare that environmental impacts matter most in their decision to participate. Environmental attitude and socio-demographic factors have limited correlation. Filson (1993) found that younger, well-educated farmers, especially if female, were most concerned about the seriousness of rural environmental degradation. Our results only partially converge. Older farmers feel slightly more responsible towards others¹⁷¹. Women are more willing to agree with environmental protection on private land (S6). Women, older farmers, and farmers with primarily non-farm income are more convinced that investing in the environment might help them secure or develop their market (weak correlation, S9).

Ownership and self-direction. Some respondents expressed a clear preference for private ownership and self-direction, supporting the attitudinal statements S5 and S7: “There is too

¹⁷¹ Correlation significant at $p=0.1$ between age and support to S4: “As a landowner I have the responsibility to take into account the values and interests of society at large when making a decision on my land”.

much government regulation on private land use” and “I do not want anybody to tell me what to do on my farm”¹⁷². In general, farmers supporting those statements (‘Private-minded farmers’) are less supportive of statements in favour of environmental protection. However, nuances are worth mentioning. ‘Private-minded farmers’ tend to dismiss environmental views that conflict with their sense of private ownership (S6) and independent decision-making (S4). Positions are different on statements more compatible with self-direction (S3; S8)¹⁷³. In particular, ‘Private-minded farmers’ care for environmental impact on their children and communities (S8). Women, farmers whose household income comes primarily from off-farm activities, and farmers with higher education tend to have less pronounced preferences for ownership and self-direction (weak correlation)¹⁷⁴. The survey was not advertised through landowners’ rights associations, and while some farmers in the landowners’ rights movement in Eastern Ontario have probably received a survey invitation by postcard, we cannot assume that the survey reflects their position. However, - as strong preferences for ownership and self-direction were expressed by a group of farmers - the choice experiment helps understand if those preferences are compatible with a willingness to participate in various types of stewardship programs.

Economic objectives. We assessed respondents’ priority for economic objectives by asking their opinion on Maybery et al.’s (2005) statement, “When planning future farming activities, I only focus on how profitable they would be”. Half of the respondents agreed

¹⁷² Forty percent of respondents agreed with both statements, and 36% strongly agreed with at least one.

¹⁷³ Support of the statement “Managing environmental problems in my farm is a very high priority” is only slightly negatively correlated with preferences for ownership and self-direction, and farmers with stronger preferences for ownership and self-direction do not react differently from others to the statement “I like to show my children or my community that I can have a positive impact on the environment”.

¹⁷⁴ Our findings do not concur with Filson’s finding (1993) – on a much larger sample of Ontario farmers – that the largest operators were most opposed to government conservation regulations.

with this statement. Economic and environmental objectives are not perceived as opposed: 88% of farmers reporting an economic focus also consider managing environmental problems on their farms a very high priority (S3). However, farmers reporting a focus on profitability are less supportive than other farmers of pro-environmental statements and are more likely to declare that financial incentives influence the most their choices in the CE. Most educated farmers are less likely to focus on economic aspects alone (S1), and older farmers are less inclined to declare that financial incentives impact the most their decisions in the CE.

Based on this analysis, and following the methodology recommended by Fishbein and Ajzen (2010), we built three indicators of attitudinal traits, corresponding to (1) pro-environmental attitude, (2) preference for ownership and self-direction, and (3) economic focus (Appendix 11).

In their reference paper, Maybery et al. (2005) identified three groups of farmers with contrasting farming objectives: economic, environmental, or lifestyle objectives. To identify respondents with lifestyle as a primary motivation for farming, we used Maybery et al.'s statement: "The lifestyle that comes with being on the farm is very important to me". With 92% approval, this statement is not discriminative in our sample. We thus decided not to include an attitudinal trait with lifestyle as a primary motivation for farming.

4.3.2.2 Social connectedness

Our research also intends to bring light on the potential relevance of social connectedness in farmers' willingness to participate in agri-environmental incentive programs. During our qualitative analysis, we identified two types of social networks particularly relevant to our

research: farmer organizations and informal networks of neighbouring farmers. Questions in the survey targeted these two networks.

- **Farmer organizations.** To register as a farm and benefit from advantageous fiscal measures, Ontario farmers must be members of a recognized farmer organization. While they can withdraw from the organization after registering, farmers rarely do so, and most Ontario farmers with significant farm income are members of a farmer organization. Instead of using membership in a farmer organization as an indicator of social connectedness, we thus asked respondents if they were on the board of directors of farmer organizations. During qualitative interviews, we noted that farmers on boards interacted closely with both board and organization members. A lot of information relevant to stewardship programs is made available through board meetings. In addition, several interviewees mentioned that a limited number of farmers tend to be on the board of multiple farmer organizations, creating a distinct group of farmers with specific connections, responsibilities, and commitment to collective action.
- **Farming neighbours and local peers.** To understand the level of collaboration (or potential collaboration) between neighbours, we asked farmers to what extent they would be interested in collaborating with neighbours, or local peers to: (1) receive free technical assistance in common; (2) coordinate their stewardship projects and receive a bonus; and/or (3) implement research plots with a group of farmers¹⁷⁵. An

¹⁷⁵ For the exact formulation, see Figure 38.

indicator was developed, with scores based on the number of collaboration modes respondents declared they were interested in.

Social networks, social capital and peers: Interestingly, memberships in stewardship groups and responsibilities in farmer organizations rarely correlate with attitudinal statements¹⁷⁶. Confirming our qualitative analysis, we found that farmers involved in collective action (giving time for others) tend to participate in several areas, with a strong correlation between being on the board of a farmer organization and membership in stewardship groups. This confirms that these are important indicators corresponding to a specific level of social connectedness and willingness to engage in collective action¹⁷⁷.

Peer to peer influence. No attitudinal survey item directly focused on the influence of social networks; however, after the choice experiment, farmers were asked if they consider “what their peers do” in selecting their preferred programs. Less than 40% of farmers declared that what their peers do matter in their choice. The importance given to what peers do decreases with the level of education. This limited weight is not necessarily surprising, as what peers do played only a limited role in the choice experiment (farmers deciding not to participate in any of the two proposed programs in a choice task were asked if they would change their mind if most of their neighbours participated). There might also be a

¹⁷⁶ The only exception being a preference for a farming lifestyle slightly higher for FO board members.

¹⁷⁷ In our response group, almost half of the board members of farmer organizations are members of a stewardship group, an environmental, fishing or hunting association. Board members of farmer organizations more frequently cite farming as their main source of income.

gap between the level of peer influence stated and the actual impact of peers' behaviour, some influence being unconscious or not admitted.

Contact person: A majority of respondents declare that the program contact person matters a lot or matters the most¹⁷⁸ in their decisions. Farmers for whom the contact person matters most are more likely to care about what peers do, appreciate farming as a lifestyle, consider the selection process in their choice, and agree with the statements “I like to show my children or my community that I can have a positive impact on the environment”, and “Investing in the environment will help secure and develop my market access”. These correlations sketch the profile of a group of community-minded farmers.

An indicator of social connectedness was developed, considering respondents stated answers on the influence of peers and the influence of the contact person profile on their choices. In the choice experiment analysis, we tested if this indicator was a significant covariate in our choice models, or significantly varied across latent classes. Membership in a stewardship organization and participation in the board of a farmer organization were also tested as indicators of social connectedness.

4.3.3 Latent classes and latent class models

We used **Latent Gold Choice software**, developed by Statistical Innovations, a firm specialized in latent class models, to identify Random Utility Maximization (RUM) models and latent class models (Vermunt & Magidson, 2005). Using Latent Gold, we tested

¹⁷⁸ The answer “This is what mattered the most” should be taken with circumspection. Thirty-six percent of respondents did not select this answer for any of the factors; and 21% selected it multiple times. For most respondents, this choice probably reflects the very high importance of a factor rather than literally ‘the most’.

various numbers of classes and compared the relative importance of program attributes in each latent class. In line with recommendations by Lancsar et al. (2007), we also tested **interactions between attributes** (Appendix 12).

4.3.3.1 Key results

We used the **Bayesian Information Criterion (BIC) as a parsimony index** to identify our preferred number of classes in the model (Schwartz, 1978). BIC introduces a penalty term to avoid adding parameters with a limited increase in the likelihood function. Choosing the model with the lowest BIC prevents over-fitting. While BIC is similar to the Akaike Information Criterion (AIC), another widely used parsimony index, the penalty term is larger in BIC¹⁷⁹. Choosing the number of classes based on BIC avoids having a large number of classes, as a large number of classes would make it difficult to develop policy adjustments adapted to each group of farmers with heterogeneous preferences.

Result 1: Depending on the model, the Bayesian Information Criterion was minimal for either a four or a five latent class model. The Akaike Information Criterion was minimal for a larger number of classes, and basing the number of classes selection on AIC alone would introduce a level of complexity incompatible with operational policy recommendations. As BIC are generally very close for 3- to 5-class models (see example Table 16), we tested various specifications on 3- to 5-class models (Appendix 12). Within

¹⁷⁹ For n larger than 8.

the 3- to 5-class range, we chose to use AIC rather than BIC to select our preferred model, to maximize accuracy (Table 37).

Table 16: Comparison of statistics of fit and repartition for latent class models with various class numbers, with covariates¹⁸⁰

	N parameters	Log Likelihood	Pseudo R ²	AIC (LL)	BIC (LL)	Correct predictions	Repartition by class					
							Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
1-Class	9	-1668	0.052	3353	3386	100%	100%					
2-Class	22	-1560	0.182	3164	3245	95%	88%	12%				
3-Class	35	-1516	0.242	3103	3230	94%	74%	15%	11%			
4-Class	48	-1477	0.338	3049	3226	91%	59%	17%	13%	11%		
5-Class	60	-1445	0.405	3010	3230	86%	42%	23%	13%	12%	10%	
6-Class	72	-1423	0.451	2989	3252	85%	34%	21%	13%	12%	10%	10%

Our preferred model (Table 17) is a **5-class model**, which outperforms 3-class and 4-class models in AIC and R² (Appendix 12), and helps understand better the diversity observed on the ground through the qualitative research. 4-class models aggregate Class 1 and Class 2 in the 5-class model, representing almost 60% of the population, thus masking some relevant diversity. The utility functions in Table 17 describe the estimated marginal utilities for the choice attributes held by each class (i.e. each segment in our respondent population). The class membership covariates capture the impact of observables on class membership probabilities. We also developed a simplified model - based on our preferred 5-class model - by removing insignificant effects and using the same parameter across several classes when original parameters were not significantly different. A resulting simplified model, outperforming our preferred model in parsimony (BIC and AIC, Table 44), is presented in Appendix 14 (Table 45). Classes' characteristics and utility profiles in the preferred model and simplified model are similar.

¹⁸⁰ For selection and technical assistance attributes considered nominal variables.

Table 17: Preferred 5-class model with covariates

	Class1	Class2	Class3	Class4	Class5	Overall						
R ²	0.257	0.292	0.306	0.47	0.093	0.405						
Percentage of respondents	42%	23%	13%	12%	10%	100%						
<i>Attributes:</i>												
Selection***							Wald	p-value	Wald(=)¹⁸¹	p-value	Mean	Std. Dev.
First-come first served	-0.37**	-1.05***	-0.28	1.75***	0.05	65	0.000	34	4.70E-05	-0.21	0.81	
Merit-based	-0.24	1.21**	-0.00	0.77	-0.79					0.19	0.68	
Conservation tender	0.62***	-0.16	0.28	-2.52***	0.74*					0.02	1.00	
Technical assistance***												
Not included	-1.24***	-0.96***	-0.45	1.48	-0.48	116	0.000	36	0.0003	-0.66	0.85	
TA to groups	0.86***	-1.00	0.66	-1.13	-0.09					0.06	0.86	
One-on-one TA	0.17	1.40***	-0.37	-0.97*	0.46					0.27	0.74	
One-on-one TA + admin. support	0.21	0.56	0.16	0.62	0.11					0.33	0.19	
Contact^{182***}	-0.18	-0.41**	2.27***	0.18	-0.92**	53	0.000	51	1.80E-10	0.06	0.90	
Contract ^{183***}	-0.40**	-0.02	-0.05	1.30*	0.95**	16	0.007	15	0.0043	0.08	0.60	
Price^{184***}	0.52***	0.00	0.04	0.47***	0.25	64	0.000	64	5.10E-13	0.30	0.23	
No program***	-1.04***	-2.53***	1.34***	-0.48	2.52***	109	0.000	88	2.80E-18	-0.63	1.56	
Intercept***	-3.58**	2.51	-6.95***	5.52**	2.50	15	0.006					
<i>Covariates¹⁸⁵:</i>												
Preference for ownership and SD***	-0.01	-0.15	0.61***	-0.25*	-0.20*	20	0.000					
Economic motivation***	0.34***	-0.33***	-0.05	-0.11	0.15	15	0.005					
Preference for the environment***	0.10**	0.06	0.10**	-0.14***	-0.11**	17	0.002					

* z<-1.645 or z>1.645: significance level of 0.1

*** z<-2.576 or z>2.576: significance level of 0.01

** z<-1.960 or z>1.960: significance level of 0.05

Bold: z<-3.291 or z>3.291: significance level of 0.001

¹⁸¹ Wald(=) tests if the hypothesis that an attribute has the same effect across classes can be safely rejected. If p< 0.05 the attribute effect varies across classes.

¹⁸² Contact with the program: 0=conservation specialist; 1= experienced farmer

¹⁸³ Commitment (contract duration), with potential inspections: 0= No; 1= Yes for 3-5 year depending on treatment.

¹⁸⁴ Six payment levels defined in Table 7.

¹⁸⁵ Composite indicators of attitudinal traits.

Result 2: All attributes in the Choice Experiment matter in farmers' preferences (Table 17, and Figure 28), as Wald p-value in Table 17 is less than 0.01 for all attributes. In addition, attribute effects significantly vary across classes (p value of 'Wald =' test is less than 0.01 for all attributes).

Result 3: The choice experiment was successful in identifying groups of farmers with heterogeneous preferences for agri-environmental programs. Preferences differ in particular with regards to the relative importance conferred to the provision of technical assistance, versus the level of financial incentive, the preferred type of technical assistance (either as a group or individually), the preferred mode of project selection, and the preferred profile of the contact person.

Result 4: The relative importance of attributes varies across classes.

Figure 28: Importance plot of choice attributes by class in Latent Gold

Class 1 (about 42% of respondents) value particularly the level of incentive (price) and technical assistance (TA), with a probable trade-off between those two attributes, which are separate benefits from participating in agri-environmental incentive programs. Class 2

(about 23% of respondents) value TA and the mode of project selection. They are indifferent to the level of incentive. Class 3 respondents confer a very strong importance to the profile of the program contact person. Class 4 respondents value the mode of project selection and the financial incentive. Class 5 often choose not to participate. Latent class profiles are described in more details in the next section (Section 4.3.3.2).

Result 5: In the preferred model, TA and selection are both nominal variables (effect coded). When we first designed the CE, we had considered our levels of TA to represent a logical progression, with one-on-one technical and administrative support preferred to one-on-one technical support alone; one-on-one TA preferred to collective TA; and collective TA preferred to no TA at all. This would have allowed us to treat TA as an ordinal variable. Responses contradicted this assumption. Some groups of respondents prefer collective TA to one-on-one support; while others prefer to receive no TA at all rather than collective TA with a group of peers. This finding lead us to define TA as a nominal variable with effects coded for each level. Similarly, selection modes could be ranked from the least to the most project-specific competitive option (with conservation tenders > merit-based selection > first-come-first-served). But respondents' preferences do not follow such gradation, as many respondents prefer merit-based selection to both other options. The 'Selection' attribute was thus also defined as a nominal variable.

Result 6: The preferred model considers no interaction among attributes. Interactions were tested between TA and the profile of the contact person, and between TA and selection mode. While some of the interactions tested are significant, the resulting models did not outperform our preferred model in both BIC and AIC (Appendix 12). One of the

models presents interesting insight: Class 1 farmers, representing about 42% of all respondents, only prefer technical assistance to be provided in group if their contact point with the program is an experienced farmer, rather than a conservation specialist.

Result 7: Variables of attitudinal traits are the only significant covariates. Our preferred model includes three significant covariates of attitudinal traits. We tested 19 variables as potential covariates in the latent class models, including socio-economic characteristics of the respondents, attitudinal traits, indicators of social connectedness, and indicators of past experience. All socio-economic variables appear to be insignificant (at $p < 0.05$). This is not fundamentally surprising as previous research shows contrasting results for all tested socio-economic variables (Chapter 2). Indicators of social connectedness are not significant either. But all three indicators of attitudinal traits are significant covariates (Appendix 13). The importance of attitudinal variables confirms our hypothesis that attitudes towards environmental and economic objectives, and preference for ownership and self-direction matter in farmers' decisions to participate in agri-environmental incentive programs. It also confirms that the program design features we have chosen as attributes matter in the decision of Ontario farmers with different attitudinal traits. As age and education are significant at $p < 0.1$ in some of our models, we also developed a model with three covariates of attitudinal traits, age and education (Appendix 13, Table 42). While education is significant at $p < 0.1$ in this model, it does not add much, as utility functions and repartition of respondents by class are very close to those of our more parsimonious preferred model, with no improvement in R^2 (Appendix 13, Table 41).

Result 8: Respondents in both treatments were pooled. Our qualitative research concludes that the type of environmental improvement (BMP) has an impact on farmers' motivations to participate, with personal norms weighing most in decisions to increase environmentally beneficial areas on farm (Treatment 1 in our CE), while risk aversion and compliance with social norms are most likely to impact participation in soil health programs (Treatment 2). To take this finding into consideration, we included two treatments in the CE. Respondent samples in both treatments share the same characteristics with regards to socio-economic variables, attitudinal traits, social connectedness, and past experience (Table 18 and Appendix 15¹⁸⁶).

Table 18: Comparison of average values across treatments

	Type	Range	Average Treatment 1	Average Treatment 2	Total
Socio-economic variables:					
Size group	Successive ranges	0 to 8	6.18	6.02	6.10
Acres farmed	Value	1.4 to 5100	511	600	554
Acres owned	Value	1.2 to 4800	351	428	389
Education	Ordinal	1 to 4	2.19	2.37	2.28
Age group	Successive ranges	1 to 4	2.79	2.84	2.82
Gender	Dummy	0 or 1	0.16	0.19	0.18
Having a successor	Dummy	0 or 1	0.60	0.58	0.59
Farming: main income	Dummy	0 or 1	0.64	0.63	0.64
Attitudinal traits:					
Preference for ownership and self direction (PP)	Score	2 to 10	7.39	7.50	7.45
Economic motivations (ECO)	Score	2 to 10	7.34	7.34	7.34
Preference for environment (ENV)	Score	8 to 30	22.56	22.54	22.55
Social connectedness:					
Indicator of peer / contact influence	Score	2 to 10	5.68	5.68	5.68
Leader in FO	Dummy	0 or 1	0.39	0.36	0.38
Member if stewardship gr	Dummy	0 or 1	0.30	0.40	0.35
Past experience:					
EFP	Ordinal	0 to 2	1.28	1.28	1.28
Grant approved	Ordinal	0 to 2	0.81	0.83	0.82
Grant unsuccessful	Ordinal	0 to 2	0.54	0.60	0.57

Note: Difference between Treatment 1 and Treatment 2 is never significant at 0.05

¹⁸⁶ While Table 18 only compares averages, Appendix 15 demonstrates similarities in distributions.

Appendix 15 compares latent class profiles when separate models are run for each treatment. Comparisons in Latent Gold Choice, SI-CHAID and SPSS found no significant difference across treatments.¹⁸⁷ The treatment is never a significant covariate in our model; and, having similar respondents' profiles, we could pool respondents in our analysis. In future research, presenting both treatments to the same respondents, or designing the CE specifically to test the hypothesis that key motivations differ across BMPs, could bring additional insight on our qualitative results.

Result 9: Open and direct answers confirm and refine latent class profiles.

Respondents in the CE were also asked direct and open questions. We analyzed their responses by class, to discuss and refine latent class profiles derived from the CE. This analysis is presented in section 4.3.5 below.

4.3.3.2 Latent class profiles

Table 19: Preferences by class and potentially inferred attribute non-attendance (ANA)

	Class 1	Class 2	Class 3	Class 4	Class 5
Selection	(Conservation tenders)	Merit-based	ANA*	Fist-come first-served	(Conservation tenders?)
Technical assistance	TA to groups	Individual TA	TA to groups	None or with admin. support	(ANA?)
Contact	ANA*	(Conservation specialist)	Experienced farmer	ANA	(Conservation specialist?)
Commitment	No	ANA	ANA	Yes	(No?)
Price	Important	ANA*	ANA*	Important	(ANA?)

* Not confirmed by stated attribute non-attendance, see below

¹⁸⁷ Limited differences – that are not statistically significant at a 0.05 level – are observed with slightly more respondents in Class 1 under the first treatment, and slightly more in Class 2 under the second treatment. This could be interpreted as a greater importance of the incentive level when land is taken out of production; while technical assistance matters more for changes in cropping systems, but would require future research for confirmation.

Class preferences and attribute non attendance, as inferred from the choice experiment, are summarized in Table 19. Preferences are summarized based on estimated coefficients from Table 16. Attribute non attendance is potentially inferred when coefficients in our preferred model (Table 17) are not significantly different to zero ($p>0.1$).

Table 20: Average Values of Farmer-Specific Covariates by Class

	Type	Range	Class 1	Class 2	Class 3	Class 4	Class 5
Socio-economic variables:							
Size group	Successive ranges	0 to 10	5.05	4.88	5.36	4.71	5.93
Acres farmed	Value	1.4 to 5100	549	510	510	608	663
Acres owned	Value	1.2 to 4800	376	386	399	350	477
Education	Ordinal	1 to 4	2.18	2.31	2.19	2.59	2.30
Age group	Successive ranges	1 to 4	2.74	2.88	2.86	2.74	3.04
Gender	Dummy	0 or 1	0.86	0.73	0.86	0.79	0.81
Having a successor	Dummy	0 or 1	0.61	0.61	0.67	0.44	0.56
Farming: main income	Dummy	0 or 1	0.63	0.56	0.69	0.65	0.78
Attitudinal traits:							
PP	Score	2 to 10	7.45	6.97	8.78	7.09	7.26
ECO	Score	2 to 10	7.88	6.47	7.03	7.18	7.74
ENV	Score	8 to 30	22.98	23.30	22.78	20.97	20.67
Social connectedness:							
Indicator of peer / contact influence	Score	2 to 10	5.86	5.64	5.89	5.03	5.52
Leader in FO	Dummy	0 or 1	0.35	0.34	0.53	0.32	0.41
Member in stewardship group	Dummy	0 or 1	0.39	0.31	0.39	0.26	0.33
Past experience:							
EFP	Ordinal	0 to 2	1.30	1.23	1.39	1.23	1.23
Grant approved	Ordinal	0 to 2	0.87	0.80	0.58	0.91	0.83
Grant unsuccessful	Ordinal	0 to 2	0.59	0.40	0.75	0.49	0.72

The latent class profile descriptions below build on our preferred model (Table 17).

Differences across classes are further analyzed using SPSS (for dummy or nominal

variables), and SI-CHAID¹⁸⁸ (for continuous or ordinal variables). Combined with Latent Gold Choice, SI-CHAID¹⁸⁹ identifies variables significantly different across certain classes for variables not significant as covariates in our preferred model. SI-CHAID has the capacity to pool contiguous levels for continuous or ordinal variables (Appendix 17). Analyses in SI-CHAID confirmed that only attitudinal statements and composite indicators of attitudinal traits (Appendix 11) are significantly discriminant across classes. Appendix 16 presents detailed class characteristics. This analysis, conducted using SPSS software, helped identify some significant differences in socio-economic variables, attitudes, and past experience across classes. SPSS provides the opportunity to identify significant differences across two or more classes, that would not be considered sufficiently different to appear in Latent Gold Choice or SI-CHAID. Distribution of covariate levels by class and tests of significance are presented in Appendix 16, and average values in Table 20.

Class 1 – ‘Business Farmers’ (about 40% of respondents)

Class 1 members pursue multiple objectives. While they support environmental statements, as most respondents do, they also rank highest in declaring that they only consider profit when making a decision on their farm. Their choice of program is particularly sensitive to the level of financial incentive; but technical assistance also weighs in their decisions, with a preference for collective technical assistance delivered to groups of farmers. ‘Business Farmers’ prefer not to commit to multi-year contractual agreements, but are open to

¹⁸⁸ A software developed by Statistical Innovations.

¹⁸⁹ “The SI-CHAID 4.0 add-on program, which assesses the statistical significance between each covariate and the latent variable.” (Vermunt & Magidson, 2005, p. 21)

opportunities, and participate in almost all choice sets, with no significant impact of the contact person profile. A large majority of ‘Business Farmers’ are men.

Class 2 – ‘Environmental Champions’ (about 25% of respondents)

Class 2 respondents rank higher in pro-environmental attitude. They have a high support for all pro-environmental statements, including statements that can be interpreted as infringing on private property by farmers in other classes. ‘Environmental Champions’ choose to participate in almost all choice sets. They seem particularly interested in the technical assistance agri-environmental programs can provide, with a preference for one-on-one TA. The level of financial incentive is insignificant in their choices¹⁹⁰. ‘Environmental Champions’ clearly prefer projects to be selected on merit, and prefer conservation specialists as their contact point. They are open to approaches with or without commitment through multi-year contractual agreements. Women, and respondents whose main source of income is not farming, are more represented in this class than in other classes, while remaining a minority.

Class 3 – ‘Private Stewards’ (about 13% respondents)

Class 3 respondents (‘Private Stewards’) also rank high in their approval of pro-environmental statements; but while ‘Environmental Champions’ have a high support for all pro-environmental statements, ‘Private Stewards’ environmental commitments are

¹⁹⁰ If we had not defined the incentive level attribute as having necessarily a positive effect on farmers’ decisions, models would even show a negative impact of the price attribute for this class.

primarily driven by concerns for their community and children¹⁹¹. ‘Private Stewards’ attribute a lot of importance to ownership and self-direction, ranking significantly higher than all other classes in attitudinal statements associated with private property. In line with ‘Environmental Champions’, ‘Private Stewards’ look primarily for TA; but they prefer TA to be delivered to groups of farmers rather than individually. The level of financial incentive weighs less than other attributes in their decisions and is insignificant in our simplified model. ‘Private Stewards’ are open to approaches with or without formal contractual agreements. Contrary to ‘Environmental Champions’ - who prefer to interact with conservation specialists - ‘Private Stewards’ only choose to participate if their contact is a fellow farmer¹⁹². Board members of farmer organizations are most represented in this class. ‘Private Stewards’ participated less than other classes in stewardship funding program in the past, but may have implemented environmental practices on their own budget, as they participated in EFP more than other classes. They are particularly represented in Eastern Ontario; and almost two thirds of ‘Private Stewards’ have a college degree as their highest level of education¹⁹³.

Class 4 – ‘Busy Farmers’ (about 12% of respondents)

Farmers in Class 4 rank lower than average on pro-environmental attitude. ‘Busy Farmers’ are sensitive to both the levels of grant and TA; but for ‘Busy Farmers’ simplicity is the

¹⁹¹ They particularly strongly approve the statement ‘I like to show my children or my community that I can have a positive impact on the environment’. This high level of community concern rather than nature-driven motives is coherent with findings by Armstrong (2015) in her study of farmers in the Christian Farmers Federation of Ontario.

¹⁹² ‘Private Stewards’ almost systematically opted out when both proposed programs have conservation specialists as contact point, and thus selected the “no program” option in about a third of the choice sets.

¹⁹³ For only 47% when considering all respondents.

essence. While they choose to participate in almost all choice sets, they prefer approaches minimizing transactions costs, coordination costs and paperwork. They prefer first-come-first-served rather than merit-based selection; and multi-year contractual commitments rather than annual programs. They prefer to receive technical and administrative support, rather than technical support alone; and do not want to have to coordinate with other farmers to receive TA. ‘Busy Farmers’ are indifferent to the profile of their contact person. Younger farmers (18-45), farmers with no clear successor, and farmers with masters or PhD degrees are particularly represented in this class.

Class 5 – ‘Disenchanted Stewards’ (about 10% of respondents)

The support of Class 5 respondents to pro-environmental statements ranks lowest. ‘Disenchanted Stewards’ choose not to participate in more than two third of the choice sets. Their priorities vary and no model could provide a good prediction of their choices. But, in general, they are reluctant to participate and skeptical of agri-environmental funding programs. ‘Disenchanted Stewards’ are older than average, and, while they have completed environmental farm plans and applied to funding programs more than other classes in the past, they are also more likely to have seen former application(s) denied. A large proportion of this group depends on farming as their primary source of income. 20% of respondents farming 1000 acres or more belong to this class. The analysis of these respondents’ open answers is particularly insightful (see section 4.3.5.5 below).

Result 10: Respondents’ willingness to participate varies very significantly across classes. Class 1, Class 2 and Class 4 respondents, representing collectively about 77% of all participants, show a wide interest for agri-environmental incentive programs, and

almost always choose to participate, opting out respectively in only 7%; 6% and 4% of the choice sets (Figure 29). This result echoes the large interest for mainstream agri-environmental funding programs in the Ontario farming community. Class 3 respondents (13% of participants) have a very specific profile: they usually choose to participate when they are given the option to interact with an experienced farmer, but opt out when contact points for both proposed programs are conservation specialists. Class 5 respondents (10%) are reluctant to participate and opt out in 69% of the choice sets. Participants who always chose to participate were asked what their main motivation was (Figure 29). Most of them always chose to participate for financial reasons, or because they want to show their children or their community that they can have a positive impact on the environment (27% each). A smaller proportion already has a project in mind; or would like to innovate and stay ahead of their time. With less than 6% of all respondents choosing to always participate because they are convinced that environmental areas should be expanded regardless of payment levels, ‘Yea saying’ is not an issue in the choice experiment.

Figure 29: Which respondents always chose to participate and why

Note: Proportion of the respondents who chose to participate in all choice sets, and motives they selected to explain this choice among proposed options

Result 11: CE demonstrates clear trade-offs between TA and incentive levels, with a demand for both. Our CE primarily intended to identify heterogeneous preferences among Ontario farmers with regards to agri-environmental incentive programs; and single out most impactful program features, affecting acceptability and participation. Estimating willingness to accept levels was not a main objective of our research. However, latent class models provide elements to value willingness to accept and quantify trade-offs among attributes. As price attributes differ across treatments, willingness to accept has to be estimated on a split sample. Having only half of the respondents in each treatment, 3-class models outperformed 5-class models in BIC, and we thus used 3-class models to assess trade-offs between the incentive level and technical assistance for each treatment. In both cases, only Class 1 utility functions could be used to estimate trade-offs, as other respondents have either very low participation rates, or did not significantly consider the price attribute. Various models were tested, showing that Class 1 respondents would be ready to give up on their grant up to \$1400 to \$1500 per acre (i.e. about half of estimated project cost, and above 1/3 of maximum proposed grant¹⁹⁴) to access technical assistance for projects investing in environmental areas (Treatment 1) and up to \$30 to \$40 per acre per year to access technical assistance and eventually administrative support on soil health projects (i.e. about 1/4 to 1/3 of the maximum proposed grant). Those figures vary depending on the model retained and should probably mainly be considered as a strong indication of farmers' willingness to give-up a large part of the proposed grant to access technical assistance, with a preference in most models for TA in groups.

¹⁹⁴ Among the 6 price levels in the choice experiment.

Result 12: Bidding strategies vary across classes, but confirm an anchoring bias associated with the reserve price. Conservation tenders were proposed as a selection method in 13 of the 48 alternatives (27%). Respondents selected a conservation tender in 23% of their choices (Table 21). The preference for this selection mode was heterogeneous across classes, Classes 1 and 2 selecting it in about 30% of their choices; while other classes selected it less than 15%. When choosing a program with a conservation tender, respondents could choose among various incentive levels. Most respondents chose to bid at the highest proposed level (76% of choices, Figure 30), with Classes 2 and 3 respondents bidding more often than others below the maximum level. A few respondents in Class 1 even bid higher than the proposed maximum level.

Table 21: Heterogeneities across classes in the selection of a conservation tender option

	Class 1	Class 2	Class 3	Class 4	Class 5	TOTAL
Conservation tender is selected (proportion of choice sets)	30%	28%	14%	11%	11%	23%
No program is selected	7%	6%	30%	4%	68%	16%
Conservation tender as % of actual participation	32%	30%	20%	11%	33%	27%

Figure 30: Bidding strategies

Result 13: Survey method biases appear limited. Whether the choice experiment was conducted face-to-face or online is also not a significant covariate in our models, which is a positive indication of no major bias associated with self-selection, or Internet access and

proficiency. Allocation by class in the group of face-to-face respondents aligns with Eastern Ontario (where computer-assisted interviews were conducted), with a more limited proportion of 'Busy Farmers' (3% instead of 13%), and a corresponding larger proportion of 'Business Farmers' (largest class in all models). Those differences, which may not be statistically significant, could otherwise indicate that online surveys being less time consuming than personal interviews offer more opportunity for farmers concerned by time to respond.

4.3.4 Similarities and differences in farmers' segmentation with previous research

Other researchers have segmented farmers into groups of heterogeneous preferences, associated with various farming 'sub-cultures', in particular to target extension and engagement programs. Our segmentation shares similarities with Burton's (1998), who distinguished four 'identity sub-cultures', namely: 'agricultural producer', 'diversifiers/entrepreneur', 'conservationist', and 'agribusinessman'. Maybery et al. (2005) categorized farming values in Australia as: 'economic', 'conservation' and 'lifestyle'. Upadhaya et al (2021) differentiated in a study on soil conservation practices in Iowa between: 'conservationist', 'deliberative', 'productivist', and 'traditionalist' farmers. While those studies used mostly multivariate analysis (Principal Component Analysis, and Cluster Analysis), similar findings were derived from our CE. Chouinard (2008) used a theoretical model, confirmed by contingent valuation, to separate farmers self-interested and considering profit only; self-interested considering profit and environment; and farmers with both self-interested and altruistic environmental motivations.

Similar to our research, previous work established a distinction between a ‘conservation sub-culture’ versus a ‘business sub-culture’. Our segmentation is original as it also considers preferences associated with ‘ownership and self-direction’, willingness to spend time on administrative tasks, and endogenous preferences built on past experience (e.g. disenchantment, resentment...). Contrary to other research, we did not identify a group which would be particularly influenced by others (former generations, neighbours, innovators, etc.), but this dimension was not central in our choice experiment as it did not emerge out of the qualitative analysis as a characteristic that farmers would be comfortable stating in a general context (while interviewees often stated that they were not influenced by their peers, they described “other farmers” as influenced by local agricultural norms and innovative farmers). We tested this assumption in the choice experiment by asking respondents to which extent they were influenced by their peers in their choices, with above 60% of respondents stating that what their peers do did not matter or not much (Figure 31). ‘Private Stewards’ stated their independence from their peers significantly more than ‘Business Farmers’, in line with their strong preference for ownership and self direction (Figure 31). The indicator of peer / contact influence was not a significant covariate in our models. This question would deserve dedicated research, which could compare direct answers with inferred valuation (Kaczan et al., 2013 tested social desirability bias by comparing the two methods and found no significant difference, but analysing farmers’ propensity to make independent choices is a different research question).

4.3.5 Limits in the choice experiment design

Our qualitative research concluded that motivations to participate in agri-environmental incentive programs in Ontario differ depending on the type of BMPs offered, with clear differences between BMPs requiring to take land out of production that are often associated with public benefits (tree plantations, windbreaks, wetlands...), and BMPs that modify cropping patterns, often associated with private benefits (e.g. cover crops, manure fertilization, no-till...). According to interviews, adopting the first category is often motivated by strong preferences for the environment (personal norms), while adopting the second category is more often dependant on the willingness to take risks (for innovators) and evolutions in agricultural (social) norms (for mainstream farmers). To further investigate this distinction, we made a point to take it into account in the choice experiment. As proposing different types of BMPs in the same choice set or in successive choice sets may have confused our results on other attributes and increased cognitive burden, we decided to use different treatments. Detailed interviews and back-and-forth exchanges with field practitioners on the CE design allowed us to choose either identical attributes and attribute levels across treatments, or – when attribute levels needed to be adjusted (e.g. price attribute) – to ensure that those adjustments represented equivalent levels of incentive for farmers. Interestingly, in the CE results, we did not find any significant difference across treatments. The proportion of choice tasks in which respondents chose the option not to participate was even identical across treatments (15.84% in Treatment 1 and 15.87% in Treatment 2). The treatment variable was not a significant covariate in our models, and the repartition of respondents by class did not significantly differ across treatments. This alignment allowed us to pool the respondents and derive conclusions on a larger sample.

However, some conclusions, in particular the evaluation of trade offs between the incentive level (price) and technical assistance attribute, may have benefited from a simpler design. In addition, one can argue that the very short presentation of the treatment-specific context in the choice experiment may have limited farmers' understanding of the choice context, and pros and cons of each set of BMPs. After 30 years of BMPs promotion and cost-sharing in Ontario, we assumed that farmers had a mature perception of the proposed BMPs (i.e. that they had made their own mind on the proposed BMPs pros and cons). We were interested to understand farmers' behaviours in the context of their current knowledge and experience, and did not want to influence their choice by framing BMPs risks and benefits. While environmental areas on-farm are often associated with public benefits, Ontario conservation agencies have promoted the private benefits of those environmental areas for decades, and 85% of our respondents consider that on-farm environmental areas benefit their farms (Figure 33). In addition, several respondents in the CE clearly showed in their comments that they had a clear understanding of the BMPs proposed (or excluded) in their specific treatment. This leads us to argue that the very short presentation of the choice context may not have been the main reason explaining similarities across treatments. Former promotion campaigns, social desirability bias, and respondent self-selection may also have played a role. The argument that limited information on BMPs explains the limited difference across treatments could be tested in a future choice experiment by providing either detailed information on the proposed BMPs and their assessed impacts, or information limited to a ubiquitous list of eligible BMPs (as in our CE). Comparing respondents with either detailed or limited information on BMPs' public and private

benefits (and risks) would allow us to understand to which extent detailed information matters.

A second limit, and perspective for further research, regards the treatment of decision factors associated to risk. We approached the ‘risk’ dimension in our motivation framework through the TA attribute in the choice experiment. However, an attitudinal trait could also have been associated to risk. During our qualitative research, we identified farmers more or less prone to take risks; or more or less durably affected by failure. Some farmers take failure personally, build resentment, and do not want to try again (e.g. when their application for funding is rejected, they consider that program managers are biased or against them personally and rule out future applications; when a cover crop fail, they decide that they know better than trying again...). Other farmers are more prone to take risks; they consider themselves innovators, who learn through trials, errors, fixing... and use this experience to inspire others. This characteristic could have been approached through attitudinal statements. The impact of rejection appeared important in the CE result. Classes 3 and 5 (‘Private Stewards’ and ‘Disenchanted Stewards’) have seen their past projects more often rejected than other classes; they are also significantly more likely to be unwilling to participate; and express resentment in open answers (Table 20 and Figure 39). It would thus have been insightful to test an attitudinal trait associated to ‘risk’ as a criterion to segment farmers in groups of heterogeneous preferences. This could be the subject of future research.

A third limit is associated with documenting language representativeness. While we developed a French version of the choice experiment survey, very few respondents took

the survey in French. Many Ontario farmers being bilingual, we could not conclude on the representativeness of the Ontario francophone community in our survey. An additional question on the respondent's mother tongue would be worth adding in anonymous surveys with Ontario farmers. Finally, asking how the respondents learned about the survey would have allowed to refine the analysis on survey dissemination methods' respective efficacy and impact in bias correction.

4.3.6 Confirming and informing CE results with direct and open questions

4.3.6.1 Comparing stated and inferred attribute non attendance

Figure 31: Stated attribute non attendance

(Proportion of respondents declaring that a dimension did not matter or not much in their choices)

Potentially inferred attribute non attendance was derived from insignificant parameters in the latent class utility functions (Table 19). To confirm attribute non attendance, we compare those results with the proportion of respondents who declared that a specific attribute did not matter or did not matter much in their choice (Figure 31). 20 to 30% of respondents confirm that the profile of the contact point (Class 4), and the presence of a multi-year contractual commitment (Class 2 and Class 3) did not matter in their choices,

which tends to confirm inferred attribute non attendance. However, while – based on latent class models – we had concluded that ‘Private Stewards’ (Class 3) hardly consider the mode of project selection, ‘Business Farmers’ (Class 1) the profile of their contact point, and ‘Environmental Champions’ (Class 2) the level of monetary incentive, those findings do not concur with directed responses.

Respondents’ declarations of what matters most, or a lot, in their choices (Figure 32) confirm analyzes inferred from the CE. TA matters a lot for ‘Environmental Champions’, ‘Business Farmers’ and ‘Private Stewards’ (Classes 1; 2 & 3)¹⁹⁵, but the level of incentive is much more important for ‘Business Farmers’, than ‘Environmental Champion’, and ‘Private Stewards’. ‘Private Stewards’ decisions are highly impacted by the profile of their contact person. ‘Private Stewards’, ‘Environmental Champions’ and ‘Business Farmers’ consider that environmental motivations drive their decisions.

Figure 32: Respondents declaration of what matters in their choices, by class
(Proportion responding that the dimension matters the most (level 5), or a lot (level 4))

In conclusion, stated preferences tend to confirm preferences inferred from the CE, with some major nuances. In particular, the hierarchy between attributes is conserved, but less pronounced in stated preferences (e.g. we deduct from the CE that price does not matter at

¹⁹⁵ Older farmers, farmers who care most about the environment and the profile of the program contact person, those who are attached to a farming lifestyle, and are convinced that environmental investments can secure or facilitate market access are significantly more likely to consider TA a prominent program feature.

all with regards to TA for ‘Environmental Champions’, whereas stated preferences lead us to conclude that TA just matters more than price). Two hypothesis could explain this distinction: (1) CE is a more efficient method to appreciate trade-offs among various program dimensions (farmers actually have to choose); (2) attribute non attendance could – to some extent – be associated to cognitive burden rather than actual indifference. The fact that respondents often declare that several dimensions mattered ‘the most’, tends to confirm at least partially the first hypothesis.

4.3.6.2 Perception of environmental benefits

Respondents were questioned on their perception of benefits associated with on-farm environmental areas. A very large majority of respondents considers that environmental areas benefit their farm, with limited heterogeneities across classes (Figure 33). This confirms that the conclusion from our qualitative research that motivations differ across BMPs (with public benefits associated with on-farm areas, and private benefits with soil health) needs to be nuanced, reconsidered or further investigated in follow-up research.

Figure 33: Proportion of respondents that consider that environmental areas benefit their farm

Question: "Do you think that having buffer strips, windbreaks, fencerows, grassed waterways, or wetlands on your farm has a positive impact on... Your farm"

Besides the proposed options (Figure 34), respondents also pointed out benefits on air quality; soil erosion; pollinator habitat; animal safety; security; pasture rotation; species at

risk; wildlife and wildlife habitat (3 respondents); landscape¹⁹⁶; and public perception of farm. Four respondents (in Classes 3, 4 and 5) used the open field to mention negative impacts, or underline the absence of positive impact, on their farm. These pointed out in particular that “Buffer strips, and wetlands reduce the amount of farmable land”, and “All of the above have a negative impact due to cost, maintenance, taxed land taken out of production, and workability”. Out of those respondents, two had never participated in any agri-environmental program (including no EFP), and often chose the option not to participate in the choice sets, but could be convinced if their neighbours participated; one had applied several times and always seen his applications denied, he did not choose to participate in any choice set and would not change his mind under the influence of his peers. While those qualitative responses are informative, perceptions of environmental benefits generally do not significantly differ across classes, with an exception for climate change, less often considered a benefit by ‘Private Stewards’ (Figure 34).

Figure 34: Perceived environmental benefits by class, on... (n=286)

Question: "Do you think that having buffer strips, windbreaks, fencerows, grassed waterways, or wetlands on your farm has a positive impact on..."

¹⁹⁶ "Pleasing to the eye".

4.3.6.3 Preferred program design

Direct questions on program design preferences were introduced at the beginning of the survey to ensure that respondents had common definitions in mind, and started thinking about their preferences on individual dimensions before making multi-dimensional choices in the choice tasks. Proposed options were often more detailed than in the choice tasks and help put in perspective CE results.

Preferred mode of project selection

Participants in the CE were asked their preference among five project selection approaches currently used in Ontario (Table 22 and Figure 35).

Table 22: Preferred mode of project selection: proposed options (direct question)

Selection mode	Definition presented to the respondents
Merit-based selection	Projects should be selected based on their individual environmental merit, and receive a fixed cost-share.
Environmental bonus	Projects with higher or more diverse environmental benefits should receive a higher cost-share.
Geographical targeting	Environmental programs should concentrate funding on the most environmentally sensitive areas.
First-come-first-served	Funding should go to the eligible farmers who applied first.
Conservation tenders	Farmers should propose a funding amount, and projects with the highest environmental benefit per dollar should be selected.
None of the above	all eligible projects should receive funding even if it is a limited amount.

With 38% of respondents supporting it, merit-based selection is the preferred approach. Most current provincial and federal funded programs in Ontario rely on merit-based selection, as well as some conservation authority programs. The strong preference for merit-based selection from ‘Environmental Champions’ is in line with CE results. Environmental bonus and geographical targeting are variations on the merit-based approach with funding levels progressing with the level of environmental ambition

(environmental bonus), or strict geographical criteria (geographical targeting). Those options come next in farmers' preferences.

First-come-first-served was the selection mode of the former federal-provincial funding cycle, and is well-known in the farming community. Given the options, only 8% of respondents favoured this approach. Unlike in the CE, not even 'Busy Farmers' selected it. Open answers in the survey testify of the negative experience Ontario farmers had with this approach.

Conservation tenders emerged in Ontario since 2013, with the increasing interest for competition and cost-efficiency. However, with only 4% of respondents preferring it, conservation tenders receive limited support. This finding is coherent with Holmes' conclusions from focus groups with Ontario farmers (Holmes, 2015). However, it contrasts with CE findings, where conservation tenders seem to be the preferred mode of selection for the largest group of respondents ('Business Farmers'). 'Business Farmers' choices in the CE may have been driven by their high preference for the price attribute, and the opportunity given to bid on price in conservation tenders, rather than by the selection method itself.

Finally, about a quarter of all respondents would not choose any of the proposed competitive approach, but prefer to see all eligible projects receive funding, even if a limited amount. This proportion is significantly higher for 'Disenchanted Stewards', which confirms that this group largely has a negative opinion of competitive approaches.

Figure 35: Preferred mode of project selection by class (n=283, direct question)

Question: “Given that funding is limited, what do you think is the best way for environmental and soil health programs to select individual projects for funding?” The question specified that ‘conservation tender’ and ‘environmental bonus’ usually require a more detailed application than the other options.

Preferred implementing agency¹⁹⁷

CE participants were asked the type of institution they prefer to run programs and select projects for funding. While farmer organizations have the preference of a majority of farmers, the Ontario Ministry of Agriculture and Rural Affairs (OMAFRA), and local conservation authorities also receive support (Figure 36)¹⁹⁸. Only about 20% of respondents have no preference. Those responses are in line with programs administered on the ground in Ontario. Support also reflects the way the survey was disseminated, i.e. through farmer organizations. In line with the result of the CE, ‘Private Stewards’ express a very strong preference for farmer organizations.

¹⁹⁷ While interpreting these results, we should remember that OSCIA, a long-standing farmers’ organization responsible for implementing and sometimes designing a number of Ontario agri-environmental programs, had kindly accepted to broadcast the survey and that many respondents are likely to be OSCIA members.

¹⁹⁸ Five respondents specified in an open field that they prefer OSCIA (the long-term farmer organization specialized in soil and crop improvement) to administer programs, two mentioned the leading Ontario farmer union (Ontario Farmers Association, OFA) as an example, and one cited a private program supporting annual agri-environmental payments (Alternative Land Use Service, ALUS).

Figure 36: Preferred implementing agency by class

Question: “Do you have a preference regarding who runs the program and selects projects for funding?”
Options: (1) Yes, I prefer programs run by local conservation authorities; (2) Yes, I prefer programs run by farmer organizations or led by farmers; (3) Yes, I prefer programs administered by OMAFRA; (4) No; (5) Other. Multiple choices were possible.

Open answers insisted on qualities respondents expect from programs and program administrators. Science-based approaches, evaluation, accountability, adaptations to local contexts, simplicity and accessibility, were listed as required qualities (Table 23). One respondent mentioned that he is simply “*Too busy to deal with organizations.*” The insistence on simplicity, reflected throughout the qualitative and quantitative research, contrasts with the current institutional preference for merit-based or competitive approaches associated with demanding applications.

Table 23: Qualities expected from programs and program administrators

Quality	# of answers	Answers elicited in follow-up open field (‘other’)
Science-based approaches	2	“Arm's-length apolitical un-biased, science-based & informed farmer-led entity”. “Independent Scientists in universities, who are capable of setting up projects and measuring their effects”.
Accountability	1	“We have to have accountability for misused money”.
Adaptations to local contexts	1	“Each program needs the appropriate authority to run it in the most effectively implemented manner. Each area has intricate differences.”
Simplicity and accessibility	1	“The main thing is to make the funding accessible and easy to get to make a positive impact.”

Preferred technical and administrative support

CE participants were asked what type of technical or administrative assistance (TA) they would prefer if the program could provide some. The preferred choice across classes would be to have a specialist help them identify priorities on their farm and design their project (Figure 37).

Figure 37: Priority in technical assistance by class

Question: “If the program could provide support to help you with your project, which type of technical or administrative assistance would you prefer?”

A quarter of participants (among the oldest farmers) would prefer to have someone help them fill out the paper work. A significant minority would prefer to talk with experienced farmers (11% in average, but up to 28% for ‘Private Stewards’) or a partnership with a research team (10%). These results confirm our qualitative analysis (Chapters 2 and 3). A large proportion of farmers are not quite sure what can be done to improve conservation on their land, or what are the best available techniques to make such improvements. While many government-funded incentive programs have moved away from direct technical support, the absence of such support – at least at a project design stage - seems to remain a

barrier to participation for a number of farmers, in particular new participants, or participants with limited access to private agricultural advisors or not willing to rely on advisors associated with input providers.

4.3.6.4 Collaboration and compliance with social norms

Collaboration. We asked CE respondents if they would be willing to collaborate with other farmers to get extra support. 90% expressed interest in at least one of the three modes of collaboration presented. Interests are diverse, with at least¹⁹⁹ 49% of CE participants (n=286) interested in receiving free technical assistance together with other farmers with the same type of project; 36% ready to coordinate their project with their neighbours' to get an extra bonus on their cost-share, and 35% to receive financial support to run test plots on their farms with a group of fellow farmers (Figure 38). None of the socio-economic variables we tested significantly correlates with the respondents' willingness to collaborate.

Figure 38: Interest for collaboration with extra-funding

Note: Farmers had the possibility to select several options among the following:

- Coordinate my project with my neighbours', if we all get an extra bonus on our cost-share (Coordinate)
- Receive free technical assistance with other farmers having the same type of projects (Group TA)
- Receive financial support to run test plots on our farms with a group of fellow farmers (Test plots)

¹⁹⁹ The proportion of farmers interested in multiple options might be underestimated as the question did not explicitly state that multiple responses were possible. To assess the distribution by class, proportions were calculated by respondents who completed the CE after removing protest answers.

Farmers unwilling to collaborate had the opportunity to explain why. Those mentioned: **coordination costs**, with time and collaboration constraints the main barriers; **competition, mistrust or tensions among farmers**; the absence of neighbouring farmers, or farmers with similar operations; preference for individual approaches; and failure of past experiences (Table 24).

Table 24: Reasons for choosing not to collaborate

Motive	# of answers	Answers elicited in open fields
Coordination costs	7	"It's difficult to get everyone together at the same time to collaborate" "We have too much to do" "Time and sales pitch required to get neighbours onboard" "Too difficult to coordinate similar projects with others. Each farm is unique" "We don't have time to hang out with our "neighbours" and brainstorm on ideas. We don't all sit in an office all day" "It is so hard to collaborate with neighbours with timing and priorities" "More difficult to coordinate"
Competition, mistrust or tensions among farmers	4	"Farming is competitive" "Farmers get jealous" "Not into group deals; too many do not tell the truth" "Sometimes my neighbours do things that adversely affect the way I farm. I would not want to play mediator and defend my property at the same time."
Irrelevance	3	Absence of neighbouring farmers, or farmers with similar operations (2 respondents) "Interested producers have a financial interest in test plots to improve results; both financial and otherwise and do not need to receive financial support."
Preference for individual approaches	2	"Would rather have just my project". "What is this, communist Russia?"
Failure of past experiences	1	

A few farmers offered **alternative design solutions** to coordination bonuses for more efficient incentive programs, including: focusing on progressive farmers; result-based approaches; equal distribution to all participants; or a case-by-case approach (Table 25). One farmer explained that, to minimize coordination costs, he would prefer to **rent his neighbour's land** and co-finance environmental projects himself on this rented land, with

support from stewardship programs he was already experienced with, rather than having to convince neighbours and organize collaboration, confirming viewpoints we heard in interviews. Those responses offer useful insight on the diversity of farmers' viewpoints with regards to program design.

Table 25: Alternative options to funding collaboration

Option	# of answers	Answers elicited in open fields
Focus on progressive farmers	2	<p>"I prefer to rent my neighbour's land for five years and do the work, it takes less time and complication, and I already have all contacts and experience I need from the project I did"</p> <p>"You can't force your neighbour to be progressive. Focus on progressive farmers who will be in the industry for years to come"</p>
Result-based approaches ²⁰⁰	1	"It should only be results based. This way is too subjective."
Equal distribution	1	"Better to add the money to the program payout to everyone"
Case-by-case approach	1	"All three are good but it depends on the project which would be more effective"

Compliance with social norms Direct questioning is not the most reliable method of assessing the impact of social norms on behaviours (Lusk & Norwood, 2010). However, being limited by the format of a choice experiment, we introduced a follow-up question to evaluate the influence social norms in the agricultural sector have on participation decisions. Farmers who had chosen the option not to participate in a choice set were asked if they would change their minds if they knew that most of their neighbours participated in a program. Respondents who had only refused to participate in one choice set, followed their peers 60% of the time, while farmers who had chosen not to participate more than twice rarely responded that they would change their mind under the influence of others (Table 26).

²⁰⁰ Result-based designs are discussed in Chapter 3.

Table 26: Peer to peer influence reported in the choice experiment

Respondents chose not to participate (original choice)...	Number of respondents	Would change their mind to follow their peers (%)		
		No	In some choice sets but not others	Yes
Once	121	40%	-	60%
Twice		67%	21%	12%
More than twice		72%	28% ²⁰¹	-
Total		58%	29%	13%

Interviews helped us understand that collective action in the farming sector is rarely presented as a condition to act: environmental benefits are rarely framed in interviews as a public good among farmers (in economics terms), i.e. only effective if neighbouring farmers or a critical mass of farmers would contribute or participate. But environmental issues (e.g. water pollution, land degradation) are often framed as a public goods conundrum in the context of a rural/urban divide, with farmers justifying a limited level of environmental ambition as ‘most pollution comes from urban areas’ (e.g. “The worst environmental disasters are generally where urban areas are ruining prime agricultural land”, South Western Ontario sheep, goats, or horses farmer).

4.3.6.5 Content analysis of open answers

Seven fields in the CE survey allowed for open answers. Six were follow-up questions. A very general final question asked farmers if they had any other idea or thought on stewardship programs that they wanted to share. 131 of the 286 CE participants provided open answers in at least one field. Appendix 18 (Figure 52) presents a content analysis of those open answers, with main aspects summarized in Figure 39. Figure 40 indicates the

²⁰¹ In average, those respondents followed their peers 43% of the time.

proportion of open-answer respondents in each class mentioning specific themes. This analysis is used to triangulate choice-experiment findings.

Figure 39: Some key themes in open answers²⁰² (# of respondents)

Motivations. Open answers illustrate the importance of economic considerations (even when those are not the main motive to participate) on the one hand, and demand for technical assistance, education, and research on the other hand. They also confirm that Ontario farmers consider themselves good stewards of the land (personal norms). Many respondents mention existing environmental commitments, duty towards their communities and future generations, and several explicitly refuse shaming from urban citizen sometimes perceived as driving agri-environmental policies (Appendix 18). Others call for more environmentally ambitious programs, longer-term commitments, or more stringent monitoring or auditing.

²⁰² More detailed content is presented in Appendix 18 (Figure 52).

Participation barriers. Open answers highlight Ontario farmers' concern for transaction costs ('administrative burden'). Coordination costs are also identified as a potential barrier to collective action.

Preferences for ownership and self-direction. Open answers illustrate a strong preference for ownership and self-direction among Ontario farmers. Respondents insist on farmers' necessary autonomy, freedom of decision. A number of respondents are critical of regulations on private lands, and institutions enforcing them.

Perceived fairness. Open answers also confirm the importance of perceived fairness in farmers' views of agri-environmental programs. A number of respondents highlights that every one benefits from conservation measures, and everyone should pay for them. Others plea for programs to preferably benefit small farmers, through capped grants; or to support innovators, rather than late adopters. Finally, some respondents consider that urban expectations of farmers are unfair.

Past experience. Negative past experience is confirmed as a strong motive not to participate.

4.3.6.6 Summary of additional information on latent class profiles from direct and open answers

The analysis of direct and open answers puts in perspective CE results, informing in particular the profiles of farmer groups with heterogeneous preferences (latent classes). Table 28 below uses open answers to illustrate key features in the latent class profiles, while Figure 35; Figure 36; Figure 37; and Figure 38 describe stated preferences by class (direct answers).

Table 27: Proportion of respondents who provided open answers in at least one field

Total	Class 1	Class 2	Class 3	Class 4	Class 5
46%	38%	48%	50%	51%	63%

Figure 40: Dominant themes by class

‘Business Farmers’. Open answers confirm the primary importance of economic motives for ‘Business Farmers’. Given that the CE focused on the design of grant programs, the importance of economic and financial considerations in open answers is not surprising. Answers highlight that ‘Business Farmers’ are interested to collaborate with researchers.

‘Environmental Champions’. Direct questions confirm that ‘Environmental Champions’ value TA above the monetary incentive (Figure 32). They are confident that farmers can be great stewards. They appreciate conservation specialists, plea for more funding to be directed to innovators, more environmentally ambitious programs, and more stringent monitoring of actual impacts to avoid windfall effect. ‘Environmental Champions’ are for example concerned with tree clear cutting currently happening in Ontario. They call for

more research and science. They propose innovative schemes, including schemes to reverse tree cutting. In qualitative statements, ‘Environmental Champions’ express concern for nature, but do not mention future generations. Contrary to other classes, no open answer conveys a sense of urban / rural divide.

‘Private Stewards’. ‘Private Stewards’ strong preference for ownership and self-direction, in particular their attachment to private property rights, is confirmed and illustrated by direct answers. Their decision not to participate in stewardship programs if their contact point is a conservation specialist is also confirmed: no ‘Private Steward’ chose a conservation authority as her/his preferred implementing institution (Figure 36). While positive views on conservation authorities are also expressed (Appendix 18), some open answers illustrate mistrust of conservation authorities, and other public institutions with regulatory powers on private land²⁰³. On the other hand, open statements confirm their sense of personal responsibility towards their community and future generations (Table 28).

‘Busy Farmers’. Requests for more simple applications are wide-spread across classes (Appendix 18). Numerous qualitative interviews in our research (Chapter 2) and 2016 Census in Ontario highlight heavy Ontario farmers’ workload, with numerous farmers conducting multiple activities, even when they are responsible for large farms. The choice experiment revealed that preferences for solutions with limited transaction costs mostly

²⁰³ In 2020, the main Ontario farmers’ organization, OFA, expressed strong support for conservation authorities including in their regulatory powers (Ontario Federation of Agriculture, 2020).

affect decisions from a small group of ‘Busy Farmers’ (Class 4). Open answers confirm that complexity in program design and application process is an issue for these farmers but also identified as a constraint for other groups²⁰⁴.

‘**Disenchanted Stewards**’ are the more eager to provide qualitative answers (Table 27). They express explicitly critical views of government funding programs, which may explain their very limited willingness to participate in PES, revealed in the choice experiment. In particular, they perceive competitive programs as unfair. Their experience seems particularly negative with First-come-first-served approaches; and none of the ‘Disenchanted Steward’ chose this selection mode in direct questioning. In line with their preference for non-competitive approaches (Figure 35), ‘Disenchanted Stewards’ prefer programs administered by conservation authorities in larger proportion than other groups (Figure 36). ‘Disenchanted Stewards’ are more dubious than other groups of collective approaches, including for technical assistance (Figure 38), and more often declare that they do not need any TA (Figure 37). While those farmers are only a minority of respondents, their very low willingness to participate, expression of long-term mistrust, at least sometime associated with negative experiences of rejection in the past, and sometimes willingness to share their negative opinion, attract our attention on the unintended consequences of competitive program designs.

²⁰⁴ No variable in the survey could help us appreciate whether farmers in Class 4 were particularly busy, or just could not be bothered with the workload associated with applying for grants.

Table 28: Open answers: confirmation and refinement of CE results

Latent class	Key Feature	Examples of open answers
'Business Farmers'	Economic motives	<p>"Farmers should be paid for environmental efforts"</p> <p>"I don't mind trying to better the environment, however a token financial incentive would sure help"</p> <p>"we are quite interested in using Variable Rate technologies on our farm, but (...) costs are currently prohibitive"</p> <p>"if the farm is not profitable your hands are tied."</p>
	Funding and technical assistance are complementary	"Any funding will defiantly make a stronger case to do something but I think we all would have a better return on investment if we have specialists help us plan these projects to maximize the funding and time we are allocating."
	Interest for research	"More involvement from university research team's experts would help."
'Environmental Champions'.	Importance of technical assistance, available in the long-term	<p>"I firmly believe in the strength of one-to-one technical and administrative assistance by local conservation professionals."</p> <p>"I think that there should be more support from people who know the problem over the following years of the projects. (...) Soil improvement is at least a 3-5 years thing, if done correctly".</p> <p>"The financial incentive is great, but the assistance is better, either an expert or a farmer."</p> <p>"I would have liked someone to talk to about planning and designing the layout for the projects. My neighbors have different needs and couldn't help me. The teachers had conflict of interest and couldn't help. I know what I would like to do but have trouble implementing."</p>
	Appreciation of conservation staff	<p>"The local conservation authority staff have visited many farms and have gained knowledge of Best Management Practices from researchers and their farm clients. This is their full-time job so they are not drawn away from the projects by their own farming operations. They also understand how practices work upstream and downstream from my farm. They are there for the long-term and have helped with follow-up."</p> <p>"I have a project in mind and I am waiting for our local conservation to have funding to do it."</p>
	Plea for funding innovators, and research	"More support is need for the innovators and researchers to help develop a sustainable agricultural system".
	Concern with damages on nature	"I'd like to see more incentives for maintaining forest cover (possibly prov. or fed. income tax rebates/credits or bigger municipal tax savings). There are mun. tax savings for farm owners who rent to farmers or who declare over \$8000 in annual farm income. Relax this a bit so land owners get the break even if their farm is not being farmed. It may be good for wildlife. It's sad to see clear cutting in large amounts on rocky or wet land which would be best left to nature."
'Private Stewards'	Strong preference for ownership and self-direction	<p>"If government wants to have control of how private land is used then we need to have compensation for the lost rights of use and enjoyment of ownership."</p> <p>"We are very leery of conservation authorities coming on to our land and dictating our practices."</p>

		<p>“In my humble opinion, these conservation authorities have more power than they need to get their job done. They scare me, although not all are the same, they are moving in that direction. Very few people say they don't care about the environment, but they are treated that way by conservation authorities. If there is a conservation officer involved, I'm not interested. Province has invested too much authority into these conservation authorities.”</p>
	Importance of trust, preference for fellow farmers	<p>“I would deal with an experienced Farmer who would give advice and be trusted.”</p>
	Concern for community and future generations	<p>“All the farmers I know, including myself, are very good stewards of their land. I have a family that will inherit the land and it is important to preserve what I can of that land.”</p> <p>“Farmers are the first environmentalists. We make our living from the ground, they are experts in environment. We've been here for seven generations.”</p>
‘Busy Farmers’	Concern with transaction costs	<p>“They [the programs] should be easy to apply to. Please make them simple.”</p>
	Concern with coordination costs	<p>“Too difficult to coordinate similar projects with others. Each farm is unique.”</p>
	Importance of commitment, and long-term support	<p>“I think these types of programs require a medium-term commitment - 3 years.”</p> <p>“I feel that programs should be offered with technical assistance and commitments to maintain the project by the recipient.”</p> <p>“Perpetual credits gets farmers ears.”</p>
‘Disenchanted Stewards’	Perceived unfairness	<p>“The current system of G? Is highly flawed. Very few projects are selected. And the ones that are questionable as to why they were selected. Sometimes they seem to be politically motivated. Thus myself and others don't bother to participate in funded programs anymore.”</p> <p>“The money is not getting into the hands of the practitioner. It is paying salaries of the administration.”</p> <p>Grants... “MUST not be lottery games”.</p> <p>“To go through the whole process and do all the applications, and then race over before 8 AM to a person's house and wait in line to see if it will be in time, is totally a non starter for me. I will never participate in that crap!!! I am too busy to fill in huge amount of forms and go to meetings to see if I can get 30% funding on something to help the public. Pay it or don't have the program!!!”</p>
	Perceived inefficiency	<p>“These programs should be abolished. There is too much government intervention already. My taxes would be better spent on the government buying and maintaining the areas they deem environmentally sensitive.”</p> <p>“It has been my experience that any programs funded by the government mostly goes to the bureaucracy which means my hard earned money would be better spent on my farm instead of taxes to support useless interventions.”</p>
	Disenchantment	<p>“I had a negative experience with past programs.”</p>

4.4 Conclusions and policy insight

Most research on farmers' preferences explains how behaviours vary with farmer socio-demographic characteristics (age, gender, education...) or farm characteristics (farm size, farm type, etc.). Understanding how these factors impact choices can help with targeting strategies, i.e. help target farmers most likely to participate; but is insufficient to inform program design, as these factors are not directly amendable through public policies. Understanding how social preferences and other psychological factors impact farmers' decisions can inform policy design more directly. Specific design features can be further aligned with farmers' preferences. In our choice experiment, while none of the socioeconomic factors tested explains farmers' choices, attitudinal factors impact decisions, help segment farmers in groups with similar preferences, and confirm the importance of behavioural research in agri-environmental policy design.

The choice experiment confirms and clarifies some of the key findings of our qualitative analysis, and brings new insight. The experiment confirms in particular that preferences for agri-environmental program design are heterogeneous among Ontario farmers. Some farmers are most sensitive to the level of financial incentive, while others are particularly interested in the technical support that can come with agri-environmental incentive programs. For several classes of respondents (representing about 40% of our response group²⁰⁵), technical assistance is a priority.

While the importance given to **technical assistance** was already outlined in our qualitative research, the choice experiment reveals that technical assistance can be considered more

²⁰⁵ Classes 2 and 3 above.

important than funding for a significant proportion of farmers interested in agri-environmental programs. In addition, it unveils a particular interest for technical assistance provided **collectively to a group of farmers**, denying our assumption that individual assistance would be systematically preferred. This results led us to transform the ‘technical assistance’ attribute in our model from an ordinal²⁰⁶ to a nominal variable. Several groups converge in their interest for collective technical assistance. However, collective approaches would not suit all farmers. Some farmers (in particular in the ‘Busy Farmers’ class), are concerned with coordination costs associated with collective approaches. Programs providing free technical assistance to groups of farmers could thus be further developed in Ontario, while remaining optional rather than conditional in agri-environmental programs. As underlined by Greiner, this highlights: “the importance of complementing new PES-style programs with education and extension. Attitudes can be changed by explaining how PES work and illustrating the social co-benefits that voluntary conservation contracts can deliver to farmers” (Greiner, 2015, p. 17).

The choice experiment also confirms the importance of **ownership and self-direction** already highlighted in the qualitative research. While the existence of a contractual agreement did not appear to be a major restriction for farmers with a high preference for ownership and self-direction, the profile of the contact person appeared critical for some of our respondents. Many programs in Ontario (including programs designed and run by conservation authorities) prioritize farmer-to-farmer approaches. In our CE, this indeed appeared to be critical for a minority of farmers (13%). While 13% can be considered a

²⁰⁶ A categorical variable is considered ordinal if it is known that a level is better (or worse) than another.

limited proportion, underestimation associated with research design cannot be ruled out. In addition, farmer leaders are particularly represented in this group and their decision may weight on the program's capacity to mobilize farmers.

The CE confirms that merit-based approaches tend to be preferred to first-come-first-served approaches by Ontario farmers, with a significant exception for farmers most concerned by time saving, identified above as 'Busy Farmers', representing about 12% of our respondents. The **selection mode** does not appear to strictly prevent participation, as no group of respondents systematically refused to participate in programs with a specific selection approach. However, the CE confirmed a concern revealed by our qualitative research. Falling to see one's project selected can have a lasting impact. About 10% of respondents ('Disenchanted Stewards') demonstrate a strong reluctance to participate in agri-environmental programs, both in their discrete choices (preference for the opt out option) and in their qualitative comments in the survey open fields. While 10% may seem little, them voicing out their concerns may also impact negatively program reputation in farming networks. This aspect could deserve further investigation and policy attention. A large body of research has discussed the risk of payments crowding out intrinsic motivation, but little attention has been given to **risks of long-term motivation loss associated with competitive approaches**. Our case study shows serious drawbacks for farmers whose projects were not selected, that deserve consideration in policy design. Potential measures to manage motivations are further detailed in Conclusion (Chapter 5).

Chapter 5: Conclusion and policy recommendations

Based on a literature review, an international benchmark in OECD countries, and a qualitative and quantitative case study in Ontario, this dissertation provides insight on the main motivation factors affecting farmers' decisions to participate or not to participate in agri-environmental PES and variations of those motivations based on program design. In particular, our research underlines the importance of non-financial motivations (including social preferences associated with equity, concerns for nature, and social networks), the extent those motivations matter when compared with financial motives, and differences among groups of farmers with heterogeneous preferences. While previous research has raised similar questions, our research is original by proposing an analytical framework focusing on motivation factors rather than combining socio-economic, demographic, political, geographic and attitudinal variables. Our research identifies program design features that matter in Ontario farmers' decision, with differences among farmers based on attitudinal traits. In particular, we question program features that foster competition or collaboration among farmers.

This conclusive policy chapter successively presents: (1) key research findings, (2) policy recommendations derived from those findings, and (3) perspectives for future research. Key findings and policy recommendations build on the conclusions of Chapters 2, 3 and 4.

5.1 Key findings

5.1.1 Farmers' preferences for agri-environmental incentive programs in Ontario are heterogeneous

In line with previous research, our research in Ontario revealed heterogeneities in farmers' preferences (Chapters 2 and 4). Ontario farmers tend to self-identify in a farmer profile, or 'farming vision', with different preferences towards innovation, business success, community involvement, and environmental impact. Demand for agri-environmental funding in Ontario often exceeds availability, and Ontario farmers are open to a variety of designs. This situation raised government and program managers' interest in competitive approaches (Chapter 3). Our choice experiment revealed segmentation in farmers' preferences for agri-environmental programs (Chapter 4). In particular, depending on attitudinal traits, farmers look either for a monetary incentive (cost-share...), or technical assistance, or both, in agri-environmental programs. Farmers who consider economic motives as the only factor to decide on future farming activities ('Business Farmers') tend to value the monetary incentive over technical assistance, but both aspects still matter in their decisions. About a third of the Ontario farmers consulted through the choice experiment value technical assistance above the incentive level or are even indifferent to the level of financial incentive if they can access technical assistance. Preferences for project selection methods also differ between those two main farmer groups, with 'Business Farmers' preferring approaches that give them the flexibility to bid on high prices, while 'Environmental Champions' prefer merit-based approaches with a fixed rate. About 13% of the CE respondents, showing a strong preference for ownership and self-direction, almost systematically opt-out (refuse to participate) when the only option offered

is to have a conservation specialist, rather than an experienced farmer, as their program contact person. Those respondents show a high level of defiance towards collaborating with governments or NGOs. In their case, the profile of the contact person can be a strong participation barrier. Those respondents highly value environmental preservation for their communities and children, but, in practice, they have participated in environmental programs less than other respondents in the past. While they represent a minority, their position matters, as leaders of farmer organizations are particularly represented in this group²⁰⁷.

About 12% of respondents, among the most educated and younger farmers, prioritize approaches that minimize transaction costs, electing a project selection on a first-come-first-served basis (rather than merit-based), and contractual commitment over several years. Again, those farmers are a minority, but their age, education level, and paradoxical rejection of complicated approaches emphasize the importance many respondents and interviewees give to simple program applications, minimizing administrative burden²⁰⁸.

Finally, about 10% of the choice experiment participants show a very limited willingness to participate in any agri-environmental incentive program, despite choosing to respond to the choice experiment survey²⁰⁹. Those are older than average farmers. They have generally gone through several rounds of Environment Farm Plans and applied to stewardship programs in the past. But their applications have often been rejected, and their

²⁰⁷ Farmers in this group are under 13% of CE respondents, but above 18% of those who are on the board of a farmer organization.

²⁰⁸ Farmers in this group represent 12% of CE respondents but 17% of those who are under 45 years old and 32% of those who have a Masters or PhD level.

²⁰⁹ Participants had the opportunity to withdraw at any stage, and responses considered protest answers have been eliminated.

qualitative statements testify of a strong built-up resentment towards stewardship programs, and managers or governments designing and administering them. We noted this long-term impact of rejection both in qualitative and quantitative research. This finding calls for a better consideration of the long-term consequences of project selection methods, in policy research and policy innovation.

5.1.2 Farmers' preferences for agri-environmental incentive programs are at least partially endogenous; they evolve with policies, social norms, and experience

Our research shows that farmers' preferences for agri-environmental incentive programs are context-dependent and evolve as information emerges, engagement occurs, applications succeed or fail, and farmers discuss approaches and their impacts. At least three factors play a role:

(1) Motivations and attitudes evolve with lifetime goals, experience and feedback. As motivations evolve, farmers may also be interested in different types of programs.

(2) Farmers' willingness to participate in agri-environmental incentive programs depends on the broader policy context and range of instruments used at a certain point in time or in the past, and instruments considered for the future.

(3) Farmers' preferences are impacted by the practices or perceptions of their peers.

Farmers' preferences for PES can thus be considered at least partially endogenous (Bowles, 2004). Uncovering endogeneity factors in farmers' preferences was a significant outcome of our research and could deserve further investigation in the future. With a long experience of diverse agri-environmental incentive programs, Ontario is a particularly interesting ground for such research.

Endogeneity positively impacts participation when there is social pressure within the farming sector to adopt an environmentally beneficial measure. In Ontario, fencing off river creeks to keep cattle away has been accelerated by evolution in social norms in the farming sector, particularly since the Walkerton tragedy (“nobody wants to be the last one to have his cattle wander in the creek”). Endogeneity can also support participation when farmers build motivations from a positive first experience. In interviews, participation in incentive programs was reported to enhance farmers’ environmental motivations, with farmers adopting progressively more environmentally ambitious projects as trust, awareness, experience, and positive recognition developed. A personal sense of achievement and positive recognition were reported to foster a pro-environmental attitude. Endogeneity can also be a deterrent to participation when environmentally beneficial practices are frowned upon by neighbouring farmers (e.g. practices make fields look untidy), or when farmers became discouraged or resentful after a negative experience (e.g. their application was rejected). Concerns with a program’s perceived fairness, relayed within a farmers’ social network (e.g. at meetings, or on Twitter), also colour the perception of the program among farmers.

The literature on PES has abundantly debated crowding out effects - with payments crowding out personal or social norms (Chenard & Parkins, 2010; Ezzine-de-Blas et al., 2018; Rode et al., 2015; Toogood et al., 2004; Vincent, 2007). For Muradian and Rival (2012), incentives covering only part of the new practices’ implementation costs should be the preferred form of PES, as such incentives build on existing motivations rather than suppressing them. They argue that, contrary to schemes building on existing motivations,

practices supported under a purely market-based scheme would disappear as soon as payments ended. In the absence of long-term recurring funding schemes (except for ALUS in a few Ontario communities), the debate on the risk of crowding out intrinsic motivations through payments is not central in Ontario, where cost-share programs only cover part of the BMPs investment costs. However, the impact of PES on motivations should not only be analyzed through the lens of a potential crowding-out effect. Other factors should be considered. In Ontario, being denied funding discourages farmers from (ever?) reapplying. Rejection in a competitive project selection process can further impact motivations than getting used to payments.

5.1.3 Transaction costs are a key participation barrier, with competitive and collaborative approaches both raising cost-efficiency issues

Our research started from the debate among proponents of collective and competitive approaches in PES design. However, based on the review of Ontario PES and contrasting PES in OECD countries – under an original analytical framework –, we conclude that competitive and collaborative designs should not be considered antagonistic. A number of hybrid programs, combining competitive and collaborative features, were observed. In particular, PES with strong farmer governance (e.g. designed and implemented with or by farmer organizations, which we consider a key collaborative feature) have used competitive designs in Ontario, including conservation auctions.

Conservation auctions have been proposed in the international literature as a solution to maximize PES cost-efficiency. Cost-efficiency analyses suggest that competition among landholders can reduce global costs for ecosystem services users (or their representative),

as funding would concentrate on the most cost-efficient projects only (ÉcoRessources Consultants, 2008; Johansson, 2006; OECD, 2010). But several factors hinder auctions' cost efficiency in Ontario. In the context of multiple cost-share programs, conservation tenders were often perceived by Ontario applicants as an opportunity to get higher funding than usual cost-share ceilings. A number of applicants thus bid above rather than below usual cost-shares. In interviews, farmers reported trying to guess what would be the highest cost-share the funder would take. Cost shares indicated in the call for tenders or used to fund similar BMPs in prior or parallel projects act explicitly or implicitly as references. They trigger an anchoring bias and limit the expected benefits of competition on price through reverse auctions. While only based on hypothetical bidding, our choice experiment confirms this probable anchoring bias in Ontario, as most respondents bid on the highest proposed price. To limit this phenomenon, researchers have recommended that reserve prices are not announced. However, in repeat auctions, bidders tend to learn reserve prices and similar anchoring occurs (Latacz-Lohmann & Schilizzi, 2005). In Ontario, OSCIA chose to mention, in a call for bids, a large range of reference cost-share (Chapter 3, Box 2). We have no information on whether this was efficient in limiting anchoring.

Conservation auctions were usually implemented for a short period, with important costs in human resources to develop, learn, participate in, and analyze the program. Several program managers we interviewed in other jurisdictions explained moving away from conservation auctions - after an initial phase used to reveal prices - in particular due to the cost of running auctions. Finally, perceived complexity and transaction costs were also a deterrent to applying. Competition creates higher transaction costs for the farmers, who

have to design specific projects and demonstrate their value-added, decreasing interest in the programs.

Programs where governments or ES buyers provide administrative support to applicant increase participation but raise cost-efficiency questions for governments. This trade-off has been a critical question in the design of PES programs for decades, with an underlying question on who should be paying for these costs. Policy should consider transaction costs in a broad sense: for ES buyers (e.g. governments in public programs), landholders, and intermediary institutions. While intermediary institutions usually increase direct transaction costs, they can improve the overall program efficiency by adapting individual project designs to local needs, conditions, and priorities. Intermediary institutions can also build on a capital of trust to increase participation, and facilitate project monitoring and continuous adaptation, thus improving program impact in the medium-term.

Farmers' transaction costs when applying to PES in Ontario were at the center of most discussions on participation barriers in qualitative interviews (Chapter 2). While financial costs were sometimes mentioned (some farmers recruit consultants to prepare their applications), time was the main transaction cost farmers and key informants referred to. In Ontario, many farmers, including large cash crops farms, are part-time farmers, with multiple competing activities. The administrative burden associated with a complicated application process, and the necessity to minimize this burden by making applications simple, was also one of the main themes of farmers' open answers in the choice experiment survey; 31 respondents spontaneously mentioning this aspect (Chapter 4).

5.2 Policy insight and recommendations

Agri-environmental policies in Ontario have considerably evolved over the last 80 years (Chapter 3), and continue to raise interest in research and policy communities (Dupont, 2010; Empson-Laporte, 2014; Environics Research Group, 2001; Filson et al., 2009; Holmes, 2015; Juhasz, 2014; Lamba et al., 2009; Nailor, 2000; Nebel et al., 2017; O’Grady, 2008; OMAFRA, 2015; OSCIA, 2014a; Prairie Research Associates, 2011; Rosenberg, 2010; Stonehouse, 2010; Weber, 2017). Experts in the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), and in prominent Ontario farmer organizations (OSCIA, Farm and Food Care, OFA, etc.) take stock of former approaches and explore potential innovations in policy design. Since 2015, OMAFRA has in particular shown interest in behavioural approaches (OMAFRA, 2015; Weber, 2017), with the objective to account for farmers’ motivations and potential heterogeneities among farmers when designing future agri-environmental programs. Our research brings policy insight in this context.

Our research reveals significant heterogeneities in farmers’ preferences. However, a first set of recommendations builds on positions widely shared in the farming community. Three objectives emerge in priority: (1) considering demand for technical assistance in agri-environmental programs; (2) minimizing farmers’ transaction costs; and (3) managing farmers’ motivations in the long-term. Recommendations associated with these objectives are developed in specific sections below (recommendations 1 to 11). While those recommendations are of broad relevance for Ontario farmers their adoption is more or less critical depending on farmers’ attitudinal profiles and experiences (Figure 41).

First-level recommendations feed in the debates between collective and competitive approaches, with a nuanced conclusion, to account for local motivations and experiences. This provincial analysis leads to recommend supporting bilateral agreements between farmers and/or landowners, and some collective action (recommendations 12 to 15). These recommendations vary across farmer groups with specific attitudinal profiles (Figure 41). Finally, the historical analysis of Ontario PES, and consultations with Ontario farmers lead to recommend improving impact monitoring, evaluation, traceability and third-party verification (recommendation 16).

Several of those recommendations build on innovations that are **already active in Ontario**, but deserve to be sustained, strengthened, or could inspire other regions.

Figure 41: Summary of policy recommendations by class

5.2.1 Consider demand for technical assistance

“You cannot “purchase” environmentalism, it can only be learned. (...) The best return is on education coming from on farm research or comparisons delivered by farm organizations lead by stewardship motivated farmers, researchers and conservation authorities.” (South-Western Ontario field crop farmer)

Since the 1990s, public agricultural extension has been drastically reduced in Ontario (Milburn et al., 2010). Public extensionists have been replaced by certified crop advisors, working for a fee, often associated with input providers. Our research shows that there remains a strong demand for technical advice on agri-environmental practices and programs in Ontario²¹⁰. Most participants in the choice experiment are ready to receive a lower incentive to adopt a BMP if they can benefit from technical assistance. Some farmers, representing at least a quarter of the CE participants, would even overlook the payment if they could benefit from technical assistance.

Recommendation 1: Propose technical assistance on-farm for project identification and design, in particular in critical areas and for first time participants.

“The most important item I consider is having a single personal contact that would come to the farm, discuss possible projects and then assist with the paperwork. This would be intensive from a work point of view from the conservation authority however it would see a very high rate of success of projects. Farmers are busy enough without having to work through more unfamiliar paperwork that doesn't financially benefit them that year. I agree that conservation will serve farmers in the future but everyone views the world from the present with less thought to the future.” (South-Western Ontario field crop farmer)

After 30 years of incentive programs in Ontario, some farmers have acquired a solid experience, and adapt to new designs. The Environmental Farm Plan has helped many

²¹⁰ Farmers originally mandated to help their peers prepare applications do not provide this service any longer under the EFP framework. While some conservation authorities and ALUS provide such support, it is not generalized.

farmers identify environmental shortcomings on their farm and leads for improvement. However, our qualitative and quantitative research shows that there remains a strong demand for technical support in Ontario. Specialized knowledge can help farmers optimize projects and move beyond most common environmental practices. If they could access technical assistance with agri-environmental incentive programs, almost half of the CE respondents would prioritize having a specialist to help them identify priorities on their farm and design their project. Technical assistance could help bridge the growing divide between repeat participants and non participants; i.e. between farmers who have the knowledge or can afford to hire consultants to identify projects and prepare their application; and farmers who have never applied, applied only once or twice in a non-competitive process, or applied unsuccessfully.

Several programs in Ontario (GLASI, South Nation Clean Water Program, and ALUS for example) have already adopted this approach, with experts, certified crop advisors, or experienced farmers helping farmers in project identification and design. Those experts sometimes also provide program managers with important technical information for project ranking based on objective indicators. This approach has the potential to increase farmers' buy-in of agri-environmental programs, improve project quality, and facilitate selection based on objective criteria. While this approach increases transactions costs for the government or ES buyer, it reduces farmers' transaction costs and has the potential to increase program environmental impact, in particular in areas where broad-scale adoption is critical (e.g. to reduce fertilizer and pesticide run-off in Great Lakes watersheds). Building on experience in specific locations (cf. above), this approach could be expended, and offered more systematically to farmers who are new to the programs. Finally, technical

support is sometimes only provided in a small part of the farm, when it could often be worth engaging in a diagnosis and transition plan for the whole farming system, to optimize project design, and help farmers engage in a broader, multi-year transition. This is in particular the case for newcomers and alternative farmers with an ecological project. This experience could also inspire other regions.

Recommendation 2: Offer technical assistance to groups of farmers with common agri-environmental interest. Our research also brings insight on the nature of farmers' demand for technical assistance. Many farmers who participated in our research²¹¹ would be interested to receive collective technical assistance, in particular if provided by an experienced farmer to a group of his peers. These findings lead us to recommend offering collective technical assistance as an option in Ontario agri-environmental incentive programs. Similar approaches have been implemented for example in Quebec with agri-environmental advisory clubs (*clubs-conseil en agroenvironnement*, CCAE²¹²), since 1993. CCAE in Quebec started at the same period as the Rural Conservation Club Program (RCCP) supporting collective innovative projects in Ontario. But while public support for RCCP was short-lived, CCAE have had a sufficient time-span to significantly impact rural communities and farming practices. Public funding for CCAE in Quebec was continued through successive evaluations and reforms. While culture and experience with collective approaches are different in Ontario, with limited cooperative background in the farming

²¹¹ Representing at least half of CE respondents.

²¹² The movement started in Quebec with 300 farmers' groups in 12 clubs in 1993. In 2004, there were already 82 clubs with 250 advisors and 6792 members, i.e. 19% of all Quebec farms, representing 35% of cultivated area and 35% of livestock (Turcotte, 2004).

sector, our research shows that demand for collective technical assistance exist. Programs could learn from experience in Quebec, France, etc. Adaptations in Ontario may include the profile of group advisors. While CCAE in Quebec mobilize specialized technicians, Ontario farmers mentioned their interest to learn from experienced peers.

Recommendation 3: Bridge (some of) the divide between mainstream and alternative farmers through joint events, or joint farm-based research networks. We observed a strong divide between mainstream and alternative farmers in Ontario, with clear farmer self-identification in a group, and very different beliefs with regards to environmental practices. While in Europe organic farming has been at the forefront of agri-environmental incentive programs, organic farming remains controversial in Ontario. Several mainstream interviewees consider that supporting organic farming would be environmentally irrelevant, as many organic farmers continue tilling. On the other side, organic farmers deplore not being eligible to receive incentives for reduced fertilizer and pesticide application (dedicated to ‘smart farming’ or ‘precision farming’), despite not using chemical input, which they consider a major environmental benefit.²¹³ Positions also differ with regards to urban-rural collaborations; with mainstream farmers expressing a strong urban-rural opposition, while alternative farmers aim at collaborating with urban citizen in particular on sustainable local food systems (Andrée et al., 2017; Di Felice, 2020; Qualman, D. & the National Farmers Union, 2019). Relevant environmental knowledge

²¹³ After we completed our field work, an incentive program supporting organic farming was developed in Eastern Ontario: Growing Eastern Ontario Organically (GEO-O). GEO-O is a three-year initiative supporting transition to organic farming through mentorship, financial incentives, and on-site experiential learning. This \$543,600 program is administered by the Canadian Organic Growers with funding from the Ontario Trillium Foundation. In Canada, organic farming is also supported in Quebec and Prince Edward Island for example

has been developed by innovative farmers, mainstream and alternative farmers. Sharing experience and insight across groups can help cross-fertilize innovations. Strong interest for soil health in all groups opens the opportunity to exchange and learn from respective experiences. Joint events, for example on soil health, regenerative agriculture, traceability, or sustainable food systems, could help bridge ‘farming visions’ divides and be mutually beneficial (e.g. mainstream innovators have focused most efforts on soil structure, and alternative farmers on soil biology including microbiology). Events organized in 2015-2016, on the occasion of the International Year of Soils, may prefigure future collaborations. Joint events could lead to strengthened collaborations, and potentially joint networks of farm-based field research, for example on soil health, or regenerative agriculture²¹⁴.

Recommendation 4: Facilitate farmer-researcher collaborations on agri-environmental practices. Several farmers we interviewed and about 10% of respondents in the CE survey (17% among ‘Environmental Champions’), mentioned their interest to learn in priority through partnerships with research teams. Farmers who are engaged in collaborations with researchers see it as an important source of information and a high mark of recognition for their environmental action²¹⁵. This recognition reinforces pride and motivation. Obviously, collaborations with farmers are also a great benefit for researchers. Agri-environmental program managers in Ontario already facilitate on-farm research. They

²¹⁴ Initiatives along this lines were developed after the research was concluded. For example: OSCIA led an application for funding from Agriculture and Agri-Food Canada, to evaluate BMPs through living labs, together with EFAO, Innovative Farmers Association of Ontario, and several conservation authorities.

²¹⁵ We located this recommendations under the ‘technical assistance’ heading, but it is also relevant to section 5.2.3: ‘Manage motivations in the long-term’.

broadcast research announcements from universities through their networks and media. We directly benefited from such intermediation, which was a key element of success. However, efforts could be more structured. A specific platform with a ‘matching function’ could be envisaged. Interests rising from farmers could thus also inspire new research.

5.2.2 Minimize farmers’ transactions costs

Farmers’ transaction costs (investment in time) when applying to PES are a key barrier to participation. Simplicity is the main demand Ontario farmers formulate on PES design. In an analysis of the conditions to encourage regenerative agriculture in Ontario, Duncan (2020, online) concluded: “Beyond increasing dedicated funding, government, not-for-profit, and private organizations trying to incentivize regenerative farming methods can start by making incentive programs as user-friendly as possible.”

To minimize transactions costs, program designers should consider transactions costs globally, i.e. for institutions managing the payments, farmers and potential intermediary institutions, and in a multi-year perspective. Adopting a multi-year perspective in the analysis of transaction costs would lead to favour longer-term programs and incremental changes in PES design over consecutive phases, rather than adopting completely new approaches, to minimize the need for farmers and staff to learn and adapt. Adopting a systems approach, i.e. considering the whole farm and potential interactions with neighbours, at least at the stage of project design and planning, would also reinforce coherency among investments supported, minimize farmers’ transactions costs, and allow to offer technical assistance at a limited cost.

Recommendation 5: Propose multi-year contracts, fund transitions. Adopting a multi-year perspective of transaction costs would also lead to allow farmers to apply for multi-year projects rather than a succession of annual grants. In-line with previous research, many respondents would prefer not to sign a multi-year contractual agreement associated with potential project inspections, as a condition to access agri-environmental funding. However, this condition did not appear to be an absolute barrier to participation. More than a third of respondents in our choice experiment did not express any preference, while more than a fifth would prefer to sign a multi-year contractual agreement.

Recommendation 6: Mutualize place-based information under (a) single umbrella(s). Develop a stewardship programs platform, with a network of go-to people in existing institutions. “Existing programs (...) can be hard to find and difficult to navigate” (Duncan, 2020, online). During our research we heard multiple times that farmers had difficulties finding incentive programs corresponding to the project they intended to do, on-time to apply. Information on funding sources is fragmented, and interviewees find it difficult to keep up to date with frequent evolutions. Several interviewees called for a consolidated source of information on farm stewardship funding programs available in Ontario. Several respondents in the choice experiment also regretted the lack of coordination among organizations supporting agri-environmental programs and underlined the need for consolidated information: “Another issue is overlap between organizations, without coordination between them”; “It would be nice to have a way that small farmers could learn about what grants are available to them and how to receive them” (Ontario farmers). In practice, some key people long-established in rural areas help farmers navigate

through multiple opportunities, even beyond their individual mandate (e.g. soil & crops local representatives, or conservation authority staff). Farmers refer to them as their ‘go-to person’. EFP workshops can also be an opportunity to learn about multiple funding sources. Some collaborations are formally or informally organized among funding programs (e.g. ECFSC in East Central Ontario gathers 13 organizations; South Nation Conservation Authority collaborates with ALUS Eastern Ontario; Conservation Ontario organizes collaborations among conservation authorities; etc.). But a broader and more systematic networking would help. A simple, regularly updated, user-friendly database under a digital platform, where farmers could find information on all available or upcoming support programs with clear calendars, geographic information and eligibility criteria would already be a most useful innovation. An existing website provides Ontario farmers with information on all government support programs (Ontario Business Grants, 2021). This platform redirects farmers to the respective programs’ websites, but it is not dedicated to agri-environmental funding and not a search engine per se. A dedicated search engine with a user-friendly interface could facilitate accessing information on agri-environmental programs by geographic location, type of BMP, date, nature of the support (technical assistance versus financial incentive), funding range, etc. As all similar initiatives, this platform should be defined as a long-term process, with limited administration requirements, rather than a one-shot project. All program managers should be able to enter and update information on their program.

Some farmers ask for more than a simple search engine. They ask for farm-based information to be consolidated across programs and funding sources, as they do not want to have to provide similar information multiple times:

“I think it's important that programs try to not have too much overlap with other groups and associations so that there is not the same/conflicting information in multiple places. A lot of groups ask the same questions to farmers over and over and there is a lot of overlap in paperwork between departments and organizations. This could be much more efficiently coordinated. For example, the environmental farm plan and nutrient management plan I am worried about having to do it over again even though the farm hasn't changed much over the years at a cost of 25 hours of paperwork. There should be an opportunity to just add changes to previous submissions.” (Eastern Ontario dairy farmer)

Such consolidation could be considered under a farm resilience administration or alliance (Recommendation 7), and use the Environmental Farm Plan – which is already required by multiple funding programs and industries – as a common basis.

Recommendation 7: Consider a farm resilience alliance. While the recommendations above (1 to 6) build on existing programs and initiatives, some farmer groups call for more radical changes. In *Tackling the Farm Crisis and the Climate Crisis*, The National Farmers Union calls for the creation of a Canadian Farm Resilience Administration. This entity would provide direct support “to help farmers protect soils, land, water, and our food-production capacities; support moves toward alternative land use, including wetland restoration and afforestation; and assist in the mobilization needed to meet our emission-reduction targets and stabilize our climate.” (Qualman, D. & the National Farmers Union, 2019, p. 7). While, under current budget restrictions, a new administration may not be within reach of public budgets in the short-term, findings in our research call for at least a strong agri-environmental alliance, where: (1) **available programs and complementary**

policy instruments could be pooled and presented to potential applicants as a coherent set, with alliance members trained to provide information and advice on all agri-environmental funding and technical assistance opportunities, and possibilities to stack them, thus reducing transaction costs; (2) **policy research, evaluation and innovation** can be discussed across programs. On the first point, this alliance could build on the experience of the East Central Farm Stewardship Collaborative while having a much broader mandate. On the second point, it could build on the experience of the Federal-Provincial Working Group on Ecological Goods and Services (WG-EGS) in its most active phase. A national initiative would be particularly relevant. In the absence of a nation-wide initiative, an alliance could be organized in Ontario. This alliance could draw from existing networks: in particular, the Ontario Farm Environmental Coalition, and Conservation Ontario. The Agricultural Soil Health and Conservation Working Group, which supported OMAFRA in the preparation of *New Horizons: Ontario's Agricultural Soil Health and Conservation Strategy* (Ontario, 2015), could also be a strong foundation for such alliance²¹⁶. Recommendations 3; 4 and 6 above could be implemented under this alliance. Besides farmer organizations, public administrations and conservation groups, the relevance of including private organizations in the value chain, and citizen groups in this Alliance could also be discussed with a core group of founding members. Such private partners could usefully discuss environmental premiums associated with 'green markets', environmental standards built as marketing conditionality, or supporting the expansion of local sustainable

²¹⁶ Agriculture and Agri-Food Canada; Christian Farmers Federation of Ontario; Conservation Ontario; Ecological Farmers Association of Ontario; Farm and Food Care; Grain Farmers of Ontario; Innovative Farmers Association of Ontario; National Farmers Union Ontario; Ontario Certified Crop Advisor Association; Ontario Federation of Agriculture; Ontario Fruit and Vegetable Growers Association; Ontario Soil and Crop Improvement Association; Soil Conservation Council of Canada; University of Guelph.

food systems. Farmer banks, insurances, and local governments could also usefully contribute to thematic debates (e.g. on stewardship rental agreements, or sustainable local food systems).

In a context where public funding for agri-environmental programs is limited, a number of research participants suggested innovative policy instruments, not currently available in Ontario, including tax incentives. Some of those ideas are listed in Appendix 19. Spontaneous recommendations can be grouped in four main themes. Firstly, several interviewees and participants in the choice experiment are concerned with widespread tree cutting in Ontario. Viewpoints on potential solutions varied from support to tree cutting by-laws (by non-farmers), regulatory protection of exceptional natural areas, mandatory offsets, legal commitment to preserving trees planted with project support... to recurring payment schemes or tax exemptions to incentivize keeping land forested. No farmer in the choice experiment suggested options to facilitate stewardship on rented land; but this theme was mentioned many times in interviews. Interviewees suggested solutions to increase adoption of medium to long-term stewardship leases with environmental clauses. Those suggestions were presented as tentative options to explore, rather than firm recommendations. For example, interviewees suggested making farmland tax breaks (that non-farming owners can get on land rented to farmers) conditional to long-term, environmentally conscious stewardship agreements; bank loans for farming conditional to or cheaper in case long-term stewardship rental; stand-alone or bonus agri-environmental incentives for long-term rented land. A third group of research participants suggested options to increase small farmers' participation in agri-environmental PES by capping grants or supported acreage. These suggestions fall in an active debate in Ontario, where

farmland sizes are extremely varied: several experts recommend on the contrary focussing engagement efforts on large farms to ensure significant environmental impact (e.g. reducing phosphorus run-off). A last set of farmer viewpoints plea in favour of recurring payments, in particular on sensitive areas (e.g. long grass). Agri-environmental incentive in Ontario have largely relied on cost-share programs, leaving the responsibility to farmers to invest, at least partially, to preserve or restore environmental conditions on their farms, which is coherent with the notion of stewardship. Moving towards recurring payments would change this implicit principle that farmers are responsible for what happens on or from their farms. The Alliance could examine policy ideas and instruments suggested by research participants, among others.

5.2.3 Manage motivations in the long-term

As outlined by Sieberg et al. (2006), influencing and changing farmers' behaviour and willingness to act needs to be conceived of as a medium- to long-term process. Our research results lead to recommend to **give further importance in program design to preserving or nurturing motivations, including with non-participants.**

Recommendation 8: Stay away from shaming. Reconcile conflicting purposes and values. Build on farmers' sense of ownership and self-direction. Long-standing stewardship programs in Ontario have learned to respect farmers' attitudinal traits. In particular, programs tend to stay away from shaming (being shamed has been seen to trigger a defensive attitude with farmers blaming urban citizen for environmental degradation). Programs such as ALUS also tend to reconcile 'business culture' in the

farming sector with environmental objectives, by using a productive terminology to speak about ecosystem services farmers could develop on their land (Chapter 2). Weber (2017, p. i) recommends, along this line, for new programs to “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”. Finally, programs such as ALUS build on farmers’ sense of ownership and self-direction by clearly identifying the program as farmer-led, and giving most decision responsibilities to farmers. Those features could inspire other programs, including outside Ontario.

Recommendation 9: Manage expectations. Provide constructive feedbacks. As above mentioned, being denied funding can discourage farmers from (ever) preparing stewardship projects. To prevent such reaction, some Ontario programs, such as South Nation Clean Water program, have developed strategies to manage applicants’ expectations. Those can include: (i) stringent and explicit eligibility criteria; (ii) early screening based on a basic project idea; (iii) clear feedback during project preparation, and suggestions for improvement; (iv) explicit feedback and/or availability to answer questions when a project is rejected. While features may vary, we strongly recommend managing stewardship grant applicants’ expectations in Ontario, to avoid discouragement and resentment in the farming sector. In addition, constructive feedbacks on rejected applications could increase reapplications.

Recommendation 10: Build competition on funding level per project rather than on projects. While most research participants recognize that a merit-based approach is probably the best selection method, program designers should keep in mind that rejection

can have long lasting effects on program applicants' willingness to participate in PES and adopt environmentally beneficial practices. In a context of limited public and private funds, competition among projects cannot be discarded. However, to avoid discouraging farmers, recent Ontario programs build competition on the level of funding, rather than binary in or out options. Projects can be funded at different levels depending on their environmental benefits rather than being just accepted or rejected. This approach could inspire other programs in Ontario and beyond, in particular when targeting priority areas and high environmental stakes.

In the United States, the US Wildlife service has developed another approach to purchase conservation easements on strategic wetlands, which avoids rejecting offers: adaptive pricing. Conservation easements are proposed at a set price in a wetland management district, depending on land market prices and productivity of the land. Prices offered evolve annually depending on landowners' acceptance rate of land purchase offers – with a rate between 40 and 60% of acceptance considered optimal. This approach creates a market, and adapts to market fluctuations, to reach a pre-set acquisition objective cost-efficiently.

Recommendation 11: Support motivations crowding in, by including in program design, or in a broader policy mix, features to build self-esteem and recognition. “the amount would not even have to be significant; a small amount that shows society values the effort would mean a lot to farmers who want to help the environment” (South-western Ontario field crop farmer).

Several research participants testified that, while seeking recognition was not the reason for their participation, it did encourage them to do more. In particular, showing non-farmers

that farmers “are not the bad guys” can be an important benefit farmers get from participating in PES, even though it was not their primary motivation. Recognition by their peers can also be important. Environmental awards, recognition as a ‘farmer champion’ in a brochure, publication, or event, and partnership with researchers on environmental practices are some of the non-market ways of supporting positive motivations through recognition. Those instruments already exist in Ontario, but they often focus recognition on a limited number of environmental champions. To support motivations crowding in, programs could consider recognizing a broader number of deserving farmers. Motivations to adopt environmental practices can also be supported through market-based instruments, with the development of labels or value-chains for environmentally-beneficial products. Synergies between incentive programs and other instruments in the policy mix (BMP brochures, conferences with environmental champions, awards, research partnerships, green markets ...) could be strengthened to support motivations crowding in.

5.2.4 Incentivize (some) collective action

There is no strong tradition of farmer cooperatives in Ontario; and our research revealed collective action barriers, including tensions within the farming community, and strong preferences for individual decision making (Chapters 2 and 3). Coordination costs were mentioned by farmers, and supporting institutions, as a barrier to participation. However, Ontario also has a long tradition of collective action in the farming sector (Holmes, 2015), and research participants expressed interest for collective action, in the form of joint projects, joint access to technical assistance, or collective action bonus for individual projects. Collective approaches would probably not be a panacea in Ontario, but there is

room for considering specific collective action incentives. Our research leads us to recommend developing opportunities for collaboration among farmers in Ontario PES, at least on a pilot basis. 90% of the CE respondents showed interest for some type of collective action incentive, including at least 36% willing to coordinate their project with their neighbours' to get an extra bonus on their cost-share. We thus recommend trying collective action bonuses, rewarding individual projects with an additional cost-share beyond a threshold adoption in an environmentally-relevant area.

Recommendation 12: Support and/or require stewardship rental agreements.

Collaboration does not necessarily need to be broad scale. In the context of an increasing farming system specialisation, and tensions in the farming community over precarious land agreements, even bilateral agreements could bring significant improvements. Many interviewees highlighted difficulties to adopt stewardship practices on rental land in Ontario, in a context of very precarious rental agreements, often just based on annual handshakes. Agri-environmental programs could support formalizing rental agreements with stewardship clauses, as promoted by Farm & Food Care in Ontario, to improve stewardship on rented land. Bilateral agreements could be supported with legal advice or monetary bonus in cost-share programs. Several interviewees even suggested to explore making stewardship rental agreements mandatory for landowners to receive tax breaks eligible on farmland (cross-compliance). Others mentioned that banks or insurance could play a role by requiring formalized stewardship rental agreements to access loans, or agricultural insurance contracts. While a more drastic change, Ontario government could also consider regulating farm land rental agreements.

Recommendation 13: Support – at least on a trial basis - projects based on bilateral agreements among neighbours or livestock/crop producers. Farming system increasing specialisation in Ontario (Introduction, Chapter 1) limits farmers’ capacities to implement sustainable systems based on crop-livestock complementarities. PES could support contracts between crop and livestock farmers, for grazing cover crops, and extending grazing season into the fall; or organize rotational grazing through shared investments in temporary fences. Such partnerships would be important for soil improvement and critical for regenerative farming.

Recommendation 14: Offer the possibility for joint projects to get funded under existing programs. Some farmer groups have benefited from community funding through private grants (e.g. from the Trillium Foundation) or community grants from the Ontario Ministry of Environment, sometimes with a conservation authority or a farmer organization helping with project design and application. However, such cases remain exceptions, and rely on individual goodwill rather than purposeful design. These often fund the same few long-standing initiatives. We recommend that mainstream agri-environmental programs open the option to finance group projects. Group projects are not expected to become a panacea in Ontario. However, being funded by mainstream agri-environmental programs would increase the visibility of existing group initiatives, and could trigger a ripple effect.

Recommendation 15: Test collective action bonuses in environmentally sensitive areas. Collective action bonuses raise increasing interest in policy and research communities worldwide. The literature shows that cooperative approaches are very

promising for biodiversity conservation, water quality... (OECD, 2021; Sieberg, 2006). In Ontario, international experiences fostering collective action have been discussed by Holmes (2015), and OSCIA (2014a) but collective action bonuses were never tried on the ground. The only agri-environmental program explicitly targeting collective projects in Ontario was too short-lived to conclude on its relevance and replicability. Some Ontario farmers argue that their large farm size makes collective action irrelevant. However, other interviewees mention that specific environmental stakes would benefit from collective adoption (e.g. wetland restoration, protecting a creek, planting a windbreak along a road, restoring a sensitive sub-watershed or habitat, etc.). The principle of adding a bonus on a basic grant already exists in Ontario. Recent programs (such as GLASI, LEAD, SARFIP) allow for staking various bonuses associated with specific benefits (Chapter 3). Ducks Unlimited's grant levels on private land also depend on environmental stakes. Those programs could serve as a basis and an inspiration for collective action bonuses on individual projects in Ontario.

5.2.5 Improve impact monitoring and evaluation

Recommendation 16: Improve impact monitoring, traceability and third party verification. Several research participants²¹⁷ noted that individual stewardship projects are rarely evaluated, and recommended further monitoring, auditing, commitments... for a long-term impact. “I feel that programs should be offered with technical assistance and commitments to maintain the project by the recipient” (Eastern Ontario dairy farmer).

²¹⁷ Including ten respondents in the choice experiment, spontaneously, in an open question.

“Really high value high cost projects must come with guaranties that it will be protected and maintained for long periods of time even if the land is sold or changes hands” (Southwestern Ontario field crops farmer). A more stringent evaluation, known in advance, could increase program impact and cost-efficiency. As underlined by Weber (2017), most programs are not monitored for impacts; further monitoring would be an important condition to reinforce efficacy beliefs about the practices. New industry requirements will also call for increased impact monitoring, traceability and third-party verification. Synergies between monitoring for industry requirements and grant programs could be developed.

5.3 Accounting for hidden heterogeneity factors

5.3.1 Separating or pooling equilibria

In the context of hidden segmentation factors, various types of policy instruments can be used to reach either a separating or a pooling equilibrium²¹⁸. Policies could rely on either separating or pooling instruments depending on their objective to either concentrate funding on specific profiles, or broaden adoption across groups. In particular, instruments which would minimize transactions costs, provide technical assistance in project identification or design, and foster positive reinforcement would increase adoption (or repeat participation) across a broad range of farmer profiles (Figure 41). On the contrary, instruments supporting green markets, highlighting benefits for nature, supporting collective technical assistance and experimentation, and long-term contracts would appeal

²¹⁸ A separating equilibrium is an equilibrium in which agents with different characteristics choose different actions. On the contrary, under a pooling equilibrium, agents with different characteristics choose the same actions.

to specific farmer profiles (Figure 41). Collective action bonuses fostering dense adoption in a priority area have not been tested in Ontario. At least 36% of respondents in the CE and some farmers interviewed expressed interest for this type of bonus. But this interest was not associated to a specific farmer profile (it varies mildly across classes, Figure 38).

5.3.2 Proposing tailored programs with limited chosen options

Farmers' segmentation is a useful technique to target or tailor agricultural policies based on farmers' preferences and specific behavioural traits. It has been used in particular in the design of outreach and engagement programs. Our research was successful in identifying heterogeneities among farmers' preferences with regards to agri-environmental incentive programs. However, the only significant factors that explain this segmentation are hidden factors (attitudinal traits) that are not within reach of policy makers or program managers. Targeting farmers based on their attitudinal traits is complex, if at all possible. Tailoring programs to specific attitudinal traits would be feasible, but targeting program promotion (farmer engagement) would not be possible. Offering a diverse menu of program options would be the only easily feasible solution to serve all the profiles we identified. Yet, farmer segmentation in our research has led to useful conclusions. Current budgets do not give governments or NGOs the possibility to serve all farmers. For example, offering one-on-one technical assistance to all Ontario farmers may not be possible. But our CE revealed that a significant proportion of Ontario farmers ('Business Farmers' and 'Private Stewards') could benefit from collective technical assistance and experimentation, with farmer champions sharing their experience. 'Environmental Champions' could directly benefit from a support to develop green markets, in the context of an increasing urban

demand for local sustainable food systems. ‘Busy Farmers’ could receive on-farm technical assistance associated with multi-year transition projects. While this menu of options does not cover all the demand of each farmer profile, it could serve specific priority needs for each category. Farmers would self-select programs most adapted to their profile (separating equilibrium).

5.3.3 Revealing farmers’ profiles through self-identification or membership?

The fact that attitudinal traits matter in farmer segmentation was not a surprise: it corroborated previous research. However, we did not expect that attitudinal traits (hidden to policy makers) would be the only discriminating factors. Knowing that, we could investigate, in future research, whether unconcealed proxies of attitudinal traits could help sort out farmers into groups of heterogeneous preferences. During our qualitative research we observed that many Ontario farmers self-identify in a group with a specific farming vision and ‘symbolic capital’ associated with a farming ‘sub-culture’: as innovative, mainstream, business or ecological farmers. Future research could run a similar choice experiment while specifically asking farmers to self-identify in a farming vision; and **test if self-identified farmers’ profiles (‘sub-cultures’) correlate with groups of heterogeneous preferences.**

Purposive sampling in our qualitative research targeted farmers from different farmer organizations; and we disseminated the choice experiment survey through organizations and farm media corresponding to different ‘farming visions’ (‘sub-cultures’), as a way to reach farmers with different motivations. A future CE could objectivize this assumption, by asking participants to declare which farmer organization(s) they are member of, and test

for correlations with groups of heterogeneous preferences. While this could be considered a sensitive question, farmers we interviewed had no issue discussing their membership in various organizations. In addition, surveys would be fully anonymized, thus not disclose personal information. Identifying a potential link between a farmer organization and a preference profile would be particularly relevant in Ontario, where a number of agri-environmental incentive programs are co-designed and/or implemented by farmer organizations. A strong correlation between membership and preference for a specific program would allow to implement programs targeted on specific farmer preferences through their organization.

5.3.4 Exploring large farms' behaviours

Farm sizes in Ontario are increasingly heterogeneous. Environmental decisions of larger farms are particularly impactful. But environmental programs and agri-environmental research face difficulties in reaching larger Ontario farmers (Empson Laporte, 2014). Our CE did not identify farm size, or farm size owned versus rented as significant covariates in the latent class models. However, we conducted a specific analysis on the 41 CE participants who farm more than one thousand acre (up to 5100 acres).²¹⁹ This analysis is summarized in Table 53, Appendix 20. Respondents representing larger farms were generally younger than other participants and almost always relied primarily on farm income. They have participated more than average in environmental funding programs, but have also seen their applications denied more often. A fifth of those large farmers

²¹⁹ These are still smaller farms than those targeted by Empson Laporte (2014), with above 10,000 acres of land (either owned or rented) or having more than 500 nutrient units of livestock.

repeatedly refused to participate in stewardship programs choosing the ‘no program’ option in the CE. The proportion of large farmers considered ‘Disenchanted Stewards’ is thus twice the average proportion among CE respondents. Almost 60% of large farmers shared opinions and ideas in open fields, including strong concerns with perceived fairness, demand for programs that support innovators, preference for merit-based or even result-based funding, and emphasis on the importance of technical assistance and education.

5.4 Perspectives for future research

5.4.1 Tools and methodology developed for the dissertation can help in future research or local policy design and evaluation

Our research was based on an original **mixed methodology approach**, combining exploratory sequential design, triangulation through convergent design, and verification. Original questions in the choice experiment were derived and validated from the qualitative analysis (sequential design). Open questions embedded in the choice experiment survey helped us draw connections between our qualitative and qualitative approaches (convergent design).

The mixed methodology approach brought insights to the research that approaches used independently would have overlooked. Combining methodologies confirmed and explained results that would have otherwise remained unexplained and nuanced some findings. While the qualitative research allowed us map out factors which impact farmers’ decision to participate or not to participation in agri-environmental incentive programs, it did not allow us to establish an explicit hierarchy between factors that concern farmers in a general sense and those that primarily drive their decisions. The qualitative research did

not allow us to reliably segment farmers into groups of heterogeneous preferences, nor to appreciate the relative importance of different groups among farmers potentially interested in stewardship projects. The quantitative approach was necessary to draw these conclusions. On the other hand, the qualitative research allowed us to understand heterogeneities in preferences observed in the CE that would have otherwise remained unexplained (e.g. why a significant proportion of farmers are unwilling to participate); and to associate farmer profiles with specific farming sub-cultures, concerns, view points, discourse in farming networks, and past experiences.

Benefiting from a solid informal **field advisory committee**, with whom I regularly interacted at key research stages, was critical to build the research on a wealth of long-standing experience, anchor it in current policy questions and decisions, and verify intermediate and final findings. In particular, the field advisory committee was a major source of information to understand the Ontario context. The choice of program design options to be tested in the choice experiment relied on their perspective of future Ontario policy decisions. The field advisory committee reviewed the scripts of semi-structured interview guidelines and choice experiment survey to ensure that vocabulary, program description, and options were unambiguous and anchored in farmers' shared experience. They also provided contacts and recommended dissemination media to ensure that purposive sampling of key informants and survey dissemination covered a representative diversity of viewpoints and experiences. Discussions with 'field advisors' allowed us to understand which intermediate conclusions corroborated analyses they had already developed, and which fell into controversial debates (e.g. the relevance of collective action incentives in Ontario). Presenting and discussing research findings through a research-

policy network (EEPRN) and visio-conferences with OMAFRA staff were also important steps for verification.

Former research concluded that no ubiquitous factor can explain participation in agri-environmental incentive programs and farmers' adoption of conservation measures (Brick, 2013; Carlisle, 2016; Knowler & Bradshaw, 2007; OECD, 2012; Prokopy et al., 2008; Scottish Government, 2012). Researchers concluded that relevant factors need to be identified locally; but no framework was proposed to identify such factors. My research contributed to fill this gap by proposing a five-dimension framework to identify local farmers' decision factors. This five-dimension motivation framework was instrumental to understand farmers' decisions to participate in PES in Ontario, identify locally relevant motivations and participation barriers, compare design options, and identify heterogeneities across types of environmental practices, farmers' social networks and attitudinal profiles. In particular, including 'ownership and self-direction' in this framework, a dimension rarely taken into account in agri-environmental research, appeared extremely relevant in Ontario. This framework evolved slightly during the research, based on case study findings. The revised framework (Figure 42) could be used in other provinces and countries to evaluate farmers' decision factors, and subsequently support locally-relevant PES design and targeting strategies. The framework could also be further refined to distinguish, within each of the five groups of factors between expected outcomes (efficacy belief) and attitude towards the outcome (preference).

Figure 42: Analyzing farmers' decisions to apply or not to a PES: a five-dimension framework

In our research we also built original frameworks to compare policy designs on collaborative and competitive dimensions, using a systematic review of Ontario agri-environmental PES and international benchmarking (Figure 43 and Figure 44). Those frameworks can help in the analysis of other regional experiences. They can be instrumental to conduct meta-analyses, compare programs, identify blind spots, or propose innovative designs to be tested locally. In Ontario in particular, the collaborative framework helped identify a discrepancy between a large participation of farmer organizations in PES governance, recognized worldwide (Figure 12, Figure 43, horizontal axis), and an absence of incentive for farmers to collaborate on specific projects (Figure 12, Figure 43, vertical axis). This finding contrasts with the interest expressed by many farmers for further collaboration, and leads to recommend testing collaborative designs already adopted in other OECD regions.

Figure 43: Collaborative framework: Analyzing incentives to collective action in PES design

Figure 44: Competitive framework: Analyzing incentives for competition in PES design

The competitive framework helped point out that projects designed to be most competitive (ranking highest in both vertical and horizontal axes, Figure 15, Figure 44) were probably not the most cost-efficient, in particular due to larger transaction costs and fewer applications which limited actual rivalry among applicants. This finding leads to recommend designs reducing transaction costs, while managing motivations to avoid discouraging applicants in the long-term.

5.4.2 Future research can build on alternative sources of information, in particular social media

During our research, we came across discussions on Ontario agri-environmental incentive programs on social media, including Twitter conversations from farmers, self-identifying as innovative farmers, complaining of the perceived unfairness of programs benefiting ‘laggards’ rather than ‘innovators’ (as per the diffusion of innovation theory, Rogers, 1962; Rogers & Shoemaker, 1971). Discussions online among farmers in the landowners’ rights movement also reflected concerns with government or NGO-led programs potentially infringing on private property. Those online discussions were used in the dissertation, but they were not at the center of the research. Material available on social media in Ontario might not be sufficient to substantiate a research paper. But a paper adopting a broader geographical scope (e.g. Canada or North America), could build on discussions on social media to analyze farmers’ views on PES, motivations to participate, and participation barriers. Social media could be useful ways to approach broader discourses in social networks; however, such paper should take into account Internet proficiency bias and self-

selection bias associated with farmers voicing their positions on social media, who do not necessarily represent the majority.

5.4.3 Who should pay? Exploring the perceived fairness of polluter-pays versus user-pays boundaries in agri-environmental policies in Ontario

“I firmly believe land owners have a certain obligation to protect the resource and not be allowed to do whatever injurious practice they want on the precious limited resources of water, soil, air and habitat, but on the flip side I believe very strongly that farmers should not shoulder the entire cost of providing environmental services that benefit society as a whole... its to find the balance that is the challenge. I guess I would sum it up as "farmers should not be paid not to destroy the environment, but rather rewarded for preserving and enhancing..."” (Ontario field crop farmer)

The research presented in the current dissertation focuses on farmers’ individual behaviours, i.e. on individual decisions on participating or not participating in PES, with a specific interest on the influence of distributive impact (perceived fairness) and social networks on farmers’ decisions. However, interviews in Ontario and Prince Edward Island, conducted during the research, revealed that distributive impacts and social networks can also play a more structural role: they can shape policy negotiations, policy mixes, and broad trends in PES adoption, thus impacting collective decisions. A paper was sketched during the research with a focus on those **collective dynamics**. This future paper will describe negotiations on agri-environmental decisions between groups of diverging interests and view points. In particular, it will explore how negotiations lead to setting an implicit or explicit boundary between polluter pays and user pays principles (i.e. boundary between regulations (or taxes) and payments for environmental services). This boundary has practical and distributional consequences for farmers: on the one side of this limit, farmers are responsible for implementing environmental measures and covering the corresponding

costs, on the other they can be paid, compensated, or incentivized to do so. In certain policy contexts, the boundary between polluter pays and user pays principles is explicit and respected (a large proportion of farmers comply with regulations and participate in incentive programs); in other situations, this boundary can be fuzzy, mobile, or a source of conflicts. Setting a socially accepted and respected boundary is not a technical decision alone; it results from local policy bargains, governance institutions, social preferences and a number of facilitating factors. This paper will help identify conditions that facilitate or impede the negotiation of and respect for this boundary. It will build on various cases in Ontario and PEI, in particular the active debate in Ontario on municipal tree cutting by-laws. By comparing findings in Ontario and in PEI, this paper will illustrate that the presence of explicit distributional stakes associated with agri-environmental issues is one of the factors facilitating the establishment and respect of a clear boundary between polluter pays and user pays principles with a high level of participation in both voluntary and regulatory instruments. It will also highlight the importance of distributive impacts and social networks in agri-environmental policy negotiations. The paper will outline how the involvement of farmers' organizations can be an important contributing or disrupting factor in setting up an accepted balance between polluter pays and user pays principles. It will also detail the role of municipal, provincial and federal governments, as well as environmental NGOs, local resource management authorities and committees. Finally, the paper will examine how evolutions in commodity prices, and subsequent farm land price developments can profoundly disrupt an implicit boundary between polluter-pays and user-pays principles. Holmes (2015, p. 22) underlined "growing tensions between the private landowner community and civil society broadly" in Eastern Ontario and made a case for a

new **social contract** between Ontario farmers and other Ontario citizen. This paper will bring light on the necessary conditions to reach such social contract.

5.5 Summary conclusion

Environmental transition is not central to agricultural policies in Canada: government support to agricultural producers has long focused on market price support (MPS), and has considerably decreased since the late 1980s to accounts now for about 9% of gross farm receipts, i.e. about half of the OECD average (OECD, 2021)²²⁰. While MPS to the grains industry was discontinued in 1995 and MPS currently focuses on milk, poultry and egg sectors only, MPS continues to dominate government support to agricultural producers; and environmental policy objectives are only one of many objectives for the farming sector, in a context of reduced government funding²²¹. However, agri-environmental policies continue to be relevant in Ontario. New ambitions are associated with climate change mitigation and adaptation, increasing citizen interest for sustainable local food systems, and export requirements. Water, soil and biodiversity degradation also continue to be of concern. The Ontario farming sector has not benefited from a massive, long-lasting environmental incentive strategy. However, agri-environmental policies in Ontario can count on three long-lasting and broadly recognized features: The Environmental Farm

²²⁰ The cost of total support to the agricultural sector in Canada fell from 1.6% of Canada's GDP in 1986-1988 to 0.3% 2018-2020 (OECD, 2021).

²²¹ The current Canadian Agricultural Partnership (2018-2023) frames general policies and programs, with flexible adaptation in design and delivery systems at provincial and territory levels. This framework "comprises a suite of business risk management programs to help farmers manage market volatility and disaster risks, and strategic initiatives to increase competitiveness, productivity and profitability in the sector, increase its environmental sustainability, expand domestic and international markets, and improve the anticipation and mitigation of and response to risks." (OECD, 2021)

Plan, a major farmer-led voluntary self-assessment program; Beneficial Management Practices, a set of agricultural practices with environmental and economic benefits; and organizations involved for decades in stewardship programs, including farmer organizations, conservation authorities, NGOs, and professionals at the Ontario Ministry of Agriculture, Food, and Rural Affairs. Many geographically focused, thematic and often short-lived agri-environmental incentive programs have been tried in Ontario; and while environmental objectives have not mobilized massive funding, there is a wealth of experience to learn from, as observed throughout the research. In this context, recommendations presented in this conclusive chapter can be summarized in Table 29.

Table 29: Summary recommendations

Recommendations	Details
Consider demand for technical assistance	Propose TA on-farm for project identification and design, in particular in critical areas and for first-time participants Offer TA & experimentation to groups of farmers with common agri-environmental interests (peers), with support from farmer champions Bridge (some of) the divide between mainstream and alternative farmers through joint events, or joint farm-based research networks Facilitate farmer-researcher collaborations on agri-environmental practices
Minimize farmers' transactions costs	Propose multi-year contracts, fund transitions Mutualize place-based information under (a) single umbrella(s) Consider a farm resilience alliance
Manage motivations in the long-term	Stay away from shaming. Reconcile conflicting purposes and values, by recognizing and documenting the multiple functions of agriculture. Build on farmers' sense of ownership and self-direction Manage expectations. Provide constructive feedbacks Build competition on funding level per project rather than on projects. Support motivations crowding in, by including in program design, or in a broader policy mix, features to build self-esteem and recognition
Incentivize (some) collective action	Support and/or require stewardship rental agreements Support – at least on a trial basis - projects based on bilateral agreements among neighbours or livestock/crop producers Offer the possibility for joint projects to get funded under existing programs Test collective action bonuses in environmentally sensitive areas
Improve impact monitoring, traceability and third party verification	

Transformative change would require either a broad budget increase for ambitious environmental investments, from public or private sources, a shift in the type of farming system or value chain models supported in Ontario, or a shift in policy instruments. In line with the research approach, our recommendations build on existing experiences and lessons learned in Ontario and current policy objectives, rather than discussing transformative action. They are thus of incremental nature, rather than accompanying paradigm shifts. Understanding heterogeneities in farmers' motivation profiles could help strengthen future programs, improve targeting, and innovate to build on stewardship motivations in a multi-instruments policy-mix. With limited public extension and regulation, limited support to the expansion of green markets, recurring incentive schemes in only few communities, almost no tradition of farmer cooperatives, and no farmer collective action incentive, the agri-environmental policy mix in Ontario relies essentially on voluntary self-diagnoses (EFP), voluntary individual investment cost-share programs, and long-standing experience in support programs. Policy-mixes in Europe, Prince Edward Island, Quebec, and the United-States, for example, present a very different picture. Analyzing the impact and cost-efficiency of Ontario incentive programs Future policy developments in Ontario would benefit from this broader perspective, to maximize the impact of cost-share programs by combining them with technical support, further support to peer-to-peer innovation/experimentation groups, support to green market development and/or a regulatory framework to secure land tenure.

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Appendix 1: Interview Guides (indicative, actual questions differed)

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Remark 1: In most interviews, questions 1 and 2 have been skipped, as the researcher had collected previous factual information on the PES program, based on program documents.

Remark 2: Once approved by the ethics committee, this draft interview guide was tested for duration with 2 key informants, with the target of about 60 minute interviews.

INTERVIEW GUIDE: PROGRAM MANAGERS

1. Can you briefly describe your program (objectives, start date, number of beneficiaries, source of financing, volume of financing)?
2. How are beneficiaries selected (all eligible applicants that potentially benefit from it?; first-come first served; selection by intake period based or not on a point system; tenders)? How are financial incentives calculated (fixed amount, cost-share, bidding)?
3. Are group projects eligible for financing? Does the program provide specific incentive for collective participation? What is the proportion of group applicants?
4. Did farmer organizations participate in the identification, design, promotion, implementation, monitoring or evaluation of your program? (Elaborate and consider various levels of participation, including consultation and information). Have there been changes during the duration of the program in response to this?
5. Do you involve informal farmers' networks or peers at any stage of the program identification, design, promotion, implementation, monitoring or evaluation? (Elaborate) If yes, why and when was this feature introduced? How are those networks or peers selected?
6. Which types of farmers participate the most in your program?
7. What do you think are their key motivations? What are the main barriers to participation?
8. Did you notice a difference in regional uptake? Is there a concentration of uptake in specific regions?
9. Do you think that the attitude of landholders social networks (neighbours, farmer organizations, local innovation leaders, families, communities, etc.) matter in their decisions? (Elaborate)
10. Do you think that program's distributive impacts (who landholders perceive as losing or winning from the program and to which extent) matter in their decisions? (Elaborate)

11. Do you think that programs such as the one you implement can be improved by bringing more competition or more collaboration between landholders? Any example of designs you would want to test?

INTERVIEW GUIDE: FARMERS ORGANIZATIONS

1. Has your organization participated in the identification, design, promotion, implementation, monitoring or evaluation of a program incentivizing the adoption of environmentally beneficial land-use practices²²⁴? (Elaborate and consider various levels of participation, including consultation and information)
2. Do you see important contrasts among programs in the level of collaboration? (Elaborate)
3. How have programs changed over time?
4. Are there programs that you actively promote with your members? Are there programs that you follow with vigilance? Are there programs that you are reluctant or cautious about?
5. Which types of farmers participate the most in programs incentivizing the adoption of environmental practices? Which types never participate?
6. What do you think are their key motivations?
7. Do you think that the attitude of their social networks (neighbours, farmer organizations, local innovation leaders, families, communities, etc.) matter in their decisions? (Elaborate)
8. Do you think that program's distributive impacts (who landholders perceive as losing or winning from the program and to which extent) matter in their decisions? (Elaborate)
9. Do you think that programs can be improved by bringing more competition or more collaboration between landholders? Any example of designs you think would be interesting to test?

²²⁴ If not obvious to the participant, examples of such practices were listed, based on lists established by the Ontario Ministry of Agriculture and Rural Affairs.

INTERVIEW GUIDE: LANDHOLDERS (farmers or non-farming landowners)

Section1: Motivations

1. Have you participated in one or several programs supporting the adoption of beneficial land-use practices on your farm, including practices beneficial to soil health²²⁵? If so, which program(s), for which type of investment or practices, & when?
2. Do you know of other programs that you did not choose to participate in? Which ones?²²⁶
- 3.a. Participants: Why did you choose to participate in this (those) program(s)? Elaborate.
- 3.b. Non-participants: Why did you choose not to participate in this (those) program(s)? Elaborate.

Potential follow-up questions on:

- *historical aspects*,
- *comparisons*: why participate in a program but not another...

3.c. Participants: did you promote the program you participated in to other farmers? In which context?

4. Are there eligible Beneficial Management Practices (BMPs) that you choose not to apply for funding for, and why? Have you adopted those BMPs or not?²²⁷

Section 2: Social networks

5. Are you a member (or: an active member) of a farmer organization?
6. If yes, what do you think are your organization's views on agri-environmental investments²²⁸? What are your organization's view on Program X?
7. Where do you look for inspiration/advice on good farming innovations? Who do you consult the most? Who do you trust? [Would you trust people administrating Program X to provide you

²²⁵ The research might list specific beneficial management practices, based on Phase 1 of the research, and tests of the present interview guideline.

²²⁶ Follow-up question might ask their level of information on specific programs.

²²⁷ The researcher might list specific BMPs depending on the agro-ecological context.

²²⁸ The research might list specific investments, based on Phase 1 and tests of the present interview guideline.

relevant information on promising farming techniques? Would you trust that the information you provide them on your farm will be kept confidential? Are there programs that you trust and others not?]

8. Whose judgment on your farming practices matters? The opinion of your family, farmers in your organization, your neighbours, farmers in your community, your community, others? Can you recall specific occasions when you adapted your practices to benefit others?

9. Do you know if a significant proportion of your neighbours / farmers in your organization... has participated in program X? or adopted BMP Y?

10. If you decided to adopt practice X, would you feel comfortable to speak with your peers [*specify a relevant occasion*] about it? What would your peers/neighbours think if you adopted practice X?

11. Do you think that you would be more likely to adopt X if most of your neighbours / farmers in your organization did? Why? (elaborate)

Section 3: Distributive impacts

12. Who do you think benefits (benefited) from program X?

13. Were those benefits important in your decision to participate in Program X?

14. Do you think that your farm / your neighbours / other farmers/ your community benefited from Program X? In which ways?

15. Do you think that Program X has negative impacts? If yes, who is negatively impacted in what way?

16. Do you think that Program X is fair? (elaborate) What do you think is fairer: First-come-first-served; merit-based selection; conservation tenders?

Section 4: Potential Designs

17. Is there any past agri-environmental incentive program that you considered particularly successful or unsuccessful, and why?

18. Do you think that programs can be improved by putting more emphasis on selecting the best projects? By supporting collective action among landholders (e.g. group project, bonus for large adoption...)?

19. Do you have any other thought on agri-environmental incentive programs that you want to share?

Appendix 2: Heterogeneities in key decision factors across BMP types

Factors noted as most important in interviews, correspond to longer star branches and are circled in color.

Those factors vary according to three main groups of BMPs, with the first two being the most often contrasted in interviews.

Those two first groups were retained for different treatments in the choice experiment

Appendix 3: Environmental incentive programs on private land in Canada and Ontario: a historical perspective

1. Information sources

To identify payments for environmental services (PES), or schemes close to PES, in Canada, the present paper used several sources of information:

- The Green Source Funding Database;
- A survey published in 2011 by Sustainable Prosperity (Marcano, 2011);
- The final report of the Federal-Provincial Working Group on Ecological Goods and Services (AAFC, 2011);
- Program brochures and reports, most of which available online;
- Farmer press;
- Interviews with key informants with a long-term perspective on Ontario and Canadian programs;
- Research articles, which helped develop a more critical understanding of policy evolutions and lessons learned.

The **Green Source Funding Database** (Environmental Canada, 2014) has been developed by Environment Canada to help Canadians and Canadian communities identify sources of financing for environmentally beneficial projects. In 2014, the site listed 150 funding sources. Searches in the database could be made alphabetically, by region or by type of funding source (Federal; Provincial; Non-Profit; Private-Sector; Foundation). For each program, the Website provided the: (1) Name of sponsor(s); (2) Description of the funding mechanism; (3) Type(s) of candidates eligible; (4) Types of Projects Funded; (5) Range of

Funding Available; (6) Description of Funding; (7) Deadline for application submissions; (8) Contact. Programs and organizations listed may provide assistance in the form of funding, labour cost contributions, or in-kind donations.

In 2011, Sustainable Prosperity published a **Survey of economic instruments for the conservation and protection of biodiversity in Canada** entitled *Advancing the Economics of Ecosystems and Biodiversity in Canada* (Marcano, 2011). This survey identified 15 PES (or types of PES). The instruments listed included a national program financing conservation easements (the *Ecological Gift Program*), categories of public subsidy schemes (e.g. subsidy for conservation of water courses and soils), pilot PES projects, and tax incentives. Those programs were promoted by federal and/or provincial governments, by the private sector (environmental NGOs) or by municipal authorities.

Also in 2011, The **Federal-Provincial Working Group on Ecological Goods and Services** (WG-EGS) published its final report with summary findings and detailed recommendations.

PES schemes identified from those key sources were then further analyzed using information available on the programs' websites, evaluation reports, and research papers. Farmers' press was another relevant source of information on the motivations and expectations of farmers with regard to PES programs.

The research presented in this Appendix was used to develop the third section of Chapter 3, which explains some redundancy. However, while Chapter 3 Section 3 focuses on agri-environmental policies, this appendix adopts a broader perspective on PES – beyond agricultural lands alone – and does not detail other policy instruments.

2. 1930s – 1970s: setting-up institutions

Under the Canadian Constitution Acts, agriculture is a shared responsibility between federal and provincial governments.

“In each Province the Legislature may make Laws in relation to Agriculture in the Province, (...); and it is hereby declared that the Parliament of Canada may from Time to Time make Laws in relation to Agriculture in all or any of the Provinces, (...); and any Law of the Legislature of a Province relative to Agriculture (...) shall have effect in and for the Province as long and as far only as it is not repugnant to any Act of the Parliament of Canada.”²²⁹

Soil health on agricultural land has been a concern in North America at least since the 1920s²³⁰. Concerns considerably increased in the 1930s with the Dust Bowl greatly damaging soils and agriculture in the American and Canadian prairies. In the United States, the **Soil Conservation Act** of 1935 and **Soil Conservation and Domestic Allotment Act** of 1936 allowed governments to pay voluntary farmers, including tenants and sharecroppers under the 1936 Act²³¹, to reduce production and adopt soil conservation practices, introducing in practice PES in a broad sense (Cain & Lovejoy, 2004; Sheener & Lynne, 2011). Payments were dimensioned to compensate for additional costs and forgone income, and conditional to practices being adopted²³². Agri-environmental incentive programs,

²²⁹ Source: Constitution Acts, 1867 to 1982; VI. Distribution Of Legislative Powers.

²³⁰ See presentation in Arizona from the 1920s “The biggest problem in American Agriculture - How should we maintain the crops producing power of our soils” (Fertilizer Association Soil Improvement Committee of the National Fertilizer Association, n.d.). In the late 1920s, there were over 10,000 abandoned farms in southern Alberta alone (Forge, 1998)

²³¹ Landlords were now required to share the payments they received from the government for cutting back production with those who worked on their land.

²³² 74th Congress Session I Chs 84, 85 April 25, 27, 1935, Soil Conservation Act and 74th Congress Session I Chs 104. February 29, 1936 – Soil Conservation and Domestic Allotment Act (Congress of the USA, 1935, 1936).

including land retirement programs, further developed in the United States the 1950s with the adoption of the first **Conservation Reserve Program** in the Agricultural Act of 1956 (Title I: Soil Bank Act). The **Soil Bank Act** authorized governments to pay farmers to retire sensitive land, and establish and maintain a protective vegetative cover, under a multi-year contractual agreement²³³. We could not identify similar programs in Canada during this period.

Figure 45: Map of Conservation Authorities of Ontario in 2015

In this period, stewardship policies in Ontario and Canada largely relied on setting-up institutions responsible for coordinated planning, restoration on public and community

²³³ Agricultural Act of 1956 – Title I: Soil Bank Act. The Act authorized governments “to assist farmers to divert a portion of their cropland from the production of excessive supplies of agricultural commodities, and to carry out a program of soil, water, forest and wildlife conservation”. (Sec. 102) (Congress of the USA, 1956).

lands, and demonstration. OSCIA, the **Ontario Soil and Crop Improvement Association**, was formed in 1939. While **conservation authorities** were first introduced at municipal level under the Ontario Conservation Authorities Act in 1946.

The **Prairie Farm Rehabilitation Administration** (PFRA) was created in the Canadian Prairies in 1935 to develop programs addressing widespread soil erosion and water conservation (IISD, 1994). Programs included demonstration sites, reseeding land and consolidating it into community pastures, tree nurseries, and building water retention structures. Land management agencies were also given authority to withdraw land from agricultural production and control grazing rates, thus addressing concerns with land conservation. But, contrary to the United States, programs did not include individual financial incentives. During and after the Second World War, agricultural policies in Canada focused on market, prices and insurance. In 1941, a government-funded program limited area seeded in wheat in the Prairies to prevent oversupply, but did not aim at environmental benefits and soil restoration. In the late 1960s, the Canadian government used individual incentives to take land out of wheat production and increase summer-fallowing or grass seeding²³⁴. While this program probably had environmental benefits, it was still primarily intending to reduce oversupply, and was cancelled when export markets improved in the early 1970s.

The **International Joint Commission** (IJC) was created in 1909 to help Canada and the United States prevent, investigate and resolve disputes over shared waters, under the

²³⁴ The Federal Lower Inventories For Tomorrow (LIFT) was a one-year program in 1970 “designed to immediately reduce wheat inventory by reducing seeded wheat area and converting it to summerfallow or sowing it to perennial forage. Under LIFT, producers were paid \$6 per acre (\$15/ha) for converting wheat area to summerfallow, and \$10 per acre (\$25/ha) for seeding this land to perennial forage (Cohn, 1977). (Awada et al., 2014, p. 52).

Boundary Waters Treaty. The IJC has resolved more than 100 matters raised by the US and Canadian governments.

“In 1972, in partial response to Lake Erie's much publicized decline, the two nations expanded this well-established pattern of cooperative management by signing the first Great Lakes Water Quality Agreement (GLWQA) (...). The agreement paid special attention to eutrophication, (...) cited as a primary contributor to Lake Erie's problems.” (Inscoc & Durfee, 1995, pp. 55-56).

In 1972, the **Great Lakes Water Quality Agreement** mandated the International Joint Commission “to enquire into and report upon the pollution of the boundary waters of the Great Lakes System from agricultural, forestry and other land use activities, setting-up the International Reference Group on Great Lakes Pollution from Land Use Activities (PLUARG, 1972-1979). In its final report, PLUARG recommended:

“a review of fiscal arrangements (...) to determine whether present arrangements are adequate to insure effective and rapid implementation of programs to control nonpoint pollution. Such a review should include: (i) determination of the availability of grants, loans, tax incentives, cost-sharing arrangements and other fiscal measures; (ii) determination of whether or not the terms of financial assistance programs are sufficient to encourage widespread participation; and (iii) determination of the extent to which various financial assistance programs are conditional upon the implementation of nonpoint source remedial measures.” (PLUARG, 1978)

This recommendation testifies of early concerns with the evaluation of government funded PES, at least on the US side.

On the private side, Ducks Unlimited Canada, an NGO supported by its US counterpart, started delivering habitat conservation programs in Ontario in 1974, including with private landowners.

3. 1980s: the emergence of province-wide cost-share programs in Ontario

In the early 1980s, governments, conservation authorities, and environmental NGOs promoted conservation tillage, cover crops and crop rotations in Ontario, providing extension, demonstrations and study tours²³⁵.

According to Forge (1998), the first firm commitment to soil conservation policy in Canada was the renewal of the **Economic and Regional Development Agreement (ERDA)** starting around 1984. Provisions on the conservation of soil and water resources were included in the ERDAs signed by the federal government with Alberta, Prince Edward Island, British Columbia, Alberta and Saskatchewan.

In Canada and Ontario environmental financial incentives on private farmland appeared in the mid-1980s in the form of investment cost-share programs. In Ontario, the **Ontario Soil Conservation & Environmental Protection Assistance Program (OSCEPAP 1984-1988; \$18 million)** is the first program which supported environmental investments on farm through cost-share, co-financing manure storage and erosion control structures, including on-farm windbreaks, buffer strips, grassed waterways, ditch fencing, and alternative watering sources.

Tillage 2000: Introduced in 1985, the 5-year “Tillage 2000” program tested and evaluated the benefits of alternative conservation-oriented crop rotation and soil conservation practices (Stonehouse, 2000).

²³⁵ See, for example, demonstrations supported by the Thames River Implementation Committee (1976-1982), and the Stratford - Avon River Environmental Management Project (1980-1984) (Thames River Implementation Committee, 1982).

In 1986, the **National Agricultural Strategy** confirmed interest in soil conservation at federal level, and led to the **National Soil Conservation Program** whereby the federal government and the provinces negotiated the first of a series of federal-provincial agreements on soil and water conservation with a view to promoting demonstrations, research, technical and financial aid, as well as raising public awareness. The first Ontario-federal program called **SWEEP (Soil and Water Environmental Enhancement Program)** focused on reducing farmland-related phosphorus run-offs into Lake Erie.

The **Land Stewardship Program Phase I** (LSP I 1987-1990) financed by the Ontario Ministry of Agriculture and Food (\$40 million) had a broader scope than OSCEPAP and a structuring impact on posterior agri-environmental policies in Ontario. LSP I provided:

“financial incentives for first-time adoption of conservation farming practices on Ontario farmland (...) to enhance and sustain agricultural production and improve soil resources and water management by: reducing soil erosion and soil compaction; restoring soil organic matter and structure; and minimizing potential for environmental contamination from agricultural practices.” (Stonehouse, 2000, p. 22)

LSP I co-financed on-farm projects, including soil building and maintenance projects, erosion control structures, as well as rental, modification and purchase of machinery and equipment, and technical training. Individuals, partnerships and corporations were eligible for funding, with grants capped at \$30,000 per applicant. To be eligible, applicants were to complete “an acceptable Land Stewardship Inventory and Action Plan detailing past land management practices, existing problems and planned future management practices that indicate a new and long-term land stewardship approach is being adopted”. Three-quarters of the overall program funding (\$31.3 million) was intended for funding stewardship action plans. Research projects were also supported. A chair in land stewardship was established

at the University of Guelph under LSP I. New and existing staff in the Ontario Ministry of Agriculture and Food (OMAF) was in charge of education, extension and grant administration. OMAF staff reviewed every grant application, among which nearly 7,500 successful applicants in LSP I (Stonehouse, 2000). The farmer-led Ontario Soil and Crop Improvement Association (OSCIA) was mandated to help promote the program, and to establish and administer local committees mostly composed of farmers, together with government representatives, in each county. Local committees (called Local Stewardship Committees under LSP II) were responsible for reviewing stewardship action plans, recommending projects for funding, and conducting inspections. The program supported both on-farm investment (i.e. tree planting), and management practices in conservation agriculture such as crop rotations²³⁶ and residue and crop cover, in a global farming system approach. Well maintained tree plantations financed under the program could receive a multi-year annual incentive²³⁷. Local funding rates were defined per acre for each management practice and varied across agricultural regions in Ontario. To facilitate adoption on rented land, the program also supported three-year minimum stewardship leases with a grant of \$10 per acre per year (capped at \$3,000 per applicant). Farmers received support from OMAF staff and committee members to complete their applications. They also had ample opportunities to make changes once their applications were reviewed. When the total available budget was reached a given year, eligible applications were to be carried over to the next program year. According to Stonehouse (2000), LSP I was designed

²³⁶ To encourage crop rotations, the program incentivized the planting of forage grasses and legumes or plow down crops in rotation on soils showing signs of soil degradation and erosion.

²³⁷ Well maintained tree plantations financed under the program were eligible to an incentive of \$100 per acre per remaining program years.

in haste to respond to farmer lobbying prior to a provincial election, and “The difference made by LSP was not measured and was not compared against any standard, and therefore it is difficult to assess any measure of success” (Stonehouse 2000, p. 202). Stonehouse also noted that “Although greater human and monetary resource commitments would have been entailed, the LSP should have embodied a larger element of independent, objective review of each applicant’s degradation problems and proposed remedies, using among other instruments on-site inspections and interviews”; and failed to be integrated and coordinated with other conservation programs (Stonehouse, 2000, p. 203).

During the 1980s, agri-environmental incentive programs expanded in United States with the adoption of the **Conservation Reserve Program** in its current form (1985).

“Expenditures for conservation measures have also significantly increased over time. For example, the United States Department of Agriculture (USDA) provided nearly 4.5 billion dollars for conservation programs in the farm bill for fiscal year 2005, compared to 500 million dollars for the 1983 fiscal year (ERS, 2007). It also appears this trend of increased conservation expenditures will continue, as the 2008 farm bill doubles the level of conservation funding under the previous farm bill. Of this new money, nearly two thirds is scheduled to be allocated to working land programs like EQIP (ERS, 2007)” (Sheeder & Lynne, 2009, p. 2).

In Europe, the **European Union agricultural policy** first gave Member States the option to implement agri-environmental incentive schemes in the late 1980s. Since 1992, agri-environment incentive programs are compulsory in each EU Member State.

4. 1990s: Farmer-led organizations at the forefront of policy innovations and implementation

While in the 1980s, the Ontario Ministry of Agriculture and Food (OMAF) was at the forefront of PES development and implementation in Ontario, farmer organizations took a

leading role in the 1990s, throughout a second series of environmental cost-share programs financed under federal-provincial agreements.

The 1989 Canada-Ontario Accord on Soil and Water Conservation and Development recognizes this shift and reads in its section 5:

“5.1 Local organizations provide grassroot representation for local producers therefore they are needed in the advocacy, planning, and implementation of effective soil and water conservation and development practices.

5.2 Local organizations will be designated by the Province to receive and administer funds provided by the Province, or the Province in partnership with Canada as appropriate for the purposes of Section 5.1.

5.3 It is recognized that with appropriate support, existing soil and water conservation and development organizations in Ontario can adequately provide conservation management services at the farm level.”

In 1992, a coalition of farm organizations, the **Ontario Farm Environmental Coalition** (OFEC), took the initiative to develop the **Ontario Environmental Farm Plan** (EFP), a farmer-led voluntary awareness raising and self-assessment program which remains a corner-stone of Canadian agri-environmental policy to date (Box 4). This initiative, first piloted in 1993, was largely motivated by the desire to take the lead on agri-environmental policy design and prevent the regulation of farming practices by offering a credible alternative (Montpetit, 2002²³⁸; Morrison & Fitzgibbon, 2014). Morrison and FitzGibbon (2014, p. 387) highlighted that farmer organizations self-organized EFP was originally “motivated by desire to prevent the regulation of farming practices”. However, the authors also analyzed that a “widespread social interest in environmental issues (including agroecosystems)” also played an important part in the development of the EFP (Morrison

²³⁸ Montpetit, 2002, p14: “the powerful Ontario Federation of Agriculture and the Christian Farmers Federation of Ontario, along with two associations representing commodity groups, organized themselves into the coalition group OFEC in order to control the development of a provincial environmental policy for the agricultural sector.”

& Fitzgibbon, 2014, p. 388). OSCIA was mandated to implement the EFP, through workshops where farmers are encouraged and supported to conduct a broad environmental assessment of their operation, identify agri-environmental risks and opportunities on their farm, and develop an action plan to incorporate environmental considerations into business decisions (AAFC, 2013). In EFP early editions, individual action plans were validated through a confidential review by a group of locally appointed farmers (peer-review).

Participation in the EFP was at first limited by trust issues in the farming community towards government intervention, farmers being reluctant to document their environmental practices and self-assessed shortcomings. But acceptability considerably increased as trust built. Analyzes on factors which facilitated trust building pointed out the bottom-up approach and delivery by local well-respected facilitators as key facilitating factors (Holmes, 2015). The Ontario EFP was recognized a success, with a broad farmer participation and satisfaction. In an early survey, 97% of farmer participants responded that they would recommend the EFP process to their neighbours. The history of EFP in Ontario (cf. Box 4) gives an interesting perspective on how successive agri-environmental policies have maintained coherency through consistent support to a few key instruments, such as EFP. While not a PES²³⁹, EFP is an important instrument that complements PES in the context of a policy mix.

²³⁹ With exception of provinces that finance part of the strategic plan implementation under the program labeled as EFP.

Box 4: Supporting Environmental Farm Plans in Ontario across program cycles, an historical perspective

Conceived in 1992, the Environmental Farm Plan (EFP) Program started as a pilot project in 1993 in seven counties across Ontario. Since its inception, the EFP is implemented by the Ontario Soil and Crop Improvement Association (OSCIA) a farmer-led organization federating local groups. Government financial support to EFP has been maintained throughout five successive agri-environmental policies frameworks. Between 1992 and 1997, funding for EFP was provided by the Land Management Assistance Program under Agriculture and Agri-Food Canada (AAFC)'s Green Plan. Technical support was provided by the Ontario Ministry in charge of Agriculture. Between 1997 and 2004, financial support was provided by AAFC through CanAdapt, a program administered in Ontario by the Agricultural Adaptation Council. Between 2005 and 2008, funding was provided by AAFC and OMAFRA under the Agricultural Policy Framework. Since 2008, AAFC and OMAFRA supported the continuation of EFP with Growing Forward and Growing Forward 2.

The EFP is well recognized and adopted by Ontario farmers. Since 1993, the EFP has helped more than 35,000 Ontario farmers²⁴⁰ develop and implement more environmentally sustainable practices. A 2011 survey of EFP participants (Prairie Research Associates, 2011) found that farmers invested an average of \$53,900 per farm of their own finances and accessed \$15,600 per farm from cost-share programs, to implement activities in their Action Plan. 95% of farmers said their EFP has had an impact on their farming operation, including improvements in soil quality (74%), water quality (71%), family health and safety (63%), and fish and wildlife habitat (48%). Following Ontario's example, other provinces and countries have adopted the EFP. The fact that farmers are responsible for developing their own EFP is considered a major factor in its success, along with the capacity to foster peer-to-peer exchanges, and confidentiality. FAO (2001) commenting on Canadian EFP noted that "the program primarily draws on farmers' pride and their desire to garner respect with colleagues, neighbours and consumers". While support to the EFP survived across many programming phases, its design did not remain untouched. Major evolutions are described below.

To date, participation in EFP remains largely voluntary and advertised as a way to build competitiveness and strengthen the farm industry. However, having an EFP is a prerequisite for several government supports. In Ontario, for example, having an EFP is a condition to access cost-share programs such as the Water's Hedge Transformation Program (in Lake Simcoe watershed) and the Species at Risk Farm Incentive Program. In addition, some buyers have, as a condition of business, required their suppliers to implement EFPs. According to Statistics Canada's Farm Financial Survey (2008), one-third (33%) of Canadian farms had implemented EFPs due to buyer requirements.

²⁴⁰ In 2006, the Census of agriculture counted 57,211 farms in Ontario; source: Statistics Canada (Statistics Canada, 2006).

Stewardship programs and policy frameworks with relatively short lifetimes succeeded one another in the 1990s:

- In 1989, Federal and Ontario governments agreed to coordinate their agri-environmental activities under the **Canada-Ontario Accord for Soil and Water Conservation and Development**. The second phase of the Land Stewardship Program (LSP II, 1990 - 1994, \$32 million, including 22 for stewardship practices and structures for farmer participants; with grants capped at \$10,000 or 50% of expenditure less any previous OSCEPAP or LSP funding) and the **National Soil Conservation Program** (NSCP 1991-1993, \$11.1 million) were funded under this agreement. LSR II reached 7,754 applicants and more than 1.1 million acres. Due to the financing conditions of the program, those were mainly new participants (Stonehouse, 2000). The Permanent Cover Component of NSCP provided grants for the retirement of fragile lands (\$5.585 million; Agriculture Canada, 1993). Both programs were administered by OSCIA. To implement these programs, OSCIA organized committees of local farmers in each of Ontario's 55 counties, with the mandate to set local priorities and rule on applications.
- The **Canada-Ontario Land Management Assistance Program** (LMAP – 1992-1994; \$15.242 million of federal funding) extended the NSCP Permanent Cover Program and introduced a Rural **Conservation Clubs Program** (RCCP). The RCCP supported collective action among farmers and farmer-led groups with common agri-environmental objectives, funding research and demonstration projects in environmentally sustainable agriculture from 36 provincial or local conservation

clubs. To date, the RCCP seems to be the only agricultural stewardship program explicitly supporting collective projects in Ontario.

- In 1993, the **Green Plan** replaced the National Agricultural Strategy. The **Canada-Ontario Green Plan** (1993-1997) extended support to RCCP until 1997, but new projects were only accepted in 1993 and early 1994, limiting potential participation. Most of the conservation clubs have disappeared today, with the notable exception of the Upper Avon River Conservation Club.
- In 1998, a new federal **National Soil and Water Conservation Program** included \$10 million supporting the Sustainable Development Strategy of Agriculture and AgriFood Canada by funding projects to conserve agricultural land. (Forge, 1998).

While federal and provincial agreements supported province-wide programs under the responsibility of the Ontario Ministry of Agriculture and Food, the Ontario Ministry of Environment (OME) and conservation authorities addressed local priorities. From 1991 to 1996, OME funded the **Clean Up Rural Beaches Program** (CURB) to address water quality issues in 150 sub-watersheds in Southern Ontario. With CURB's support, twenty-eight conservation authorities developed and started to implement watershed-specific remedial action plans. CURB financed local investment projects, most of which on-farm. Local CURB committees²⁴¹ were set up to review project proposals. The CURB program, interrupted prematurely for budgetary reasons, distributed \$20 million of grants for 3,512 projects²⁴² together with on-site research, demonstration & extension, achieving local

²⁴¹ Typically including representation from OME, OMAF, MNR, the Medical Officer of Health, conservation authority, and farmer organizations such as OSCIA.

²⁴² Little over half of the available grant budget was expended on manure management facilities.

improvements (Ministry of Environment and Energy of Ontario, 1996). CURB concepts, administrative structure and eligibility guidelines inspired several conservation authorities, which started their own grant programs with funding from the **Federal Great Lakes Clean-Up Fund**. **South Nation Clean Water Program** was launched in 1993 and **Wellington Rural Water Quality Program** in 1999. Both programs allocate grants to farmers and rural landowners to reduce non-point source pollution. They are still active to date, and have contributed to inspire numerous other CA programs.

Despite those efforts, Canada remained more cautious than other countries in the adoption of environmental economic instruments. In 1995, a first OECD Environmental Performance Review for Canada recommended a “wider use of economic instruments to prevent pollution and conserve natural resources, in association with regulatory instruments and other instruments (...) to support a more cost-effective implementation of policies; in particular, apply economic instruments more widely to water services.” (OECD, 1995). The OECD review highlighted the underutilization of taxes and tradable permit schemes, as well as the persistence of environmentally damaging subsidies, in particular in the natural resources sector²⁴³. With regard to positive incentives, the OECD recommended, however, to “assess the effects of reducing financial assistance for the provision of environmental services (...)” (OECD, 1995).

²⁴³ “assess the effects of reducing financial assistance for (...) the exploitation of natural resources” (OECD, 1995).

In the United States, a concerted movement in the 1970s supported the adoption of state-based legislations to recognize conservation easements (Jacobs, 2014). In Canada, Ontario was the first province to adopt legislation on **Conservation Easements** in 1995, providing a legal basis for long-term stewardship agreements²⁴⁴. Conservation easements (CE) are written agreements negotiated by a private landowner and a conservation organization (environmental NGO or land trust), which limit specific uses of a property, to conserve, protect, restore or enhance natural landscapes or landscape features, including features in agricultural areas (e.g. wetlands, riparian areas, woodlands, and grasslands). Conservation of agricultural land is an explicit CE target in Ontario, where CE may limit uses that threaten fragile or high-capability agricultural soils (AAFC, 2008). CE can be permanent or temporary. They are registered on the land title, remain binding for future owners, and can be either sold or donated. Landowners who donate conservation easements can be eligible for tax deductions. In 2010, Zweibel and Cooper noted that fiscal provisions in Canada were insufficient to trigger an uptake of CE comparable with the USA. New tax rules were subsequently adopted (see Box 5). Setting a CE can be a long and costly process; it may involve severances, surveys, appraisals, detailed reports on the state of a property (e.g., a species list), an *EcoGift* application, and fiscal paperwork. Costs are usually paid by the recipient. In 2008, reported administration costs for an individual CE ranged from

²⁴⁴ Today, almost all provinces have adopted legal provisions governing conservation easements.

\$2,000 to \$120,000, with an estimated average of \$19,000 (AAFC, 2008). Land trusts such as Nature Conservancy allocate important budgets to CE.

Box 5: Tax advantages associated with conservation easements²⁴⁵

“Conservation easement or servitude: [...] Each easement is unique. For example, an easement agreement might restrict the subdivision of the property, its development or commercial use, the construction of new buildings, shoreline changes, and logging. The donor retains ownership of the property and receives a charitable receipt for the appraised value of the restrictions placed on it”²⁴⁶.

“EcoGifts: Environment Canada’s EcoGifts program provides tax advantages to landowners who donate ecologically sensitive land or a conservation easement on the land to a land trust. Corporations can deduct the value of the donation from their taxable income. Individuals will experience a **zero capital gain** on the disposition of the property and may use the full value of the **charitable credit** in one year, or carry an unused portion forward for up to five years.” Other fiscal benefits: **Reduced property tax** liability can also reduce the **land transfer taxes** upon sale, reduce any **probate fees** for transfers of property through a will, and reduce capital gains when the land is sold or transferred.

Split receipting: A landowner may sell a property [or CE] to a land trust for part of its value and may receive a charitable receipt from the land trust for the gift of the remaining value. The landowner’s gift must be at least 20 % of the property’s value.

With the adoption and dissemination of the EFP, voluntary cost-share programs and conservation easements, agri-environmental public policies in Ontario in the 1990s gave an unambiguous preference to voluntary instruments. However, preference given to voluntary instruments rather than regulation was not uncontroversial. While some authors underlined the success of the EFP, others discussed its limits. In 2002, Montpetit noted that “Plans can cover a wide range of practices, but generally lead only to small improvement projects, and the financial incentive of a maximum grant of CAN \$1500 is small.” Montpetit considered that “Essentially, Ontario has failed to adopt high environmental regulatory standards for its agricultural sector, preferring to endorse this farmer-controlled

²⁴⁵ Sources: abstracts of press article quoted above, by Vicki Schmolka, a lawyer, consultant and president of a land conservancy; and Edmonton & Area Land Trust (n.d., paragraph 3)

²⁴⁶ The value of the conservation easement is assessed by a qualified appraiser, who compares the value of the land before and after the easement.

program, which imposes few constraints on agricultural practices.” (Montpetit, 2002, p. 13-14).

5. 2002-2008: a renewed government leadership, through regulation and government-led stewardship programs

Despite the adoption of the **Ontario Water Resources Act** and **Ontario Environmental Protection Act**, in 1990, Montpetit (2002) analyzed that in Canada (contrary to the United States), federalism and past policy decisions preserved an agricultural exception with respect to environmental regulations and policies. Montpetit argued that: “Essentially, Ontario has failed to adopt high environmental regulatory standards for its agricultural sector, preferring to endorse this farmer-controlled program, which imposes few constraints on agricultural practices.” (Montpetit, 2002, p13-14). As underlined by Sustainable Prosperity (2011), Canada has also been criticized by the OECD for underutilizing economic instruments in environmental policies. The 2004 *Environmental Performance Review for Canada* by the OECD (OECD, 2004) concluded that: “Market-based instruments are insufficiently used to foster integration of environmental concerns into sectoral policies”.

While farmers-led voluntary instruments had been preferred to regulations in the 1990s, several factors induced a policy shift in the early 2000s, with regulations and government-funded programs taking more importance (see Chapter 3, Section 3).

The growing emphasis on the environment within federal agricultural policy continued in the early 2000s. Before 2003, government support was generally “focused on reacting to short-term problems or disasters after they had occurred” (AAFC, 2013, p. 11-12). In 2003,

the **Agricultural Policy Framework** (APF 2003-2008), an agreement among federal, provincial, and territorial governments, was launched to reduce reliance on ad hoc programming and to help “position producers and processors for long-term sustainability and competitiveness”. The AFP structured public support to on-farm agri-environmental measures. During this period, the Ontario government-funded substantial cost-share grants to accompany and complement new regulations. Government-funded cost-share percentages increased dramatically with support from the federal government. The AFP financed a national expansion of the Environmental Farm Plan. Cost-share grants were provided through the **National Farm Stewardship Program** (NFSP 2005-2008) with a cap of \$30,000 per farm significantly above the \$1,500 cap of the cost-share grant associated previously with the EFP, and the **Greencover Canada Program** (\$110 million nationally). Both federal programs supported the adoption of environmentally Beneficial Management Practices (BMPs) with different scopes²⁴⁷.

At the provincial level, the **Nutrient Management Financial Assistance Program** (NMFAP 2004-2005, \$23.7 million), an OMAFRA funded program, helped large farmers comply with the Nutrient Management Act. The program, implemented by OSCIA, provided up to \$60,000 per eligible farm, and cost-shares could reach 90% when coupled with federal funding under the **Canada-Ontario Farm Stewardship Program** (Agricultural Policy Framework in Ontario). Such favourable conditions triggered a large subscription. “The large number of applications received for the NMFAP by the September

²⁴⁷ Greencover Canada focus is on improving grassland management practices, protecting water quality, reducing greenhouse-gas emissions, and enhancing biodiversity and wildlife habitat (AAFC, 2005a). Beneficial management practices eligible for funding under Greencover Canada include converting environmentally sensitive land to perennial cover and planting shelter belts (AAFC, 2005c).

1 application deadline speaks to the commitment of producers to environmental stewardship," said Ron Bonnett, President of the Ontario Federation of Agriculture" (Ontario, 2005).

6. 2008 to 2013 and 2013 to date: reduced and segmented public funding, experimentation and innovation with new designs

6.1. Agri-environmental policy research sharing fora were particularly active from 2005 to 2013

In the early 2000s, some farmer unions and environmental NGOs promoted further development of PES, advocating for the creation of a Canadian program similar to the USA **Conservation Reserve Program**, with annual payments based on opportunity costs complementing existing cost-share programs. However, researchers had a more critical view of agri-environmental incentive programs. Since the late 1990s, Canadian researchers had criticized cost-share programs with very broad eligibility criteria for their universal availability and low level of cost-efficiency.

Canadian authorities did not support the idea of a nationwide land retirement program due to potentially high budget requirements and doubts on cost-efficiency associated with recurring payments. However, various options were examined. From 2005 to 2010, a **Federal-Provincial Working Group on Ecological Goods and Services** undertook extensive policy exchange and research on economic instruments likely to foster ecological goods and services preservation and restoration, in particular in agricultural areas. Key activities included six pilot projects and numerous policy reports. In parallel with the working group's efforts at the national level, Keystone Agricultural Producers (KAP),

Manitoba’s largest farmer union, and Delta Waterfowl Foundation, an environmental NGO originally founded by hunters, developed the **ALUS model** at community and provincial levels. The Agricultural Land Use Service (ALUS) concept is a PES supporting voluntary retirement of marginal farm land with annual payments, compensating both for investment and foregone income. It is advertised as being a “community-developed, farmer-delivered” program²⁴⁸. Today, ALUS has expanded in communities across Canada, with private sector supports (in particular from the Weston family) and some government support. In 2016, ALUS became independent from the Delta Waterfowl Foundation. Table 30 shows the evolution of the national policy initiative on ecological goods and services and ALUS from 2003 to 2017.

Table 30: Ecological Goods and Services (EGS): interrelated stakeholders’ and governments’ initiatives

²⁴⁸ ALUS Website, “Mission”.

²⁴⁹ Benchmarking reports untitled: Potential contribution of payments for environmental goods and services to farm income; Critical and comparative analysis of selected agri-environmental policy instruments implemented in other countries; Discussion and review of reference levels used in other countries.

²⁵⁰ Reports on Canadian experience with (i) Conservation Easements, (ii) Transfer of development credits, (iii) Property tax credits, and their potential application to agri-environmental policy.

In 2010, the Federal-Provincial Working Group on Ecological Goods and Services concluded its policy learning program, recommending integration of EGS concerns in agricultural policies rather than stand-alone instruments. From 2009 to 2013, the **Linking Environment and Agriculture Research Network (LEARN)** was funded by AAFC under Growing Forward since 2009 ceased to receive funding. LEARN had connected research efforts on agri-environmental policies, supporting original research, reports, workshops, and conferences.

6.2. Agri-environmental policies

Three types of instruments (EFP, BMPs and CE) are used by a number of publicly and privately funded PES programs in Canada. Most current and potential initiatives that enhance ecosystem services are undertaken at the provincial or sub-provincial level. They are driven by the demand or need for specific services in each region and the potential for farmers or other landholders to supply the service (AAFC, 2011).

Growing Forward. Federal funding for environmental objectives significantly decreased under the policy framework, Growing Forward (2008-2012): environmental activities²⁵¹ accounted for nearly 35% of the total budget, i.e. about 300 million CAD over five years. Program leadership shifted back from federal to provincial governments (Morrison & FitzGibbon, 2014). In Ontario, the decrease in cost-share budget led to a very fast budget disbursement on a first come-first served basis (OSCIA, 2014). Experts report that in one of the Growing Forward funding cycles, the entire funding envelope was disbursed in 20

²⁵¹ Environmental Programming – Environmental Knowledge, Technology, Information and Measurement; and On-Farm Action.

minutes. While EFP continued to receive support, Morisson & FitzGibbon underlined that *“the original emphasis on education and capacity building for the farm community became less significant”* (Morisson & FitzGibbon, 2014, p. 396), and the sense of EFP being farmer-led decreased. Public agricultural extension has also been considerably scaled-down, and extension largely relies today on private certified crop advisors, most of whom working for input companies.

Despite very high farmers’ demand for cost-share grants (at least in Ontario), the relevance to continue providing federal-provincial support to on-farm environmental investment was debated again at the end of Growing Forward.

Growing Forward 2 (2013-2018). Federal and provincial supports were finally extended under Growing Forward 2. Growing Forward 2 provides a general framework for agri-environmental incentives at the federal level through an Environmental and Climate Change component. Investments eligible for financing are then tailored at the provincial level depending on local conditions and objectives. Provincial governments are responsible for implementation. Growing Forward 2 is an “umbrella” program, which offers free workshops, education and funding assistance to eligible producers, processors, organizations and collaborations to “grow profits, expand markets, and manage shared risks” (OMAFRA, n.d.). Cost-shared projects under Growing Forward 2 have a budget of \$2 billion nationally (50% increase over Growing Forward). The program includes an environmental component, but this component is not the main priority. Environmental Farm Plans and BMPs continued to get funding; however, the environmental budget and

list of eligible BMPs were significantly reduced²⁵², and the selection process evolved radically. Under Growing Forward 2, some of the most demanded BMPs are only eligible in limited geographical areas, and applications are selected on merit. Building on research recommendations, policy innovations attempt to compensate for reduced funding, using a variety of merit-based assessments, competition processes, and partnerships with technicians on the ground.

6.3. Watershed management programs

Watershed management programs combine strategic planning at the watershed or sub-watershed level, local governance mechanisms, and PES funding for stewardship projects. Such programs are best presented through an example in Table 31. In Ontario and Manitoba, for example, local conservation authorities facilitate the implementation of watershed management programs (Box 6).

²⁵² In Ontario, for example, projects eligible under this category include: Manure Storage Improvements; Manure Composting; Land Application of Manure; Livestock Facilities Runoff Control; Cover Crops; Structural Erosion Control; Nutrient Recovery from Wastewater; Fuel Storage Improvements; Irrigation Water Efficiency Improvements; Water Well Management; Actions for Species at Risk; Preventing Wildlife Damage; and Weather Risk Mitigation.

Table 31: Implementing PES at the basin and sub-basin levels, an example

Date	Upper Assiniboine River Basin		Lake Winnipeg Basin (LWB)	Description
	Stage (action)	Institution		
1996	Targeting & Diagnosis ↓	Federal & provincial governments		In 1996, the Upper Assiniboine River Basin was identified by the governments of Saskatchewan (Sask. Water), Manitoba (Manitoba Conservation) and Canada (Environment Canada) as a critical area for water management - due to degradations in water quality and floods - and wetland habitat conservation. It was decided to conduct a hydrologic and ecological study of the watershed, which was completed in 2000.
1997				
1998				
1999				
2000				
2001	Planning ↓	Specialized agency (prov) Stakeholders Committees (local)		In 2002, the Saskatchewan Watershed Authority was created and launched a watershed management and aquifer planning initiative across the province. In 2004, two Watershed Advisory Committees were established in the Assiniboine River Basin with local representatives from Rural and Urban Municipalities, First Nations, as well as stewardship, agricultural and other interest groups. Two Source Water Protection Plans were finalized in 2006. In 2007, the Assiniboine Watershed Stewardship Association Inc. (AWSA) was created as a non-profit organization to implement those plans.
2002				
2003				
2004				
2005				
2006	Implementation ↓	Implementing Agency (non-profit; local)	LWB Initiative LWB Stewardship Fund Canada-Manitoba MOU ²⁵³ LWB Stewardship Fund phase 2	In 2007 the Lake Winnipeg Basin Initiative started for four years with 17.7 million CAD: 12.1M research, 3.7M community stewardship programs, 1.9M facilitating watershed governance To define a long-term collaborative approach, Canada and Manitoba signed in 2010 a Memorandum of Understanding Respecting Lake Winnipeg and the Lake Winnipeg Basin; overseen by an Implementation Steering Committee (federal-provincial)
2007				
2008				
2009				
2010				
2011				
2012				
2013				
2014				

Cost-sharing arrangements facilitate the participation of local municipalities in the financing and implementation of watershed management projects.

Box 6: Conservation authorities and Conservation districts

In Ontario, since 1946, the province and municipalities can regroup, based on a watershed, to form a Conservation Authority (CA). CAs are mandated to ensure the conservation, restoration, and responsible management of Ontario's water, land, and natural habitats. They are local, community-based and work in partnership with other agencies. Ontario's watershed-based conservation authorities provide technical advice, education services, watershed stewardship and facilitate farmers' and landowners' access to funding sources, such as cost-sharing programs for investment in watershed management, protection, and restoration. There are currently 36 conservation authorities in Ontario.

In Manitoba, Conservation Districts (18 to date) are also formed as a partnership between the province and local municipalities to protect, restore, and manage land and water resources on a watershed basis.

²⁵³ MOU: Memorandum of Understanding

They can be designated water planning authorities for integrated watershed management planning and for implementing watershed plans.
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6.4. Programs encouraging stewardship to protect biodiversity and natural habitats

Several programs at the national level contribute to the protection of species at risk through the implementation of the Species at Risk Act (SARA), adopted in 2002. In particular, the Habitat Stewardship Program for Species at Risk (HSP) financed by the federal government can be considered a PES. HSP co-finance habitat maintenance and restoration projects, providing cost-sharing on private lands, provincial Crown lands, Aboriginal lands, and aquatic and marine areas. Since 2000, the program has funded over 1000 projects for 62 million CAD. These projects have leveraged an additional 153 million CAD in stewardship projects. HSP fosters partnerships and promotes the participation of local communities. The Aboriginal Critical Habitat Protection Fund (ACHPF) is also a federally funded PES. It provides funding for Aboriginal communities to identify, protect, and recover critical habitats or important habitats in anticipation of designated Critical Habitat under the Species at Risk Act. In addition to funding investment projects, those funds foster institutional strengthening and finance capacity-building activities, sometimes through dedicated financing lines, such as the Capacity Building Fund implemented in parallel with ACHPF under the Aboriginal Fund for Species at Risk. Since its inception in 2000, the Habitat Stewardship Program (HSP) has established over 200 partnerships with Aboriginal organizations, landowners, resource users, nature trusts, provinces, the natural resource sector, community-based wildlife societies, educational institutions, and conservation organizations. It has contributed to the protection of over 240,000 ha of habitat and to the

implementation of temporary protection measures on another 370,000 ha. Moreover, 207,000 ha of habitat have been improved. The program reaches more than a million people every year through outreach and education activities.

A range of other **stewardship programs**, funded by Private Foundations, Provincial Governments or NGOs, support local habitats, endangered species, and inland fisheries²⁵⁴. Most of those programs do not directly finance individual farmers and landholders. They target organizations. A range of organizations is eligible, including aboriginal organizations and communities, conservation organizations, municipal governments, and non-government organizations. Depending on the program, businesses and/or universities may also be eligible. The range of financial support depends on the program and varies from \$500 for small-scale, one-year projects to more than \$1 million for durable partnerships. A majority of funds finances projects ranging from \$5,000 to \$50,000. Some of those programs explicitly refer to Aldo Leopold's values as a source of inspiration.

Some provincial programs target specific habitats, such as the **Grassland Habitat Farm Incentive Program** in Ontario (see Box 7) or the **Fisheries Enhancement Fund** in Manitoba²⁵⁵. Other funds support more generic targets, such as the **Land Stewardship and Habitat Restoration Program** supported by the Province of Ontario (Box 8). Finally, a number of funds supported by Private Foundations target a wide range of environmental issues, including biodiversity and habitat preservation.

²⁵⁴ Private funding will be further described in a following section.

²⁵⁵ The Fisheries Enhancement Fund is intended for projects that emphasize the enhancement, conservation and development of Manitoba's recreational fisheries resource (Green Source Funding Database, June 2014).

Box 7: Targeted programs at the provincial level develop innovative approaches²⁵⁶

The **Grassland Habitat Farm Incentive Program (GHFIP)**, supported by the province of Ontario, offers funding to farm projects that strengthen farming operations while supporting grassland birds. Under the GHFIP, farmers can decide how to best combine several BMPs. The GHFIP relies on a **competitive bid system and an environmental benefit index** to identify and reward proposed projects that show the greatest environmental merit for the government dollars invested.

Box 8: The Land Stewardship and Habitat Restoration Program (LSHRP) supports a range of targets

The LSHRP was created to contribute to the maintenance and restoration of Ontario's natural ecosystems. The program focuses on restoration, rehabilitation and enhancement projects that benefit fish, wildlife and biodiversity. Applicants are encouraged to link project submissions to landscape-level conservation or stewardship plans. Eligible projects include stream restoration, upland or terrestrial enhancements, wetlands restoration, and invasive species control.

6.5. Offset and water quality trading programs implemented through PES

Since 2007, the province of Alberta has implemented a *Specified Gas Emitters Regulation*²⁵⁷. This regulation does not cover the agricultural sector. However, to fulfill their requirements, regulated facilities can choose to purchase voluntary Alberta-made carbon offset credits from farmers. Carbon offset credits represent “management improvements that are science-based, additional to business as usual, and verifiable by an independent third party”²⁵⁸. Close to one-third of all Government of Alberta approved offset protocols relate to lowering the carbon footprint of agricultural management²⁵⁹.

²⁵⁶ Source: Ontario Soil and Crops Improvement Association: http://www.ontariosoilcrop.org/en/programs/grassland_habitat.htm

²⁵⁷ Regulated facilities must reduce their annual emission intensity by 12%, based on an average of the facility's 2003 to 2005 emissions intensity baseline.

²⁵⁸ Source: Agriculture and Rural Development Alberta: [http://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/cl11618](http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/cl11618) (Website updated on May 30th 2014), retrieved on July 24th 2014

²⁵⁹ Seven agricultural protocols have been approved, three are under review and five under development (Source: Agriculture and Rural Development Alberta:

From 2007 to 2012, agricultural offsets in Alberta generated close to \$132 M CAD for farmers and aggregators (intermediaries)²⁶⁰. In 2011, only 7% of Alberta's total Greenhouse Gas (GHG) emissions came from agriculture, yet agricultural offsets represented 39% of all offsets generated and 27% of total reductions achieved by regulated emitters²⁶¹. The most widespread type of agricultural offset is based on reduced tillage, which results in lower fuel use, lower nitrous oxide emissions, and higher levels of soil carbon storage as compared with conventional full tillage.

In Ontario, the South National Conservation Authority has created a water quality-trading program designed to reduce phosphorus discharge in the watershed (Sustainable Prosperity 2011). This program is implemented through PES with local farmers who agree to reduce their phosphorus discharge in the environment. Efforts were invested in developing a water quality trading program in the Lake Simcoe area, but due to legal concerns on the transfer of liability in the farming community, offsets through BMP adoption on farmland were discontinued after an exploratory phase.

6.6. Tax credit programs

At the national level, since 2001, a provision for tax-free intergenerational transfers of commercial farm woodlots encourages the preservation of forest land. This measure authorizes woodlot owners to defer the capital gains tax and prevents them from having to

[http://www1.agric.gov.ab.ca/\\$Department/deptdocs.nsf/all/cl13212](http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/cl13212), last updated in February 2014, retrieved in July 2014)

²⁶⁰ Assuming 12 CAD per TCO₂e; Source: see previous footnote.

²⁶¹ However, a decrease is expected in the proportion of agricultural offset credits as monitoring requirements (record keeping and data management) have increased, generating additional costs. Source: see previous footnote.

harvest the timber to pay the inheritance tax on capital gains. The fiscal measure benefits the environment; however, environmental considerations are not the only motivation, as this measure is also justified on economic and technical grounds. Only commercial farm woodlot owners operating the woodlot “with a reasonable expectation of profit” qualify for the tax exemption.

In Manitoba, the provincial government offers a **Riparian Tax Credit** to farm operators who improve the management of lakeshores, riverbanks and stream banks on their property, or have already done so. To benefit from this measure, farmers must make a five-year commitment. Successful applicants receive an annual payment against their property taxes. The level of payment per acre depends on the management practices in the riparian area before and after the program. Farmers who need to invest in off-site watering (or have previously done so while protecting the riparian areas) can benefit from an additional tax reduction. Since 2007, crop and livestock producers eligible to the Riparian Tax Credit can also benefit from an additional 30% tax reduction²⁶² if the natural slope towards the waterway is at least 10%.²⁶³ Provincial officials have access to sites for monitoring.

In Ontario, the provincial government implements two fiscal programs against property taxes:

The **Conservation Land Tax Incentive Program** provides a property tax relief to landowners who agree to protect the natural heritage values of their property²⁶⁴. A 100 %

²⁶² of the basic tax reduction.

²⁶³ Several sources from Manitoba Province’s Website, including:
<http://www.gov.mb.ca/finance/tao/pdf/riparian/qanda.pdf>;
http://www.gov.mb.ca/finance/tao/pdf/riparian/info_for_taxpayers.pdf

²⁶⁴ A provincial policy, updated in 2010, identifies land features or activities that, for the purposes of this program, are considered to be inconsistent with the natural heritage and biodiversity objectives. Source: <http://www.mnr.gov.on.ca/en/Business/CLTIP/index.html>

tax exemption is applied on the eligible portion of the property. Targeted conservation lands include wetlands, significant natural areas, and endangered species habitats.

The **Managed Forest Tax Incentive Program** is available to landowners who own four hectares or more of forest land and who agree to prepare and follow a **Managed Forest Plan** for their property. The plan must be approved by a **Managed Forest Plan Approver** certified by the Ontario Ministry of Natural Resources. Successful applicants have their property reassessed and taxed at 25 percent of the municipal tax rate set for residential properties. In 2012, the plan period increased from five to ten years. A five-year progress report must be submitted. Environmental considerations are not the only objective; however, they are explicitly mentioned in the requirements²⁶⁵. The Ontario Ministry of Natural Resources carries out audits, including field visits.

6.7. Private sector funded programs: Hunters and anglers, Environmental NGOs, Foundations

In Canada, large non-governmental environmental organizations such as Ducks Unlimited (\$95 M revenue in 2012)²⁶⁶ and Nature Conservancy (\$75 M in 2012) are involved both in the financing and in the implementation of PES programs. These PES programs usually

²⁶⁵ “Activities [...] are to be carried out according to “good forestry practices” as defined in the Forestry Act. Good forestry practices mean “the proper implementation of harvest, renewal and maintenance activities known to be appropriate for the forest and environmental conditions under which they are being applied and that minimize detriments to forest values including significant ecosystems, important fish and wildlife habitat, soil and water quality and quantity, forest productivity and health and the aesthetics and recreational opportunities of the landscape.”

http://www.mnr.gov.on.ca/stdprodconsume/groups/lr/@mnr/@forests/documents/document/mnr_e000245.pdf

²⁶⁶ Funded in 1937, Ducks Unlimited is a non-profit charitable organization dedicated to the conservation of wetlands and waterfowls’ habitats, in the USA and Canada.

involve partnerships with local institutions as well as co-financing with federal and/or provincial governments. Investments are targeted to specific environmental objectives and priority areas for conservation. The example presented in Box 9 below illustrates this type of program.

The example presented in Box 9 is an interesting example to analyze public-private governance as well as policy mix. Table 31 (above) helps further understand how this example is integrated into a broader watershed approach. This case is representative of the type of governance system used in watershed PES in Canada. National and regional governments were involved in the initial targeting and diagnosis, as well as in the strategic planning together with stakeholder committees and co-finance implementation. Ducks Unlimited provides additional funding and specialized expertise. A local stewardship organization (AWCA²⁶⁷) organizes information campaigns and supports stewardship groups and individuals in the preparation of project proposals, including through training workshops.

²⁶⁷ Created in 2007, the Assiniboine Watershed Stewardship Association (AWSA) is an independent, non-profit organization dedicated to protecting and enhancing source water in the Assiniboine River Watershed. Its VISION is citizens and communities of the Assiniboine River Watershed working together to protect the source waters of the Assiniboine River; its tributaries and aquifers within the watershed.

Box 9: Restoring Wetlands in the Assiniboine Watershed (Saskatchewan) through PES²⁶⁸

In 2008 and 2009, the environmental NGO Ducks Unlimited, together with the Assiniboine Watershed Stewardship Association (AWSA) and the Saskatchewan Watershed Authority, led an innovative “**reverse auction**” PES pilot project, with the support of Environment Canada²⁶⁹. About forty percent of the \$200,000²⁷⁰ budget came from Ducks Unlimited, which also provided technical expertise. Farmers placed bids on what they believed their previously drained wetlands²⁷¹ – currently fields or pastures - were worth to restore and leave in their natural state for at least twelve years. Seven bids out of about 30 were selected. Most selected bids came from forage producers. Grain and oilseed farmers were less inclined to take cultivated land out of production; they felt the payments were not high enough to cover the value of lost production, and those who did submit bids sought higher compensation. Payments - based on the auction mechanism - accounted for about two times the land’s fair market value. A total of 212 wetlands were constructed²⁷², which resulted in the restoration of an estimated 212 acres of wetlands in the Assiniboine River Watershed.

In 2011, with the help of high rainfalls, the ecological results seemed clearly positive. The program’s second phase was planned to be a multi-year study of the restored wetlands by University of Guelph researchers, to determine the impact on water quality, ground water quantity and the wetlands’ ability to sequester carbon. This pilot project took place in a broader objective by Ducks Unlimited to restore 56,000 hectares of wetlands over 20 years (Sustainable Prosperity, 2011). In 2014, AWCA still implemented PES programs to restore wetlands, using **fixed payments** instead of reverse auctions, as advertised on its Website (Figure 46 beside). Funding comes from Environment Canada’s Lake Winnipeg Basin Stewardship Fund and is targeting marginal agricultural drained lands²⁷³. To receive \$2,000 per acre, the land owner must sign an agreement stating that he will not breach/disturb the wetland for ten years. Ducks Unlimited offers an additional payment of up to \$1,500 per acre to landowners willing to put a perpetual Conservation Easement on the restored wetland. AWSA also assists farmers with the application process for BMPs funding under Growing Forward 2, as well as in the application for non-PES programs (water points).

WANTED:

Land that has drained wetlands / sloughs. We will re-establish the wetlands and lease the wetland acres from you. See the two options below.

1. Receive up to - \$3,500 / acre for a one time payment on a perpetual easement. *

2. Receive up to - \$2,000 / acre for a one time payment on a 10 yr term agreement. *

Funding is limited

- Sloughs are Wetlands -
- Conserve them for Watershed Health -

For more information contact Jesse at the AWSA:
306-783-1692 or check out our website:
www.assiniboinewatershed.com

Click on 'Wetland Restoration' under the 'Funding Available' Tab
*** Some conditions apply.**

Ducks Unlimited Canada
Conserving Canada's Wetlands

Environment Canada
Lake Winnipeg Basin Stewardship Fund

ASSINIBOINE WATERSHED STewardship ASSOCIATION

Figure 46: AWCA 2014 advertisement for a PES program

²⁶⁸ Main sources: The Western Producer 2011; AWSA Website 2014 retrieved in July 2014.

²⁶⁹ This project was one of the six pilot projects supported under the Federal Provincial WG-EGS.

²⁷⁰ \$240,000? sources differ.

²⁷¹ “Across Canada, over 49 million acres of wetlands have been lost to agriculture since European settlement. The prairies have lost an estimated 70% of their wetlands since the early 1800’s, with approx. 85% of the total loss coming from agricultural drainage “ (Assiniboine Watershed Stewardship Association, n.d.).

²⁷² Ducks Unlimited used aerial photographs and satellite imagery to restore wetlands registered in the AWSA program. The images showed the original size and location of wetlands that were drained for agricultural purposes. Artificial drainage channels were closed with a plug or an earthen berm.

²⁷³ “We are looking for agricultural landowners that have areas on their land that used to be sloughs, they drained them, but would be willing to plug them back up because in terms of production, they just aren't what the landowner was hoping for.”

In Canada, non-profit organizations provide various types of stewardship programs for farmers and landowners. Such organizations include a number of land trusts, local or provincial federations of anglers and hunters, private companies' foundations and environmental NGOs. Foundations are not directly financing individual farmers or landowners, but support a variety of projects implemented by non-profit organizations, community groups, and research institutes. Some of those projects cover on-farm costs to restore or maintain environmentally sensitive habitats, wetlands...

Almost all those organizations provide stewardship grants through calls for projects. Private actors can also provide financing under a fund created by a provincial government, as it is the case for the **Fisheries Enhancement Fund** (FEF) in Manitoba. FEF finances in priority projects that enhance, conserve, and develop Manitoba's recreational fisheries resources. The majority of the revenue for FEF is generated through a portion of recreational fishing licenses. FEF clearly applies a beneficiary-pays principle, as restoration is largely paid-for by ecosystem users

Appendix 4: Ontario PES considered in the analysis

	Collective Axe 1	Collective Axe 2	Competitive Axe 1	Competitive Axe 2	Actual level of competition
Rural Conservation Club Program (1992-1997, new projects only in 1993-1994)	No formal farmer participation?	Group projects only are eligible		NA	Competition level unknown
Growing Forward 1	FO-led implementation. OSCIA.	Group projects are not eligible, no collective action incentive (No GP, no CAI)	First-come-first-served	Uniform payment	High competition
Growing Forward 2	FO-led implementation. OSCIA.	No GP, no CAI	Merit-based. Scoring system developed by OSCIA and OMAFRA.	Innovation bonus	High competition
Water's Edge Transformation Project (WET) (2013-2014)	FO-led implementation. OSCIA, with support from Conservation authorities.	No GP, no CAI	Conservation tender	Bid-based	Funds exceed subscription
Grassland Habitat Farm Incentive Program (2013-2015)	FO-led implementation. OSCIA	No GP, no CAI	Conservation tender	Bid-based	Some competition
Great Lakes Agricultural Stewardship Initiative (GLASI) Farm Health Incentive Program	FO-led implementation. OSCIA. Collaboration with certified crop advisors	No GP, no CAI	First-come-first-served	Project-specific environmental merit ²⁷⁴ .	High competition
GLASI Priority Subwatershed Project (PSP)	FO-led implementation. OSCIA. Collaboration with CA	No GP, no CAI	First-come-first-served	Project-specific environmental merit ²⁷⁵ .	High competition
ALUS (Alternative Land Use Service) Eastern Ontario programs	Farmers-led governance	No GP, no CAI	All eligible projects	Uniform payment	Funds ~ subscription

²⁷⁴ Tiered funding system with different caps and cost-share depending on the level of priority (based on farmland health improvement): High Priority, Recommended or General; with bonus levels: Systems Bonus, Pollinator Bonus and Leading Edge Bonus. Funding vary from 35% cost-share up to a cap of \$10K per project to 75% up to a cap of \$25K.

²⁷⁵ Idem. Funding varies up to a cap of 80% cost-share and \$75K per farm.

	Collective Axe 1	Collective Axe 2	Competitive Axe 1	Competitive Axe 2	Actual level of competition
South Nation Clean Water Program, including South Nation River Total Phosphorus Management Trading System	Farmers field reps.	No GP, no CAI	Merit-based	Uniform payment	Some competition
Ottawa Rural Clean Water Program	FO in decision committees?	No GP, no CAI	All eligible projects	Uniform payment	Funds exceed subscription
Grand-River, Wellington Rural Water Quality Project	FO in decision committees	No GP, no CAI	All eligible projects	Uniform payment	Funds exceed subscription
Peel Rural Water Quality Project	FO in decision committees	No GP, no CAI	All eligible projects	Uniform payment	Funds ~ subscription
Credit Valley CA Clean Water Fund for rural landowners	No formal farmers participation	No GP, no CAI	First-come-first-served	Project-specific environmental merit	Some competition
Huron County Clean Water project	FO in decision committees	No GP, no CAI	All eligible projects	Uniform payment	Funds exceed subscription
Ducks Unlimited Canada - Landowners' Wetland Restoration Program	No formal farmers participation	No GP, no CAI	All eligible projects	Project-specific environmental merit	Funds ~ subscription
Ontario Species at Risk Farm Incentive Program	FO-led implementation	No GP, no CAI	First-come-first-served	Geographic: Bonus for direct impact on species at risks and bonus for active participation in monitoring.	Competition level unknown
Essex Region Clean Water Green Spaces	No formal farmers participation?	No GP, no CAI	All eligible projects	Uniform payment	Funds exceed subscription
Lake Simcoe/ Southeastern Georgian Bay Clean-up Fund (2012-2017)	No formal farmers participation?	No GP, no CAI	First-come-first-served	Uniform payment	Funds ~ subscription
Ontario Landowner Environmental Assistance Program (Lake Simcoe)		No GP, no CAI	Merit-based	Uniform payment	Some competition
Nottawasaga Valley Conservation Authority – Healthy Waters Program	No formal farmers participation	No GP, no CAI	All eligible projects	Uniform payment	Funds ~ subscription
Upper Thames River CA	Farmer organizations in steering committee	No GP, no CAI	Merit-based	Uniform payment	Some competition
Ontario pay for performance pilot	FO-led implementation	No GP, no CAI	All eligible projects	Project-specific environmental merit	Funds exceed subscription

Appendix 5: Heterogeneities in farmers' agri-environmental preferences

Table 32: Heterogeneities in farmers preferences: studies, methods and results

First author, date	Research method	Agricultural practice	Groups identified
Chouinard, 2008	Theoretical model ²⁷⁶ confirmed by contingent valuation (Mail survey with incentive coupons. 15% response rate: 29 complete responses ²⁷⁷)	Conservation practices (Buying conservation equipment)	Theoretical model with 3 groups: - Self-interested profit only - Self-interested: profit + environment - Self-interested + altruistic environmental
Ruto & Garrod, 2009	Choice experiment (CE). 10 case studies in 9 EU countries. Face-to-face interviews with 2262 participants and non-participants. Latent class model (LCM)	Various	Latent classes: - Low resistance adopters; with environmental preferences, larger farm sizes, and higher education ²⁷⁸ - High resistance adopters: older, renting more, relying on farm income
Bishop, 2010	Survey by postal mail (adoption & intention), 230 usable responses (20% response rate). Ordered probit model	Adoption of anaerobic digestion technology	Analyzes how intended adoption varies with composite variables: Private costs; Social/environmental costs; Innovation readiness; Alternative investments; Planned changes; Private motives and Social motives
Mzoughi, 2011	Survey on motivations (existing practices). Survey by postal mail. 243 full answers (19% response rate (RR))	Pest management	- 3 pre-identified groups depending on the type of pest management method. - No significant difference in environmental commitment between farmers using conventional methods / integrated pest management - Significant difference with organic farmers

²⁷⁶ Based on the “multiutility models that Lynne (1999) and others have employed in the conservation-stewardship literature”. These models “integrate profit motives and stewardship motives into a consistent and systematic decision model”. (Chouinard et al., 2008).

²⁷⁷ Chouinard et al. (2008) noted that this response rate is “not out of line with many recent surveys”.

²⁷⁸ “Various studies have found that youth, higher education and positive attitudes towards the environment are significant pre-disposing factors to participation in AES (e.g. Wilson, 1996; Wynn et al., 2001). Other studies have also found that increasing farm size has a significant and positive influence on the probability of enrolling in AES (e.g. Vanslebrouck et al., 2002; Ducos et al. this issue).” (Ruto & Garrod, 2009, p. 644)

Broch, 2012	CE (on-line 1027 respondents with response incentive; 28% RR)	Afforestation	<ul style="list-style-type: none"> - Low compensation group: already have forests - High compensation: rely on farm income
Allo, 2013 and 2015	CE (Face-to-face survey; 359 responses)	Type of crop; Rotation; Harvesting period	Heterogeneity taken into account through rank-ordered logit models
Kuhfuss, 2014	CE (on-line; 266 useable responses, 8.8% response rate - later 10%) - LCM	Pest management	<ul style="list-style-type: none"> - Group membership depends on technical aspects (difficulty to mechanize weeding), organization (individual or collective wine making) and personal factors (attitude/environment) - Interest in program features (technical assistance, collective bonus) varies across groups
Jaeck and Lifran, 2014	CE (face-to-face, 104 valid, 90% of the population) - LCM	Rice cropping practices	<ul style="list-style-type: none"> - Large class (60%) prefers standard cropping practices (local label); - 10%: prefer organic farming; - 30%: prefer more intensive practices than standard
Schulz et al., 2014	CE (on-line, 128 full responses)	Various	<ul style="list-style-type: none"> - Compliers (69%) - Non-compliers: high land quality, little diversification (specialized intensive farms) <p>Potential differences in attitude are not presented.</p>
Greiner, 2015, 2016	CE (face-to-face, 104 valid, 15% of sample frame)	On-farm conservation of biodiversity	<ul style="list-style-type: none"> - 4 groups but class probability was not related to socio-demographic or attitudinal factors
Villanueva et al., 2015	CE (face-to-face. 295 valid interviews, after removing 35 protest answers). LCM	Ecological Focus Areas and Cover crops in Olive growing	<ul style="list-style-type: none"> - A group willing to participate (younger, educated, know AE practices, larger farms²⁷⁹, some already comply with requirements) - A group willing to participate only if a technical condition is waived - Two groups unwilling to participate for different reasons (technical-economic constraint /older, less educated)
Schaible et al., 2015	Econometric analysis based on census data. Adoption of sustainable practices & participation in conservation programs	Land and pest management	<p>Identify factors of differences – not groups.</p> <ul style="list-style-type: none"> - Counterintuitive: Non participants in conservation programs are more frequent users of conservation practices.

²⁷⁹ “The fact that larger farms are usually more willing to participate in AES has been widely reported in previous works, [...] (Falconer, 2000; Ruto & Garrod, 2009; Hodge & Reader, 2010, among others) [...] (Franco, 2011). [...], higher economies of scale and comparatively lower transaction costs are the main reasons behind their greater willingness to participate in AES.” (Villanueva et al. et al., 2015, p. 151)

Appendix 6: Literature analysis on choice experiments for agricultural contracts

Table 33: Choice experiments on agri-environmental contracts by publication date, country and practice

Author(s)	Date	Country (region)	Type of environmental practice
Ruto and Garrod	2009	Europe	Reference scheme (known by interviewees)
Espinosa-Goded et al.	2010	Spain	Nitrogen-fixing crops in marginal dry-land areas
Christensen et al.	2011	Denmark	Pesticide-free buffer zone
Broch and Vedel	2012	Denmark	Afforestation on agricultural land
Kaczan, Swallow and Adamowicz	2013 (2011)	Tanzania	Large tree and indigenous saplings preservation on forest and agroforests
Balderas Torres et al.	2013	Mexico	Forest conservation, restoration and sustainable management (including control)
Jaek & Lifran	2014	France	Rice cropping method (weeding, rotation, variety)
Schultz et al.	2014	Germany	Share of Ecological Focus Area (EFA); Crop diversity; Land creditable in EFA; Permissible use of EFA; & Location of EFA plots
Mombo et al.	2014	Tanzania	Prevention of deforestation in wetlands catchment areas
Allo et al.	2015	Spain	Type of crop, crop rotation, harvesting period
Villanueva et al.	2015	Spain	Ecological Focus Areas, cover crops
Greiner	2015, 2016	Australia	On-farm conservation by pastoralists
Kuhfuss et al.	2016 (2014)	France	Pesticide application (quantity + spot application or not)
Trenholm	unpublished (2013)	Canada	Creation/restoration of wetlands, adjacent meadows or trees, on productive or marginal land + amount of land converted
Vaissière et al.	(2017)	France	Biodiversity offset on farmland

Table 34: Choice experiment on agricultural contract design & PES: methods, attributes and key results

Main author	Publication date	Country (region)	Environmental target	Agricultural practices	Research method	Sample size	Attributes	Observations	Key results
Hudson and Lusk	2004, Journal of Agricultural & Food Industrial Organization	USA (Texas, Mississippi)	Not an environmental target: preferences/ commercial contracts	Not applicable	Face-to-face survey	49 (exploratory)	1. Risks (3 attributes); 4. Transaction costs; 5. Management autonomy; 6. Income		- Transaction costs matter the most; - Risks matter too (risk avoidance is an important element of contract choice); - Management autonomy matters; - Preferences for contract attributes exhibit significant heterogeneity
Ruto and Garrod	2009	Across EU (10 case studies)	Not specified	Not specified	Face-to-face survey	2622 (participants and non-part. in 20 sub-samples)	1. Contract duration; 2. Flexibility; 3. Environmental ambition; 4. Administrative burden; 5. Level of payment	Uses both mixed logit and latent class models; the choice of attributes was discussed with focus groups	- Longer or less flexible, or more 'paper work' contracts require higher financial incentives; - farmers are segmented: with a difference between high resistance adopters and low resistance adopters
Christensen et al.	2011, Ecological Economics	Denmark	Not specified	Pesticide-free buffer zones	Random parameter logit framework	444 (41% usable)	1. Environmental ambition; 2. Flexibility; 3. Duration; 4. Option to cancel the contract; 5. Free assistance or not. 6. Payment	- Attributes are based on a previous survey on design features - 10% were protest responses	1) farmers are willing to trade off the size of the subsidy for less restrictive scheme requirements. 2) farmers value flexible contract terms higher than reduced administrative burdens. Giving farmers feedback on environmental impact could be an incentive (for future research)
Broch and Vedel	2012, Environmental Resource Economics	Denmark	Biodiversity / Ground Water quality / Recreation	Afforestation	On-line survey	1027 (28% response rate)	1. Purpose of afforestation; 2. Possibility of cancelling the contract (risk); 3. Intensity of control; 4. Payment	Questionnaires through ag. associations; Respondents are given the opportunity to win a prize	- Risk aversion: an option to cancel the contract within a limited period can greatly improve acceptance by new adopters; - Previous land use does not matter - Intrinsic motivations: WTA is higher for recreation than biodiversity or groundwater

Jaeck and Lifran	2014, Journal of Agricultural Economics	France (Camargue)	Not specified	Various rice cropping methods	Face-to-face survey	104 respondents; 90% target population	3 attributes of agro-ecological practices (weeding, rotations, variety); 2 attributes of outcome (yield and yield variability); 6. Payment	- Support of the main stakeholders in the region	- 3 classes with heterogeneous preferences
Kuhfuss, Préget and Thoyer	2014 (Conference Paper)	France (Languedoc-Roussillon)	Water quality	Reduction of pesticides in wine growing	On-line survey	266 (8.8% response rate; 10% in a later version)	1&2. Environmental ambition (2 attributes); 3. Collective incentive; 4. Technical support (risk); 5. Payment	- Includes both individual and collective incentives; - Partnership with "Chambres d'agriculture"	- Preferences are very heterogeneous - Collective bonus is strongly valued (reduces total WTA): strong preference for collective action
Schultz et al.	2014, Journal of Agricultural Economics,	Germany	Various public goods	Ecological focus area, Crop diversity, Grassland maintenance (precise technical options)	On-line survey	128 farmers (302 started). Young and large over-represented	Five attributes / envtl ambition: 1 Share of EFA; 2 Crop diversity 3 Land creditable against EFA; 4 Permissible use of EFA; and 5 Location of EFA plots. 6. Payment	- Greening: by default, with the option to opt-out and forego part of the CAP subsidy - Recruitment through ads in ag. magazines, online newsletters, forums	- Age and farm size are not significant
Villanueva et al.	2015, Land Use Policy	Spain (Andalusia)	Various public goods	Ecological Focus Areas and Cover crops in Olive	Face-to-face. multi-stage sampling	330 resp., including 35 protest	1 to 3. Environmental ambition (3 attributes); 4. Collective or not. 5. Monitoring. 6 Payment		- Technical and socio-economic factors contribute to group membership - Collective projects have a disutility for all groups (with wide differences)
Allo, Loureiro and Iglesias	2015 Journal of Agricultural Economics (2013)	Spain (Aragon)	Biodiversity: bird protection on agricultural land	Type of crop / Crop rotation / Harvesting period	Face-to-face survey	359	1. Mngt autonomy; 2&3. Environmental ambition (2 attributes); 4. Fine for non-compliance; 5. Payment	Assesses the importance of social capital, and punishment. Rank ordered logit model	- Importance of social trust and expectation of compliance by neighbours - A small compensation is sufficient

Greiner	2015, Australian Journal of Agricultural and Resource Economics	Australia	Biodiversity	On-farm conservation by pastoralists	Face-to-face	104 valid, 15% of sample frame; 4 protests	1. Environmental ambition 2. Contract duration, 3. Flexibility. 4. Monitoring, 5. Payment	- Clear presentation of methodological choices in a separate standalone paper	- Pastoralists have heterogeneous preferences for contract attributes - Class probability was not related to socio-demographic or attitudinal factors: no difference with property size, education, experience, ownership - Participation is positively influenced by favourable attitudes towards biodiversity and PES. - Introducing some contract flexibility increases adoption.
Trenholm	Unpublished (2013)	Canada (Ontario)	Biodiversity	Wetland restoration / creation	Postal survey		1&2. Env ambition (land type and # of acres) 3. Conversion activity 4. Public recognition 5. Free technical assistance; 6. Payment	Free technical assistance only for non farmers; Land type only for farmers	- Homogeneous preferences for farmers with opportunity costs of working land higher than marginal lands - Heterogeneous preferences for non-farmers but technical assistance always highly valued. For one group, public recognition matters.
Vaissière et al.	(2017)	France (Picardie)	Biodiversity	Biodiversity offset (BO) contracts on farmland	Online survey	5100 contacts by email, 162 responses (3,2% RR); 18 protests	1. Actual enhancement activities (management plan), 2. Contract duration, 3. Payment, 4. Bonus for the spatial extent and distribution of enhanced land	- Documents previous contracts signed (control variable) - Aggregation and distribution bonus	- Farmers have a clear preference for not signing up a BO contract. - Participation decreases with ecological requirements and contract duration. - Bonus brings organizational and ecological improvements.

Appendix 7: On line consent form, survey advertisement, survey

Clearance number: 106388

This survey aims to identify what aspects of environmental incentive programs matter most to farmers. It will be conducted by Elen Lemaitre-Curri (PhD candidate, Public Policy, Carleton University) with the support of graduate students from Carleton University, and supervised by Professor Stephan Schott in the School of Public Policy and Administration. This study received financial support from the Economics and Environmental Policy Research Network funded by Environment and Climate Change Canada.

The survey should take about **15 to 20 min** to complete. If you are unable to complete it all at once, you may come back and complete it later.

We will ask you about your professional experience and your farm, and ask your preference between various program scenarios. Project results will be presented to farm organizations and policy-makers in Ontario. Your experience and viewpoint may thus play a critical role in informing future programs for Ontario farmers.

The survey is confidential. You will not be asked any identifying data, and all data collected will be password protected or encrypted.

Research data will be kept in a secure location for up to five years, and potentially used for research projects following up on this same topic. At the end of five years, all research data will be securely destroyed. Your Internet Protocol might only be collected to ensure that no respondent enters in the survey twice; it will not be linked to your responses.

If you wish to participate in a draw, you will be offered to enter your email or postal address at the end of the survey. This contact will not be connected to your survey response. The survey uses Qualtrics, a software with multiple layers of protection subject to US privacy and confidentiality laws. Your contact information will be collected in SimpleSurvey and stay on Canadian Servers. It will be erased once the draw is over and gift cards have been mailed out.

For more information about the draw please click here: [\[link\]](#)

As you complete the survey, you will be offered the option to interrupt your participation or withdraw. If you choose to withdraw, all the information you have provided will be destroyed.

If you have any question about the survey, please contact: Elen Lemaitre-Curri
Elen.LemaitreCurri@carleton.ca

The ethics protocol for this project was reviewed by the Carleton University Research Ethics Board, which provided clearance to carry out the research. Should you have questions or concerns related to your involvement in this research, please contact: Dr. Andy Adler, Carleton University Research Ethics Board-A, 613-520-2600 ext. 2517; ethics@carleton.ca

I CONSENT TO PARTICIPATE IN THE SURVEY: YES / NO

School of Public Policy and Administration

Title: *Environmental incentives in Ontario agriculture*

Date of ethics clearance: March 2017

Ethics Clearance for the Collection of Data Expires: March 31st 2018

Clearance number: 106388

Advertisement

Would you choose to participate in an environmental or soil health program on your farm or not? What program would you prefer? By completing a 15 to 20 min confidential survey, you could inform future programs for Ontario farmers, support a scientific research, and enter in a draw and get a chance to win one of 30 gas cards valued between \$20 and \$200.

We will ask you about your preference between various program scenarios. The study will be conducted by Elen Lemaitre-Curri (PhD candidate), supervised by Professor Stephan Schott in the School of Public Policy and Administration (Carleton University).

To participate in the survey click here: [\[link to the survey on Qualtrics\]](#)

For more information on the research or on the draw, or to know how your information will be protected, click here: [\[link to information provided in the consent form & additional information on the draw\]](#)

Thanks for taking the time to participate; your input is greatly appreciated!

SURVEY QUESTIONS

Title: Environmental and soil health incentives for Ontario agriculture

Are you an Ontario farmer, 18 years or older?

☐ YES

☐ NO

Only adult Ontario farmers could enter the survey.

CONSENT: *Consent form appeared on the screen [Consent had to be obtained before starting the survey]*

Do you consent to take this survey

☐ YES

☐ NO

1. This set of questions is about your farm and your views

1.1 What is your primary commodity?

☐ Field crops

☐ Poultry

☐ Fruits or vegetables

☐ Beef

☐ Swine

☐ Greenhouse

☐ Dairy

☐ Sheep, goats, or horses

☐ Other

1.2 How many acres do you farm (in total, including rented land)?

1.3 How many acres of farmland do you own?

1.4 Do you think that having buffer strips, windbreaks, fencerows, grassed waterways, or wetlands on your farm has a positive impact on (select all relevant answers):

☐ Your farm

☐ Your neighbours' farms

☐ Your community

☐ Soil health

☐ Water quality

☐ Biodiversity

☐ Climate change

☐ Other

2 This set of questions is about your experience with stewardship programs and your preferences

2.1 Have you prepared an Environmental Farm Plan?

☐ No

☐ Yes once

☐ Yes several times

2.2 **Have you received a grant to improve soil health or the environment on your farm?**
(From any program: Environmental Farm Plan, Growing Forward 1 & 2, Conservation Authorities, ALUS, Ducks Unlimited, industry program,...)

☐ No ☐ Yes once ☐ Yes several times

2.3 **Have some of your applications to a grant program been unsuccessful?**

☐ No ☐ Yes once ☐ Yes several times

2.4 **Given that funding is limited, what do you think is the best way for environmental and soil health programs to select individual projects for funding?** Note that “merit-based selection”, “conservation tender” and “environmental bonus” usually require a more detailed application than the other options.

- **First-come first-served:** Funding should go to the eligible farmers who apply first.
- **Merit-based selection:** Projects should be selected based on their individual environmental merit, and receive a fixed cost-share.
- **Conservation tenders:** Farmers should propose a funding amount, and projects with the highest environmental benefit per dollar should be selected.
- **Environmental bonus:** Projects with higher or more diverse environmental benefits should receive a higher cost-share.
- **Geographical targeting:** Environmental programs should concentrate funding on the most environmentally sensitive areas.
- None of the above, all eligible projects should receive funding even if it is a limited amount.

2.5 **Do you have a preference regarding who runs the program and selects projects for funding??**

- No
- Yes, I prefer programs administered by OMAFRA.
- Yes, I prefer programs run by farmers’ organizations or led by farmers.
- Yes, I prefer programs run by local conservation authorities
- Other:

2.6 **If the program could provide support to help you with your project, which type of technical or administrative assistance would you prefer?**

- A specialist to help me identify priorities on my farm and design my project
- Someone to help me fill-out the paper work
- A specialist that I can call if something goes wrong after I implement my project
- A partnership with a research team
- Exchanges with fellow farmers to share their experience

- I do not need assistance

2.7 If a program provided extra support for farmers who collaborate with each other, would you be interested to

- Receive financial support to run test plots on our farms with a group of fellow farmers
- Coordinate my project with my neighbours', if we all get an extra bonus on our cost-share
- Receive financial support to run test plots on our farms with a group of fellow farmers
- None of the above. Please explain why

3 In this section, we will ask you to choose between potential programs. You will always be given the option not to participate. Please answer even if you are not willing to participate in any of the proposed programs. Please consider the options carefully – as if you were participating in a real program – since the program would have a limited budget and could only fund a limited number of projects.

You will be asked to choose 6 times. Please note that those choices are independent.

Treatment 1: “**Suppose that a stewardship program helps farmers invest to increase environmentally beneficial areas on their farms.** This includes vegetated buffer strips, windbreaks, fencerows, grassed waterways, and wetlands creation or restoration. Assume that the **total** project cost is about \$3000 **per acre.**”

Treatment 2: “**Suppose that a stewardship program helps farmers try cropping methods to improve soil health on their farms.** The program would not finance new equipment, but it would give a lump sum per acre to try practices with equipment you already have or through custom farming. Those practices could include a new cover crop, a new crop for a longer & more diverse rotation, no-till, strip-till, or organic amendments. You could test a practice that other farmers have already been successful with, or try cutting-edge innovations. But, the program would only finance technical improvements that are beneficial to soil health and new to this part of your farm.”

3.1 Would you apply to one of the following programs? Choose your preferred option

Treatment 1: Please remember that the program would only fund grassed waterways, vegetated buffer strips, windbreaks, fencerows, wetland creation or restoration.

Treatment 2: Please remember that the program would only fund new cover crop, a new crop for a longer & more diverse rotation, no-till, strip-till, or organic amendments

Click for definitions [*definitions provided for the concepts used in the choice experiment*]

If you would not choose either program, please select "No Program" below.

1ST to 6th CHOICE SET (see options& visuals in Appendix 8)

PROGRAM A // PROGRAM B // NO PROGRAM

After each choice set:

⇒ *If participant chose to participate => 3.2*

3.2 **How many acres would you apply for?** => Multiple choices and open field option

⇒ *If participant chose not to participate => 3.3*

3.3 **If you knew that most of your neighbours participate in the program, would you apply to...** (you can go back and look at the programs again) ☐ YES ☐ NO

After all the choice sets:

⇒ *If participant never chose to participate => 3.4*

3.4 **You never chose to participate in a program, why?**

- ☐ I have already done all the projects I could think of
- ☐ I had a negative experience with past programs
- ☐ I do not want anybody to tell me what to do on my farm
- ☐ I don't like this type of survey
- ☐ Other:

⇒ *If participant always chose to participate => 3.5*

3.5 **You always chose to participate in a program, why?**

- ☐ The financial incentive was the main reason for my choices
- ☐ We should expand environmental areas regardless of payment levels
- ☐ I like to show my children or my community that I can have a positive impact on the environment
- ☐ I already have a project in mind
- ☐ Other:

3.6 **How certain are you of your choices?**

- ☐ Very certain ☐ Somewhat certain ☐ Uncertain

3.7 Do the following aspects matter to you when selecting your preferred program?

	I do not consider it	I do not consider it much	I consider it somewhat	I consider it a lot	This is what I consider the most
Selection process					
Technical, admin. support					
Who is your contact point					
Environmental benefits					
Contractual commitment					
Financial support					
What my peers do					

3.8 What are your views on the following statements

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly Disagree
When planning future farming activities, I only focus on how profitable they would be					
The lifestyle that comes with being on the farm is very important to me					
Managing environmental problems on my farm is a very high priority					
As a landowner, I have the responsibility to take into account the values and interests of society at large when making a decision on my land					
There is too much government regulation on private land use					
Environmentally sensitive areas on private land should be protected from being altered or damaged					
I do not want anybody to tell me what to do on my farm					
I like to show my children or my community that I can have a positive impact on the environment					

4 This last set of questions is about you

- 4.1 **In which Agricultural Region is your farm located?** ☐ Central Ontario
☐ Eastern Ontario ☐ Northern Ontario ☐ Western Ontario
☐ Southern Ontario ☐ Other
- 4.2 **What is your gender?** ☐ M ☐ F ☐ Prefer not to answer
- 4.3 **How old are you?** ☐ 18-30 ☐ 30-45 ☐ 45-60 ☐ 60+
- 4.4 **Do you have a successor on your farm?** (for example a child who plans to keep the farm after you) ☐ YES ☐ NO
- 4.5 **What is the highest level of education you received?**
- ☐ Primary School
 - ☐ High school
 - ☐ College
 - ☐ Bachelor degree
 - ☐ Masters
 - ☐ PhD
- 4.6 **Is farming the main source of income in your household?** ☐ YES ☐ NO
- 4.7 **Are you a member of a stewardship group, an environmental association, a hunting or fishing association?** ☐ YES ☐ NO
- 4.8 **Are you on the board of directors of a farmers' organization?** ☐ YES ☐ NO
- 4.9 **Do you have any other idea or thought on stewardship programs that you want to share?**

We thank you for your participation in the survey. We greatly appreciate your contribution.

To thank you, we offer you to enter in a draw and have a chance to win one of 30 gas cards prizes, from \$20 to \$200. **Do you want to participate in the draw?**

Appendix 8: Attributes visuals

Figure 47: Visuals used in the choice experiment survey for all attributes but price

Selection & funding The program selects projects for funding & calculates cost-share using the following pnciple...	First come, first served	Merit-based selection	Conservation tender
Technical & administrative support	Not included	Technical assistance to groups	One-on-one technical assistance	One-on-one technical & administrative support
Your contact person with the program is...	A conservation specialist	An experienced farmer
3 (5) years commitment? If YES: you commit to maintain or participate in the project for 3 (5) years . Your project may be inspected by programme staff for this duration	YES	NO
Stewardship grant (environmental areas) The program offers the following grant...	35% cost-share	55% Cost-share	75% Cost-share	90% Cost-share	80% cost-share + 350\$ per acre per year for 3 years	100% cost-share + 350\$ per acre per year for 3 years
Stewardship grant (soil health) The program offers the following grant per acre per year for the duration of the commitment	\$ 20 per acre	\$ 40 per acre	\$ 60 per acre	\$ 80 per acre	\$ 100 per acre	\$ 120 per acre

Appendix 9: Experimental plan: choice sets and blocks

The experiment plan was designed using NGene. In all choice sets, a third alternative corresponds to a non-participation option. Choice sets are presented below with price levels and contractual commitment duration corresponding to Treatment 1. Treatment 2 choice sets and blocks followed the same experimental plan.

Choice set 1

	alt1	alt2
x1	First come, first served	First come, first served
x2	Technical & administrat. support	No support
x3	Experienced farmer	Experienced farmer
x4	No contract	3 years contract
x5	35%	55%

Choice set 2

	alt3	alt4
x1	Merit-based	Merit-based
x2	Technical support to groups	Technical support to groups
x3	Experienced farmer	Conservation specialist
x4	Three years contract	No contract
x5	35%	80%+350x3

Choice set 3

	alt5	alt6
x1	Conservation tender	First come, first served
x2	Technical & administrative support	Technical support - individual
x3	Experienced farmer	Conservation specialist
x4	No contract	3 years contract
x5	100% + 350 x 3	100%+350x3

Choice set 4

	alt7	alt8
x1	First come, first served	First come, first served
x2	Technical support - individual	No support
x3	Conservation specialist	Experienced farmer
x4	Three years contract	No contract
x5	95%	100%+350x3

Choice set 5

	alt9	alt10
x1	First come, first served	Merit-based
x2	Technical & administrat. support	Technical support to groups
x3	Conservation specialist	Experienced farmer
x4	No contract	3 years contract
x5	35%	95%

Choice set 6

	alt11	alt12
x1	First come, first served	Merit-based
x2	Technical support to groups	Technical support to groups
x3	Conservation specialist	Experienced farmer
x4	Three years contract	No contract
x5	100% + 350 x 3	75%

Choice set 7

	alt13	alt14
x1	First come, first served	Merit-based
x2	Technical support - individual	Technical support to groups
x3	Conservation specialist	Experienced farmer
x4	No contract	3 years contract
x5	80% + 350 x 3	35%

Choice set 8

	alt15	alt16
x1	First come, first served	Merit-based
x2	Technical support - individual	Technical support to groups
x3	Conservation specialist	Experienced farmer
x4	No contract	3 years contract
x5	80% + 350 x 3	55%

Choice set 9

	alt17	alt18
x1	Conservation tender	Merit-based
x2	No support	Technical support - individual
x3	Conservation specialist	Conservation specialist
x4	No contract	3 years contract
x5	75%	35%

Choice set 10

	alt19	alt20
x1	Conservation tender	First come, first served
x2	No support	Technical support to groups
x3	Experienced farmer	Conservation specialist
x4	No contract	3 years contract
x5	95%	100%+350x3

Choice set 11

	alt21	alt22
x1	Merit-based	Conservation tender
x2	Technical support to groups	No support
x3	Experienced farmer	Conservation specialist
x4	Three years contract	No contract
x5	35%	75%

Choice set 12

	alt23	alt24
x1	Conservation tender	Conservation tender
x2	No support	Technical & administrative support
x3	Experienced farmer	Experienced farmer
x4	No contract	3 years contract
x5	75%	95%

Choice set 13

	alt25	alt26
x1	First come, first served	Conservation tender
x2	No support	No support
x3	Experienced farmer	Conservation specialist
x4	No contract	3 years contract
x5	100% + 350 x 3	75%

Choice set 14

	alt27	alt28
x1	Merit-based	First come, first served
x2	Technical support - individual	Technical support - individual
x3	Conservation specialist	Experienced farmer
x4	Three years contract	No contract
x5	55%	55%

Choice set 15

	alt29	alt30
x1	Merit-based	First come, first served
x2	Technical support - individual	Technical support - individual
x3	Conservation specialist	Experienced farmer
x4	Three years contract	No contract
x5	75%	80%+350x3

Choice set 16

	alt31	alt32
x1	Conservation tender	First come, first served
x2	Technical & administrative support	Technical & administrative support
x3	Experienced farmer	Conservation specialist
x4	Three years contract	No contract
x5	80% + 350 x 3	75%

Choice set 17

	Alt33	Alt34
x1	Conservation tender	Conservation tender
x2	No support	Technical & administrative support
x3	Conservation specialist	Conservation specialist
x4	Three years contract	No contract
x5	95%	75%

Choice set 18

	Alt35	Alt36
x1	Merit-based	Conservation tender
x2	Technical support to groups	No support
x3	Experienced farmer	Conservation specialist
x4	Three years contract	No contract
x5	75%	80%+350x3

Choice set 19

	Alt37	Alt38
x1	Conservation tender	First come, first served
x2	Technical & administrative support	Technical & administrative support
x3	Conservation specialist	Experienced farmer
x4	No contract	3 years contract
x5	95%	95%

Choice set 20

	Alt39	Alt40
x1	Merit-based	Merit-based
x2	Technical support to groups	Technical support - individual
x3	Experienced farmer	Conservation specialist
x4	No contract	3 years contract
x5	55%	35%

Choice set 21

	Alt41	Alt42
x1	First come, first served	First come, first served
x2	Technical & administrative support	No support
x3	Conservation specialist	Conservation specialist
x4	No contract	3 years contract
x5	55%	100%+350x3

Choice set 22

	Alt43	Alt44
x1	Merit-based	First come, first served
x2	Technical support to groups	Technical support - individual
x3	Conservation specialist	Experienced farmer
x4	Three years contract	No contract
x5	80% + 350 x 3	100%+350x3

Choice set 23

	Alt45	Alt46
x1	First come, first served	First come, first served
x2	No support	Technical & administrative support
x3	Experienced farmer	Experienced farmer
x4	Three years contract	No contract
x5	100% + 350 x 3	95%

Choice set 24

	Alt47	Alt48
x1	First come, first served	Conservation tender
x2	Technical support - individual	Technical & administrative support
x3	Experienced farmer	Conservation specialist
x4	Three years contract	No contract
x5	55%	95%

CHOICE BLOCS

<p>Bloc A: Choice sets: 4; 8; 12; 13; 14; 16 Bloc B: Choice sets: 2; 9; 15; 18; 19; 21 Bloc C: Choice sets: 3; 5; 11; 20; 23; 24 Bloc D: Choice sets: 6; 7; 10; 17; 22; 1</p>
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Appendix 10: Test of significance, respondents' representativeness

Table 35: Statically tests comparing respondents profiles with the Ontario farming population

	Swine	Poultry	Green-house	Fruits or vegetables	Sheep, goat or horses	Dairy	Beef	Other	Field crops	Total
Ontario Respondents	2%	3%	4%	6%	8%	9%	14%	18%	34%	100%
z-value	0.408	-0.475	-3.174	-2.952	-2.093	5.841	-2.140	-5.632	6.651	100%

	Central	Eastern	Northern	South-Western
Ontario Respondents	14%	15%	4%	67%
z-value	-0.207	16.571	-1.887	-11.640

	Males	Females
Ontario Respondents	70%	30%
z-value	4.307	-4.307

	Under 35	35 to 54	55 & more
Ontario Respondents ²⁸⁰	8%	43%	49%
z-value	5.344	-0.885	-2.056

	Ontario	Respondents	z-value
under 10 acres	6%	1%	-3.35
10 to 69 acres	25%	9%	-6.22
70 to 129 acres	22%	10%	-4.59
130 to 179 acres	9%	10%	0.72
180 to 239 acres	9%	9%	0.28
240 to 399 acres	12%	14%	0.79
400 to 559 acres	6%	15%	5.91
560 to 759 acres	4%	10%	4.98
760 to 1,119 acres	3%	8%	4.97
1,120 to 1,599 acres	2%	7%	6.75
1,600 to 2,239 acres	1%	2%	2.70
2,240 to 2,879 acres	0%	1%	2.07
2,880 to 3,519 acres	0%	1%	4.91
3,520 acres and over	0%	1%	2.97

²⁸⁰ Those proportion in ours ample are estimates, as we considered four rather than three age ranges.

Appendix 11: Composite indicators of attitudinal traits

Composite indicators of attitudinal traits were estimated taking into account several survey responses on a five-point Likert scale, as presented in Table 36 below. While some survey responses were more discriminant than others, all received the same weight in the calculation of composite indicators.

Table 36: Survey items taken into account in the estimation of attitudinal traits

Attitudinal traits	Preference for ownership and self-direction		Preference for economic results	Preference for the environment		Influence by peers & contacts
	PP	PP2		ENV	ENV2	
Indicator abbreviation	PP	PP2	ECO	ENV	ENV2	SN: SOCIAL NETWORKS
Questions considered						
Do the following aspects matter to you when selecting your preferred program?						
- Environmental benefits				X	X	
- Who is my contact point						X
- Financial incentive			X			
- What my peers do						X
Do you agree with the following statements?						
- When planning future farming activities, I only focus on how profitable they would be			X			
- The lifestyle that comes with being on the farm is very important to me						
- Managing environmental problems in my farm is a very high priority				X	X	
- As a landowner, I have the responsibility to take into account the values and interests of society at large when making a decision on my land				X	X	
- There is too much government regulation on private land use	X	X				
- Environmentally sensitive areas on private land should be protected from being altered or damaged		(-X)		X		
- I do not want anybody to tell me what to do on my farm	X	X				
- I like to show my children or my community that I can have a positive impact on the environment				X	X	
- Investing in the environment will help secure and develop my market access				X	X	

Figure 48: Correlations among value/objective survey items

Appendix 12: Identification of the preferred model

Table 37: Comparison of various choice models performance

	# of classes	Covariates	Selection	Technical Assistance	LL	BIC (LL)	AIC (LL)	N par	Class. Err.	R ²
Model1	5	Yes	Nominal	Ordinal	-1454	3191	3008	50	0.1306	0.3851
Model2	5	Yes	Nominal	Nominal	-1445	3230	3010	60	0.1339	0.405
Model3	5	Yes	Ordinal	Nominal	-1453	3222	3017	56	0.1408	0.3754
Model4	5	Yes	Ordinal	Ordinal	-1471	3197	3033	45	0.1516	0.3632
Model5	5	No	Nominal	Nominal	-1468	3214	3034	49	0.1144	0.3955
Model6	4	Yes	Ordinal	Nominal	-1478	3206	3045	44	0.1007	0.3376
Model7	5	No	Ordinal	Nominal	-1479	3206	3046	44	0.1777	0.4147
Model8	4	Yes	Nominal	Nominal	-1477	3225	3050	48	0.093	0.3382
Model9	4	Yes	Nominal	Ordinal	-1486	3198	3052	40	0.1297	0.3332
Model10	5	No	Ordinal	Ordinal	-1498	3182	3061	33	0.1638	0.3839
Model11	4	No	Ordinal	Nominal	-1497	3191	3063	35	0.1217	0.3415
Model12	4	Yes	Ordinal	Ordinal	-1496	3196	3064	36	0.1277	0.3179
Model13	4	No	Nominal	Ordinal	-1504	3184	3071	31	0.1310	0.3353
Model14	4	No	Nominal	Nominal	-1499	3218	3075	39	0.1359	0.3405
Model15	5	No	Nominal	Ordinal	-1501	3217	3078	38	0.1634	0.4085
Model16	3	Yes	Ordinal	Nominal	-1518	3217	3100	32	0.0668	0.242
Model17	3	Yes	Nominal	Nominal	-1516	3230	3102	35	0.0604	0.2422
Model18	3	Yes	Nominal	Ordinal	-1522	3208	3102	29	0.0627	0.2374
Model19	4	No	Ordinal	Ordinal	-1527	3207	3108	27	0.1681	0.358
Model20	3	Yes	Ordinal	Ordinal	-1531	3209	3114	26	0.0669	0.23
Model21	3	No	Ordinal	Nominal	-1531	3210	3115	26	0.1223	0.2903
Model22	3	No	Ordinal	Nominal	-1529	3223	3117	29	0.1256	0.294
Model23	3	No	Nominal	Ordinal	-1536	3203	3119	23	0.1277	0.2907
Model24	3	No	Ordinal	Ordinal	-1547	3208	3135	20	0.1607	0.2942

Models were tested with three to five classes; three significant covariates of attitudinal trait or no covariate; selection and technical assistance attributes considered either nominal or ordinal variables. As we identified that 3-to 5-class models had similar performances in BIC (Table 16), we classified the models tested by increasing levels of AIC. We studied in

details Models 1 and 2 in Table 37 above. While Model1 slightly outperforms Model2 in AIC, the difference is very small, and Model2 (preferred) captures better heterogeneities in preferences, e.g. the strong preference a specific class has for merit-based project selection (an intermediate selection level). BIC usually leads to choosing models more parsimonious than AIC, but minimizing BIC in the models tested above would also lead to choosing a 5-class model (with larger class-error and lower R^2 than our preferred model).

Table 38: Testing interactions among variables (on 5-class models, with three covariates of attitudes)

	Selection	Technical Assistance	LL	BIC (LL)	AIC (LL)	Npar	Class. Err.	R ²
Preferred model	Nominal	Nominal	-1445	3230	3010	60	0.1339	0.405
Model25	Nominal	2 variables : A dummy variable for group TA, an ordinal variable with 3 levels for individual TA	-1451	3214	3013	55	0.1275	0.3917
Model26	Nominal	Nominal, with interaction TAxContact point	-1438	3300	3026	75	0.1256	0.4041
Model27	Nominal, with interaction Selection x TA	Nominal	-1439	3269	3017	69	0.1336	0.4219
Model28	Nominal	TA and TA x Contact Point, all nominal	-1422	3352	3023	90	0.1252	0.4076
Model29	Selection and Selection x TA	Nominal	-1435	3266	3010	70	0.1124	0.4181

Interactions were tested between TA and profile of the contact person, and between TA and selection mode. While some of the interactions tested were significant, models with interactions never outperformed our preferred model in both AIC and BIC (Table 38).

Model 26 (Table 39) brings interesting insight: Class 1 farmers, representing about 42% of all respondents, only prefer technical assistance to be provided together with a group of farmers if their contact point with the program is an experienced farmer himself, rather than a conservation specialist.

Table 39: Model 26, with interaction TA x contact point

	Class1	Class2	Class3	Class4	Class5	Overall					
R ²	0,23	0,36	0,33	0,40	0,13	0,40					
% respond.	42%	20%	14%	14%	10%	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Selection	-0,57***	-0,79**	-0,30	1,71***	0,13	41,76	8,30E-06	28,25	0,00043	-0,18	0,81
0											
1	0,04	1,33	0,49	-0,08	-0,68					0,26	0,60
2	0,53**	-0,54	-0,19	-1,63**	0,55					-0,08	0,76
TA_farmer	-1,34***	0,52	-0,17	0,25	-0,93	47,16	3,50E-05	20,05	0,066	-0,55	0,78
0											
1	0,95***	-1,65	0,15	0,00	-0,48					0,05	0,97
2	-0,19	-0,02	-0,10	-0,89	0,63					-0,16	0,38
3	0,58**	1,15**	0,13	0,65	0,79					0,66	0,30
TA_expert	-0,86***	-1,21***	-0,18	0,16	-0,42	54,39	2,30E-06	14,75	0,25	-0,64	0,46
0											
1	-0,12	0,10	0,07	-2,50***	0,30					-0,34	0,89
2	0,49*	0,71**	-1,06	1,12	0,50					0,41	0,63
3	0,48	0,40	1,18*	1,22	-0,37					0,58	0,46
contact	-0,57	0,32	2,50***	0,97	-1,63	16,76	0,005	16,10	0,0029	0,14	1,19
contract	-0,71***	1,38***	0,09	0,22	0,73*	28,89	2,40E-05	28,43	1,00E-05	0,09	0,80
price	0,46***	0,00	0,09	0,99***	0,28*	62,40	9,10E-13	62,40	9,10E-13	0,38	0,31
No program	-2,30***	-1,51***	1,50**	0,53	1,63	64,39	1,50E-12	42,04	1,60E-08	-0,81	1,63
Intercept	-2,41	1,71	-4,16*	1,90	2,96	8,15	0,086				
Covariates											
PP	-0,08	-0,01	0,51***	-0,21*	-0,21*	12,55	0,014				
ECO	0,22**	-0,52***	-0,24	0,38**	0,16	18,76	0,00088				
ENV	0,11***	0,10**	0,08	-0,15**	-0,14***	17,06	0,0019				

* z<-1.645 or z>1.645: significance level of 0.1

*** z<-2.576 or z>2.576: significance level of 0.01

** z<-1.960 or z>1.960: significance level of 0.05

*****Bold: z<-3.291 or z>3.291: significance level of 0.00**

Appendix 13: Significant covariates in 5-class model

Once the specifications of the models for all attributes were selected (Model 1 below), we tested for significant covariates. Several models were tested to avoid over-specification (Table 40 and Table 41). Potential covariates were first tested one by one in the model (Table 40, Models 2 to 20). Then we tested a model with all three covariates that were significant when tested one by one (Model 21). All three covariates were highly significant ($p < 0,01$) in this combined model. Significant covariates represent attitudinal traits.

We then tested adding an additional covariate to the model with the three significant covariates (Table 41). Only the covariate “education” appeared to be (mildly) significant ($0,05 > p > 0,01$) when combined with the three selected covariates (Model 34). However, adding “education” does not improve BIC, AIC, or R^2 . We finally tested all 19 potential covariates in the same model (Model 38). In addition to two variables of attitudinal traits, several other variables appeared to be significant, but with 176 parameters, the model was largely over-specified. When simplifying the model three successive times to remove non-significant covariates ($p > 0.05$), we obtained Model 40 below, with two highly significant attitudinal traits and no other significant covariate. Model 40 underperformed Model 21 in R^2 and AIC. We also tested models with socio-economic and attitudinal covariates only (13 covariates). Once removing non-significant covariates, we obtained Model 40 below, with two highly significant attitudinal covariates and mildly significant socio-economic covariates. Model 40 underperformed Model 21 in BIC, AIC and R^2 .

We thus retained, as our preferred 5-class model with covariates, the model with three highly significant covariates of attitudinal traits (Model 21 below).

Table 40: Testing models with one covariate in a 5-class model

	Covariate tested	BIC(LL)	AIC(LL)	Npar	R ²	Cov. Sign. (p value)
Model 1	None	3214	3034	49	0.396	
Model 2	Commodity	3362	3069	80	0.414	0.66
Model 3	Acres farmed	3240	3049	52	0.416	0.36
Model 4	Acres owned	3247	3057	52	0.401	0.25
Model 5	EFP	3237	3047	52	0.401	0.47
Model 6	Approval	3239	3046	53	0.411	0.055
Model 7	Refusal	3247	3053	53	0.394	0.13
Model 8	Treatment	3251	3057	53	0.413	0.83
Model 9	PP**	3233	3039	53	0.413	0.0032
Model 10	ECO**	3219	3029	52	0.397	0.0044
Model 11	ENV*	3242	3048	53	0.411	0.041
Model 12	PEERS	3250	3056	53	0.415	0.63
Model 13	Region	3313	3061	69	0.403	0.83
Model 14	Gender	3270	3047	61	0.395	0.93
Model 15	Age	3252	3058	53	0.393	0.096
Model 16	Successor	3245	3051	53	0.415	0.15
Model 17	Education	3260	3067	53	0.398	0.49
Model 18	Income	3247	3054	53	0.413	0.37
Model 19	FO leader	3253	3059	53	0.386	0.21
Model 20	Stewardship group	3249	3055	53	0.411	0.5

Table 41: Testing models with several covariates in a 5-class model

	Covariates tested	BIC(LL)	AIC(LL)	Npar	R ²	Last covariate significance (p value)
Model21	PP**, ECO**, ENV**	3230	3010	60	0.405	0.00041; 0.0054; 0.0019
Model22	PP, ECO**, ENV*, Commodity	3408	3072	92	0.395	0.52
Model23	PP**, ECO, ENV*, Acres farmed	3295	3061	64	0.362	0.62
Model24	PP**, ECO, ENV*, Acres owned	3296	3062	64	0.362	0.88
Model25	PP**, ECO**, ENV**, EFP	3256	3019	65	0.368	0.053
Model26	PP**, ECO**, ENV**, Approval	3247	3013	64	0.403	0.28
Model27	PP**, ECO, ENV*, Refusal	3294	3060	64	0.358	0.45
Model28	PP**, ECO**, ENV**, Treatment	3244	3010	64	0.401	0.15
Model29	PP**, ECO**, ENV**, PEERS	3245	3011	64	0.402	0.15
Model30	PP**, ECO**, ENV*, Region	3324	3031	80	0.386	0.92
Model31	PP**, ECO**, ENV**, Gender	3284	3021	72	0.403	0.95
Model32	PP**, ECO, ENV**, Age	3277	3043	64	0.357	0.83
Model33	PP**, ECO**, ENV**, Successor	3261	3023	65	0.391	0.089
Model34	PP**, ECO**, ENV**, Education*	3248	3014	64	0.377	0.015
Model35	PP**, ECO**, ENV**, Income	3270	3033	65	0.380	0.54
Model36	PP**, ECO, ENV*, FO leader	3294	3060	64	0.360	0.45
Model37	PP**, ECO**, ENV**, Stewardship group	3249	3015	64	0.405	0.57
Model38	All (19 covariates)	3703	3060	176	0.299	
Model39	PP**, ENV**	3226	3018	57	0.396	
Model40	PP**, ENV**, Acres farmed*, FO leader*	3252	3014	65	0.399	
Model 41	PP**, ECO**, ENV**, Age, Education	3262	3013	68	0.397	

** : highly significant $p < 0.01$

* : mildly significant $0.05 > p > 0.01$

Table 42: Model with five covariates: three covariates of attitudinal traits, age and education

	Class1	Class2	Class3	Class4	Class5	Overall					
R ²	0,25	0,29	0,31	0,43	0,09	0,40					
Respondents (%)	42%	22%	13%	12%	11%						
	Class1	Class2	Class3	Class4	Class5	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
Attributes:											
Selection***											
0	-0.42***	-1.02***	-0.26	1.60***	0.05	57	1.20E-08	38	8.40E-06	-0.25	0.74
1	-0.18	1.47**	0.05	0.70	-0.79					0.26	0.75
2	0.60***	-0.46	0.21	-2.30***	0.75*					-0.01	0.94
TA***											
0	-1.24***	-0.71**	-0.43	1.44**	-0.48	120	1.70E-18	47	4.70E-06	-0.63	0.81
1	0.83***	-1.41**	0.59	-1.04	-0.09					-0.01	0.95
2	0.18	1.40***	-0.36	-1.06**	0.48					0.27	0.74
3	0.23	0.72**	0.20	0.66	0.09					0.37	0.24
Contact***	-0.20	-0.40**	2.27***	0.26	-0.89**	53	2.80E-10	52	1.30E-10	0.07	0.91
Contract***	-0.43**	0.18	-0.03	0.98**	0.93**	18	0.0026	18	0.0011	0.06	0.53
Price***	0.51***	0.00	0.04	0.49***	0.25	67	8.40E-14	67	8.40E-14	0.30	0.23
No program ***	-1.09***	-2.44***	1.32***	-0.53	2.55***	112	1.60E-22	87	5.50E-18	-0.63	1.54
Intercept**	-2.88*	2.42	-6.50***	5.36**	1.59	12	0.021				
Covariates:											
PP***	0.01	-0.18	0.64***	-0.27*	-0.19	21	0.00029				
ECO**	0.31***	-0.38***	-0.08	-0.03	0.19	15	0.0055				
ENV***	0.11***	0.12**	0.12**	-0.22***	-0.13**	19	0.00074				
AGE	-0.14	0.11	-0.09	-0.19	0.31	4	0.38				
EDUCATION*	-0.17	-0.45*	-0.17	0.76***	0.03	8	0.099				

* z<-1.645 or z>1.645: significance level of 0.1

*** z<-2.576 or z>2.576: significance level of 0.01

** z<-1.960 or z>1.960: significance level of 0.05

Bold: z<-3.291 or z>3.291: significance level of 0.001

Appendix 14: Simplified model

Removing any insignificant effect and insignificant differences in parameters across classes lead us to define a much simpler set of models.

Table 43: Comparison of statistics of fit and repartition for LC models, without covariate, with various class numbers and the simplified 5-class model

	N parameters	df	LL	BIC (LL)/N	AIC (LL)/N	Class Error	Pseudo R ²	Repartition by class					
								class 1	class 2	class 3	class 4	class 5	class 6
1-Class	9	277	-1668	1.973	1.954	0.00	0.052	100%					
2-Class	19	267	-1562	1.883	1.843	0.05	0.183	79%	21%				
3-Class	29	257	-1528	1.876	1.815	0.11	0.289	59%	21%	19%			
4-Class	39	247	-1495	1.871	1.788	0.12	0.341	57%	17%	14%	11%		
5-Class	49	237	-1468	1.873	1.768	0.11	0.396	48%	19%	15%	12%	6%	
6-Class	59	227	-1451	1.886	1.760	0.14	0.442	34%	23%	14%	11%	12%	5%
5-Class with covariates simplified	41	245	-1460	1.836	1.749	0.16	0.396	39%	25%	13%	13%	10%	

BIC parsimony index for the simplified 5-class model significantly outperforms the original models for all classes (Table 43, Table 44). The three selected covariates remain highly significant in the simplified model (Table 45).

Table 44: Comparison of statistics of fit and repartition for LC models with covariates with various class numbers and the simplified 5-class model

	N parameters	Log Likelihood Function	Pseudo R ²	AIC(LL)/N	BIC(LL)/N	Correct predictions	Repartition by class					
							Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
1-Class	9	-1668	0.052	1.954	1.973	100%	100%					
2-Class	22	-1560	0.182	1.844	1.891	95%	88%	12%				
3-Class	35	-1516	0.242	1.808	1.882	94%	74%	15%	11%			
4-Class	48	-1477	0.338	1.777	1.880	91%	59%	17%	13%	11%		
5-Class²⁸¹	60	-1445	0.405	1.754	1.882	86%	41%	23%	13%	12%	10%	
6-Class	72	-1423	0.451	1.742	1.895	85%	34%	21%	13%	12%	10%	10%
5-Class simplified	41	-1460	0.396	1.749	1.836	84%	39%	25%	13%	13%	10%	

²⁸¹ Our preferred model.0

Table 45: Simplified 5 class model with covariates

	Class1	Class2	Class3	Class4	Class5	Wald	p-value	Wald (=)	p-value	Mean	Std.Dev.
Attributes selection											
0	-0.16	-0.64	-0.16	-0.16	-0.16	32.08	1.80E-06	16.50	0.00026	-0.28	0.21
1	-0.17	0.91	-0.17	-0.17	-0.17					0.10	0.46
2	0.33	-0.27	0.33	0.33	0.33					0.18	0.26
TA											
0	-1.13	-0.57	-0.45	-0.57	-0.57	145.56	7.30E-27	47.40	1.60E-08	-0.77	0.29
1	0.84	-0.83	0.86	-0.83	-0.83					0.04	0.84
2	0.06	0.79	-0.44	0.79	0.79					0.35	0.46
3	0.23	0.61	0.04	0.61	0.61					0.38	0.22
contact	0.00	0.00	1.99	0.31	-0.89	50.24	7.10E-11	40.07	2.00E-09	0.21	0.75
commitment	-0.66	0.00	0.00	2.63	0.93	103.08	3.40E-22	100.56	1.50E-22	0.19	1.07
price	0.60	0.00	0.00	0.60	0.40	96.00	1.40E-21	87.53	8.30E-21	0.35	0.28
No program Intercept	-0.83	-2.10	1.05	1.05	3.08	135.89	2.10E-28	121.86	3.10E-26	-0.26	1.59
Covariates	-2.91	0.96	-6.69	5.72	2.92	16.37	0.0026				
PP	-0.03	-0.10	0.61	-0.25	-0.23	19.80	0.00055				
ENV	0.08	0.09	0.09	-0.14	-0.12	14.03	0.0072				
ECO	0.32	-0.26	-0.06	-0.12	0.11	13.21	0.01				

Appendix 15: Separate model by treatment

While none of the Latent Gold Choice, SI-CHAID and SPSS software identified significant differences across treatment, we still run separate models for Treatment 1 and Treatment 2 using the same specification as our main model in Latent Gold Choice. In both cases, BIC was minimal for a 3-class model. Classes had the characteristics described in Table 46 below, with a strong overlap with the classes identified in our main 5-class model.

While none of the Latent Gold Choice, SI-CHAID and SPSS software identified significant differences across treatment, we still run separate models for Treatment 1 and Treatment 2 using the same specification as our main model in Latent Gold Choice. In both cases, BIC was minimal for a 3-class model. Classes had the characteristics described in Table 46 below, with a strong overlap with the classes identified in our main 5-class model.

Table 46: Latent classes in Treatment Specific models

	Class 1	Class 2	Class 3
Treatment 1	<p>69%</p> <p>Class 1 traits in our preferred model prevail. Sensitive to price. TA also matters, with a preference for a group approach. Choose to participate in 83% of cases.</p>	<p>18%</p> <p>Traits of class 3 in our main model prevail. Strong preference for a farmer as a contact person and a high preference for ownership and self-direction. Not significantly sensitive to price.</p>	<p>13%</p> <p>Traits of classes 4 and 5 in our main model: preference for a conservation specialist; no contract. With choice not to participate in 86% of cases.</p>
Treatment 2	<p>58%</p> <p>Class 1 traits in our preferred model prevail. Very sensitive to price; strong preference for economic aspects. TA also matters, with a preference for a group approach. Choose to participate in 78% of choices.</p>	<p>21%</p> <p>Similar to class 2 in our main model. TA and selection matter. Not sensitive to price. Prefer a merit-based approach (dislike first-come-first-served). More environmentally sensitive than other classes. Prefer individual technical assistance. Choose to participate in 97% of choices.</p>	<p>21%</p> <p>Choose not to participate in 79% of choices. Reject selection on a first-come-first-served basis. Similar to class 5 in our main model, but prefers experienced farmers as contact points and has a relatively higher preference for ownership and self-direction (some class 3 traits).</p>

Table 47: Treatment 1: 3-class model

	Class1	Class2	Class3	Overall					
R²	0,17	0,14	0,29	0,29					
Attributes	Class1	Class3	Class2	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
selection									
0	-0,34***	-0,12	0,03	14,9	0,021	4,4	0,36	-0,25	0,14
1	-0,10	0,59	-0,23					0,01	0,28
2	0,44***	-0,47	0,20					0,24	0,35
TA									
0	-0,91***	-0,18	-0,68	47,9	2,70E-07	4,8	0,57	-0,74	0,28
1	0,42**	0,21	0,26					0,36	0,09
2	0,26	-0,49	0,11					0,11	0,29
3	0,22	0,46	0,31					0,28	0,09
contact	-0,30**	1,95***	-1,79***	30,9	8,70E-07	23,8	6,90E-06	-0,09	1,08
commitment	-0,20	0,51	1,11**	8,8	0,032	8,8	0,012	0,10	0,48
price	0,38***	0,18	0,21	48,9	1,40E-10	2,2	0,33	0,32	0,09
No program	-1,59***	1,43*	1,81***	51,7	3,50E-11	42,2	6,90E-10	-0,59	1,48
Intercept	0,34	-4,35*	4,00*	4,1	0,13				
Covariates									
PP	-0,14	0,53***	-0,39***	12,0	0,0025				
ECO	0,07	-0,15	0,09	1,5	0,47				
ENV	0,06	0,05	-0,11*	4,3	0,11				

* z<-1.645 or z>1.645: significance level of 0.1

** z<-1.960 or z>1.960: significance level of 0.05

*** z<-2.576 or z>2.576: significance level of 0.01

*****Bold**: z<-3.291 or z>3.291: significance level of 0.001

Table 48: Treatment 2: 3-class model

	Class 1	Class 2	Class 3	Overall					
R²	0,13	0,43	0,05	0,29					
Attributes	Class1	Class3	Class2	Wald	p-value	Wald(=)	p-value	Mean	Std.Dev.
selection									
0	0,03	-1,91*	-0,48*	11,1	0,086	9,6299	0,047	-0,4885	0,763
1	0,09	2,98	-0,12					0,6574	1,2056
2	-0,13	-1,07	0,61					-0,1688	0,5506
TA									
0	-0,59***	-0,60	-0,59*	48,8	0,18 E-06	13,1654	0,04	-0,5942	0,0055
1	0,35	-3,21	0,35					-0,4027	1,4529
2	0,02	2,05**	0,55					0,5621	0,8007
3	0,23	1,76	-0,32					0,4348	0,7192
contact	0,13	-0,41	0,60	6,2	0,1	5,2897	0,071	0,1143	0,33
commitment	-0,19	0,45	0,23	2,3	0,51	2,1201	0,35	0,0344	0,2695
price	0,41***	0,00	0,01	40,7	1,4E-09	40,7364	1,40E-09	0,2358	0,1994
No program	-1,04***	-3,57***	1,31***	36,4	6,3E-08	31,4331	1,50E-07	-1,0696	1,5938
Intercept	-1,04	2,02	-0,98	1,0	0,6				
Covariates									
PP	0,02	-0,18	0,16	2,5	0,29				
ECO	0,35***	-0,40***	0,05	10,9	0,0042				
ENV	-0,04	0,07	-0,03	1,9	0,39				

* $z < -1.645$ or $z > 1.645$: significance level of 0.1

** $z < -1.960$ or $z > 1.960$: significance level of 0.05

*** $z < -2.576$ or $z > 2.576$: significance level of 0.01

*****Bold: $z < -3.291$ or $z > 3.291$: significance level of 0.001**

Table 49: Willingness to pay estimates, 3-class models, TA and selection nominal variables and three covariates of attitudinal traits

		Treatment 1			Treatment 2		
		Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
% respondents		69%	18%	13%	57%	21%	21%
% opt out		5%	23%	61%	6%	3%	55%
selection	0	570***	418	-74	-1,63	0,00	1078,54
	1	170	-1927	686	-4,60	0,00	276,39
	2	-739**	1508	-612	6,24	0,00	-1354,93
TA	0	1478***	575	1929	29,15***	0,00	1303,77
	1	-689*	-596	-727	-17,09	0,00	-787,85
	2	-451*	1558	-309	-0,77	0,00	-1231,61
	3	-339	-1537	-894	-11,28	0,00	715,68
contact		472**	-6353	4974	-6,16	0,00	-1335,81
commitment		311	-1660	-3126	9,30	0,00	-503,85
No program		1528**	-5751**	-6165**	30,85	0,00	-2930,27

* $z < -1.645$ or $z > 1.645$: significance level of 0.1

** $z < -1.960$ or $z > 1.960$: significance level of 0.05

*** $z < -2.576$ or $z > 2.576$: significance level of 0.01

*****Bold: $z < -3.291$ or $z > 3.291$: significance level of 0.001**

Treatment 1: One gradation in price corresponds to 20% increase in cost-share, or \$600 per acre

Treatment 2: One gradation in price corresponds to \$20 per acre

In both treatments, willingness to pay estimates are only significant for Class 1 respondents, which represent a majority of respondents.

To receive technical assistance, respondents in Treatment 1 are ready to give-up up to about \$1500 per acre (for a total investment cost of \$3000 and a cost share grant from \$1050 to \$4050 per acre); and respondents in Treatment 2 up to about \$30 per acre. In both case, preference would go to collective technical assistance to a group of farmers of common interest.

Given that average project sizes in Treatment 1 are between 5 to 10 acres and average project sizes in Treatment 2 between 70 to 100 acres.

Table 50: Willingness to pay estimates, 3-class models, TA = 2 numerical variables, selection nominal variable, and three covariates of attitudinal traits

	Treatment 1			Treatment 2		
	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
% respondents	70%	17%	13%	64%	21%	15%
% opt out	6%	24%	61%	7%	56%	2%
Selection						
0	394,33***	690,08	-141,33	5,87	147,60	-22,17
1	-23,11	-1491,71	401,67	-38,90***	-85,85	286,75
2	-371,21*	801,63	-260,34	33,03***	-61,75	-264,58
TA_group	-978,31***	-701,88	-1419,55	-39,43***	-91,13	-3,74
TA_ind	-1394,49***	-984,19	-2027,86	-2,40	-88,06	-555,40
contact	439,83**	-5433,38**	4837,42	-25,91***	-187,78	400,74
commitment	22,42	-1050,63	-3218,66	15,25*	-110,64	-218,90
No program	-152,02	-6190,31***	-7785,27*	22,35	-630,54	257,75

* $z < -1.645$ or $z > 1.645$: significance level of 0.1

** $z < -1.960$ or $z > 1.960$: significance level of 0.05

*** $z < -2.576$ or $z > 2.576$: significance level of 0.01

*****Bold: $z < -3.291$ or $z > 3.291$: significance level of 0.001**

Treatment 1: One gradation in price corresponds to 20% increase in cost-share

Treatment 2: One gradation in price corresponds to \$20 per acre

To receive technical assistance in group, respondents in Treatment 1 are ready to give-up up about \$1400 per acre receive technical assistance individually, and \$1000 to receive technical assistance in group.

To receive technical assistance in groups, respondents in Treatment 2 are ready to give-up up to \$40 per acre per year.

Figures have been rounded, as they are only estimates.

Appendix 16: Distribution of covariates and response time by class

In all following Tables, each subscript letter indicates a subset of Class categories whose column proportions do not differ significantly from each other at level 0.05.

Table 51a: REGION * Class

			Class					Total
			1	2	3	4	5	
REGION: In which agricultural region is your farm located?	Not responded	Number	4 _a	1 _a	0 _a	1 _a	3 _a	9
		% in Class	3.3%	1.5%	0.0%	2.9%	10.0%	3.1%
	Central Ontario	Number	15 _a	10 _a	3 _a	5 _a	3 _a	36
		% in Class	12.5%	15.4%	8.3%	14.3%	10.0%	12.6%
	Eastern Ontario	Number	57 _a	31 _{a, b}	24 _b	18 _{a, b}	11 _a	141
		% in Class	47.5%	47.7%	66.7%	51.4%	36.7%	49.3%
	Northern Ontario	Number	2 _a	1 _a	0 _a	0 _a	1 _a	4
		% in Class	1.7%	1.5%	0.0%	0.0%	3.3%	1.4%
	Other	Number	1 _a	0 _a	0 _a	0 _a	1 _a	2
		% in Class	0.8%	0.0%	0.0%	0.0%	3.3%	0.7%
Total		Number	120	65	36	35	30	286
		% in Class	100%	100%	100%	100%	100%	100%

Table 51b: GENDER * Class

			Class					Total
			1	2	3	4	5	
GENDER	Not responded	Number	4 _a	1 _a	0 _a	1 _a	3 _a	9
		% in Class	3.3%	1.5%	0.0%	2.9%	10.0%	3.1%
	Female	Number	16 _a	17 _b	5 _{a, b}	7 _{a, b}	5 _{a, b}	50
		% in Class	13.3%	26.2%	13.9%	20.0%	16.7%	17.5%
	Male	Number	98 _a	47 _a	31 _a	27 _a	21 _a	224
		% in Class	81.7%	72.3%	86.1%	77.1%	70.0%	78.3%
	Prefer not to answer	Number	2 _a	0 _a	0 _a	0 _a	1 _a	3
		% in Class	1.7%	0.0%	0.0%	0.0%	3.3%	1.0%
Total		Number	120	65	36	35	30	286
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51c: AGE * Class

			Class					Total
			1	2	3	4	5	
AGE	18-30	Number	15 _a	7 _a	5 _a	6 _a	3 _a	36
		% in Class	12.9%	10.9%	13.9%	17.6%	11.1%	13.0%
	31-45	Number	24 _a	12 _a	5 _a	9 _a	2 _a	52
		% in Class	20.7%	18.8%	13.9%	26.5%	7.4%	18.8%
	46-60	Number	53 _a	27 _a	16 _a	7 _b	13 _a	116
		% in Class	45.7%	42.2%	44.4%	20.6%	48.1%	41.9%
	61 or more	Number	24 _a	18 _a	10 _a	12 _a	9 _a	73
		% in Class	20.7%	28.1%	27.8%	35.3%	33.3%	26.4%
Total		Number	116	64	36	34	27	277
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51d: SUCCESSOR * Class

			Class					Total
			1	2	3	4	5	
SUCCESSOR: Do you have a successor on your farm? (for example, a child who plans to keep the farm after you)	No	Number	44 _a	25 _a	12 _a	19 _a	12 _a	112
		% in Class	39.3%	39.1%	33.3%	55.9%	44.4%	41%
	Yes	Number	68 _a	39 _a	24 _a	15 _a	15 _a	161
		% in Class	60.7%	60.9%	66.7%	44.1%	55.6%	59%
Total		Number	112	64	36	34	27	273
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100%

Table 51e: EDUCATION * Class

			Class					Total
			1	2	3	4	5	
EDUCATION: What is the highest level of education you received?	High School	Number	24 _a	9 _a	4 _a	5 _a	5 _a	47
		% in Class	20.9%	14.1%	11.1%	14.7%	18.5%	17.0%
	College	Number	53 _{a, b}	31 _{a, b}	23 _b	12 _a	12 _{a, b}	131
		% in Class	46.1%	48.4%	63.9%	35.3%	44.4%	47.5%
	Bachelor	Number	31 _a	19 _a	7 _a	9 _a	7 _a	73
		% in Class	27.0%	29.7%	19.4%	26.5%	25.9%	26.4%
	Masters or PhD*	Number	7 _a	5 _a	2 _a	8 _b	3 _{a, b}	25
		% in Class	6.1%	7.8%	5.6%	23.5%	11.1%	9.1%
Total		Number	115	64	36	34	27	276
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*As only three respondents had a Ph.D., this level was merged with Masters

Table 51f: INCOME * Class

			Class					Total
			1	2	3	4	5	
INCOME: Is farming the main source of income in your household?	No	Number	43 _{a, b}	28 _b	11 _{a, b}	12 _{a, b}	6 _a	100
		% in Class	37.1%	44.4%	30.6%	35.3%	22.2%	36.2%
	Yes	Number	73 _{a, b}	35 _b	25 _{a, b}	22 _{a, b}	21 _a	176
		% in Class	62.9%	55.6%	69.4%	64.7%	77.8%	63.8%
Total		Number	116	63	36	34	27	276
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100%

Table 51g: FO * Class

			Class					Total
			1	2	3	4	5	
FO: Are you on the board of directors of a farmers' organization?	No	Number	75 _a	42 _a	17 _a	23 _a	16 _a	173
		% in Class	64.7%	65.6%	47.2%	67.6%	59.3%	62.5%
	Yes	Number	41 _a	22 _a	19 _a	11 _a	11 _a	104
		% in Class	35.3%	34.4%	52.8%	32.4%	40.7%	37.5%
Total		Number	116	64	36	34	27	277
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51h: COMMODITY * Class

			Class					Total
			1	2	3	4	5	
COMMODITY: What is your primary commodity?	Beef	Number	12 _a	8 _a	1 _a	3 _a	1 _a	25
		% in Class	10.0%	12.3%	2.8%	8.6%	3.3%	8.7%
	Dairy	Number	21 _a	12 _a	11 _a	5 _a	6 _a	55
		% in Class	17.5%	18.5%	30.6%	14.3%	20.0%	19.2%
	Field crops	Number	67 _a	31 _a	19 _a	17 _a	16 _a	150
		% in Class	55.8%	47.7%	52.8%	48.6%	53.3%	52.4%
	Fruits or vegetables	Number	3 _a	1 _a	1 _a	1 _a	2 _a	8
		% in Class	2.5%	1.5%	2.8%	2.9%	6.7%	2.8%
	Greenhouses	Number	1 _a	0 _a	0 _a	0 _a	0 _a	1
		% in Class	0.8%	0.0%	0.0%	0.0%	0.0%	0.3%
	Other	Number	5 _a	3 _{a, b}	0 _a	5 _b	2 _{a, b}	15
		% in Class	4.2%	4.6%	0.0%	14.3%	6.7%	5.2%
	Poultry	Number	2 _a	3 _a	1 _a	0 _a	2 _a	8
		% in Class	1.7%	4.6%	2.8%	0.0%	6.7%	2.8%
	Sheep, goats, or horses	Number	7 _a	3 _a	2 _a	3 _a	0 _a	15
		% in Class	5.8%	4.6%	5.6%	8.6%	0.0%	5.2%
	Swine	Number	2 _a	4 _a	1 _a	1 _a	1 _a	9
		% in Class	1.7%	6.2%	2.8%	2.9%	3.3%	3.1%
Total		Number	120	65	36	35	30	286
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51i: EFP * Class

			Class					Total
			1	2	3	4	5	
EFP: Have you prepared an Environmental Farm Plan?	No	Number	20 _a	10 _a	6 _a	6 _a	5 _a	47
		% in Class	43.3%	46.9%	61.1%	40.0%	50.0%	46.7%
	Yes once	Number	44 _a	30 _a	10 _a	15 _a	13 _a	112
		% in Class	36.7%	46.2%	27.8%	42.9%	43.3%	39.2%
	Yes several times	Number	56 _a	25 _a	20 _a	14 _a	12 _a	127
		% in Class	46.7%	38.5%	55.6%	40.0%	40.0%	44.4%
Total		Number	120	65	36	35	30	286
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100%

Table 51j: PROJECTS * Class

			Class					Total
			1	2	3	4	5	
PROJECTS: Have you received a grant to improve soil health or the environment on your farm?	No	Number	52 _a	30 _a	22 _a	14 _a	15 _a	133
		% in Class	43.3%	46.9%	61.1%	40.0%	50.0%	46.7%
	Yes once	Number	32 _a	17 _a	7 _a	10 _a	5 _a	71
		% in Class	26.7%	26.6%	19.4%	28.6%	16.7%	24.9%
	Yes several times	Number	36 _a	17 _a	7 _a	11 _a	10 _a	81
		% in Class	30.0%	26.6%	19.4%	31.4%	33.3%	28.4%
Total		Number	120	64	36	35	30	285
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51k: REFUSALS * Class

			Class					Total
			1	2	3	4	5	
REFUSALS: Have some of your applications to a grant program been unsuccessful?	No	Number	77 _{a. b}	48 _b	19 _a	23 _{a. b}	15 _a	182
		% in Class	65.3%	73.8%	52.8%	65.7%	51.7%	64.3%
	Yes once	Number	12 _a	8 _{a. b}	7 _{a. b}	7 _{a. b}	7 _b	41
		% in Class	10.2%	12.3%	19.4%	20.0%	24.1%	14.5%
	Yes several times	Number	29 _a	9 _a	10 _a	5 _a	7 _a	60
		% in Class	24.6%	13.8%	27.8%	14.3%	24.1%	21.2%
Total		Number	118	65	36	35	29	283
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51l: TA * Class

			Class					Total
			1	2	3	4	5	
TA: If the program could provide support to help you with your project, which type of technical or administrative assistance would you prefer?	A partnership with a research team	Number	11 _a	11 _a	2 _a	3 _a	2 _a	29
		% in Class	9.2%	16.9%	5.6%	8.6%	6.7%	10.1%
	A specialist that I can call if something goes wrong after I implement my project	Number	5 _a	8 _b	2 _{a, b}	1 _{a, b}	2 _{a, b}	18
		% in Class	4.2%	12.3%	5.6%	2.9%	6.7%	6.3%
	A specialist to help me identify priorities on my farm and design my project	Number	53 _a	27 _a	13 _a	15 _a	9 _a	117
		% in Class	44.2%	41.5%	36.1%	42.9%	30.0%	40.9%
	Exchanges with fellow farmers to share their experience	Number	11 _a	4 _a	10 _b	4 _{a, b}	4 _{a, b}	33
		% in Class	9.2%	6.2%	27.8%	11.4%	13.3%	11.5%
	I do not need assistance	Number	5 _a	2 _a	0 _a	3 _{a, b}	5 _b	15
		% in Class	4.2%	3.1%	0.0%	8.6%	16.7%	5.2%
Someone to help me fill out the paperwork	Number	35 _a	13 _a	9 _a	9 _a	8 _a	74	
	% in Class	29.2%	20.0%	25.0%	25.7%	26.7%	25.9%	
Total		Number	120	65	36	35	30	286
		% in Class	100%	100%	100%	100%	100%	100%

Table 51m: IMPLEMENTATION * Class

			Class					Total
			1	2	3	4	5	
IMPLEMEN- TATION: Do you have a preference regarding who runs the program and selects projects for funding?	Not responded	Number	0 _a	0 _{a. b}	0 _{a. b}	1 _{a. b}	1 _b	2
		% in Class	0.0%	0.0%	0.0%	2.9%	3.3%	0.7%
	CA	Number	9 _{a. b}	10 _{b. c}	0 _a	3 _{a. b. c}	8 _c	30
		% in Class	7.5%	15.4%	0.0%	8.6%	26.7%	10.5%
	CA. FARMERS ORGANIZATION	Number	3 _a	2 _a	0 _a	2 _a	0 _a	7
		% in Class	2.5%	3.1%	0.0%	5.7%	0.0%	2.4%
	CA. OMAFRA	Number	1 _a	1 _a	0 _a	1 _a	0 _a	3
		% in Class	0.8%	1.5%	0.0%	2.9%	0.0%	1.0%
	FARMERS ORGANIZATION (FO)	Number	57 _a	26 _a	25 _b	11 _a	13 _a	132
		% in Class	47.5%	40.0%	69.4%	31.4%	43.3%	46.2%
	FO. OMAFRA	Number	7 _a	0 _b	3 _a	2 _{a. b}	0 _{a. b}	12
		% in Class	5.8%	0.0%	8.3%	5.7%	0.0%	4.2%
	No	Number	25 _a	14 _a	3 _a	9 _a	3 _a	54
		% in Class	20.8%	21.5%	8.3%	25.7%	10.0%	18.9%
	OMAFRA	Number	17 _a	11 _a	5 _a	5 _a	3 _a	41
		% in Class	14.2%	16.9%	13.9%	14.3%	10.0%	14.3%
	Other	Number	1 _a	1 _{a. b}	0 _{a. b}	1 _{a. b}	2 _b	5
		% in Class	0.8%	1.5%	0.0%	2.9%	6.7%	1.7%
	Total CA	% in Class	10.8%	20.0%	0.0%	17.1%	26.7%	14.0%
	Total FO	% in Class	55.8%	43.1%	77.8%	42.9%	43.3%	52.8%
	Total OMAFRA	% in Class	20.8%	18.5%	22.2%	22.9%	10.0%	19.6%
Total		Number	120	65	36	35	30	286
		% in Class	100%	100%	100%	100%	100%	100%

Respondents could select several options

Table 51n TRAITEMENT * Class

			Class					
			1	2	3	4	5	Total
TRAITEMENT	1	Number	67 _a	27 _a	20 _a	17 _a	15 _a	146
		% in TRAITEMENT	45.9%	18.5%	13.7%	11.6%	10.3%	100.0%
		% in Class	55.8%	41.5%	55.6%	48.6%	50.0%	51.0%
	2	Number	53 _a	38 _a	16 _a	18 _a	15 _a	140
		% in TRAITEMENT	37.9%	27.1%	11.4%	12.9%	10.7%	100.0%
		% in Class	44.2%	58.5%	44.4%	51.4%	50.0%	49.0%
Total		Number	120	65	36	35	30	286
		% in TRAITEMENT	42.0%	22.7%	12.6%	12.2%	10.5%	100.0%
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 51o: SELECTION * Class

			Class					
			1	2	3	4	5	Total
SELECTION: Given that funding is limited, what do you think is the best way for environmental and soil health programs to select individual projects for funding?	Not responded	Number	1 _a	0 _a	0 _{a. b}	0 _{a. b}	2 _b	3
		% in Class	0.8%	0.0%	0.0%	0.0%	6.7%	1.0%
	Conservation tenders*	Number	4 _a	4 _a	2 _a	1 _a	2 _a	13
		% in Class	3.3%	6.2%	5.6%	2.9%	6.7%	4.5%
	Environmental bonus**	Number	18 _a	5 _a	4 _a	4 _a	1 _a	32
		% in Class	15.0%	7.7%	11.1%	11.4%	3.3%	11.2%
	First come. first served***	Number	14 _a	3 _{a. b}	3 _{a. b}	3 _{a. b}	0 _b	23
		% in Class	11.7%	4.6%	8.3%	8.6%	0.0%	8.0%
	Geographical targeting****	Number	13 _a	5 _a	4 _a	2 _a	3 _a	27
		% in Class	10.8%	7.7%	11.1%	5.7%	10.0%	9.4%
	Merit-based selection*****	Number	38 _a	31 _b	13 _{a. b}	15 _{a. b}	8 _{a. b}	105
		% in Class	31.7%	47.7%	36.1%	42.9%	26.7%	36.7%
	None of the above*****	Number	25 _{a. b}	11 _b	9 _{a. b}	7 _{a. b}	11 _a	63
		% in Class	20.8%	16.9%	25.0%	20.0%	36.7%	22.0%
	Other	Number	7 _a	6 _a	1 _a	3 _a	3 _a	20
		% in Class	5.8%	9.2%	2.8%	8.6%	10.0%	7.0%
Total		Number	120	65	36	35	30	286
		% in Class	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

*Conservation tenders: Farmers should propose a funding amount. and projects with the highest environmental benefit per dollar should be selected.

**Environmental bonus: Projects with higher or more diverse environmental benefits should receive a higher cost-share.

***First come. first served: Funding should go to the eligible farmers who applied first.

****Geographical targeting: Environmental programs should concentrate funding on the most environmentally sensitive areas.

*****Merit-based selection: Projects should be selected based on their individual environmental merit. and receive a fixed cost-share.

*****None of the above. all eligible projects should receive funding even if it is a limited amount

Table 51p: COLLABORATION * Class

			Class					Total
			1	2	3	4	5	
COLLABORATION : If a program provided extra support for farmers who collaborate with each other, would you be interested to...		Number	0 _a	0 _a	0 _a	1 _a	0 _a	1
		% in Class	0.0%	0.0%	0.0%	2.9%	0.0%	0.3%
	Coordinate*	Number	22 _a	20 _a	7 _a	5 _a	5 _a	59
		% in Class	18.3%	30.8%	19.4%	14.3%	16.7%	20.6%
	Coordinate. Group TA**	Number	4 _a	1 _a	2 _a	3 _a	1 _a	11
		% in Class	3.3%	1.5%	5.6%	8.6%	3.3%	3.8%
	Coordinate. Group TA. Test plots***	Number	12 _a	4 _a	3 _a	6 _a	3 _a	28
		% in Class	10.0%	6.2%	8.3%	17.1%	10.0%	9.8%
	Coordinate. Test plots	Number	3 _a	0 _a	1 _a	1 _a	1 _a	6
		% in Class	2.5%	0.0%	2.8%	2.9%	3.3%	2.1%
	Group TA	Number	40 _{a. b}	21 _{a. b. c}	15 _b	7 _{a. c}	4 _c	87
		% in Class	33.3%	32.3%	41.7%	20.0%	13.3%	30.4%
	Group TA. Test plots	Number	5 _{a. b}	0 _b	4 _a	2 _{a. b}	2 _a	13
		% in Class	4.2%	0.0%	11.1%	5.7%	6.7%	4.5%
	None****	Number	9 _a	3 _a	2 _a	5 _{a. b}	9 _b	28
		% in Class	7.5%	4.6%	5.6%	14.3%	30.0%	9.8%
	Test plots	Number	25 _a	16 _a	2 _b	5 _{a. b}	5 _{a. b}	53
		% in Class	20.8%	24.6%	5.6%	14.3%	16.7%	18.5%
	TOTAL Coordinate	% in Class	34.2%	38.5%	36.1%	42.9%	33.3%	36.4%
	TOTAL Group TA	% in Class	50.8%	40.0%	66.7%	51.4%	33.3%	48.6%
	TOTAL Test plots	% in Class	37.5%	30.8%	27.8%	40.0%	36.7%	35.0%
Total		Number	120	65	36	35	30	286
		% in Class	100%	100%	100%	100%	100%	100%

*Coordinate my project with my neighbours', if we all get an extra bonus on our cost-share

**Receive free technical assistance with other farmers having the same type of projects

***Receive financial support to run test plots on our farms with a group of fellow farmers

****None of the above. Please explain why

Figure 49: Distribution of respondents by response time

Figure 50: Distribution of response time by class

Appendix 17: SI-CHAID outputs

Analyses in SI-CHAID confirmed that only attitudinal statements and composite indicators of attitudinal traits (Appendix 11) are significantly discriminant across classes. Strong correlations between direct follow-up questions on the attributes respondents considered in priority in their choices (Q18) and latent classes also confirm that responses in the choice experiment can be considered solid results (Table 52).

Table 52: Direct questions discriminant by class, using SI-CHAID

Code	Direct question	p-level	Groups
Q18_6	Do the following aspects matter to you when selecting your preferred program? - Financial incentive	6.8e-6	1-3; 4; 5
Q19_8	Do you agree with the following statements? - I like to show my children or my community that I can have a positive impact on the environment.	0.00046	1-4; 5
Q19_5	Do you agree with the following statements? - There is too much government regulation on private land use.	0.00084	1-3; 4-5
Q18_3	Do the following aspects matter to you when selecting your preferred program? - Environmental benefits	0.0068	1-3; 4-5
Q18_4	Do the following aspects matter to you when selecting your preferred program? - Who is my contact point	secondary, after discrimination by other questions	1-3; 4-5
Q19_7	Do you agree with the following statements? - I do not want anybody to tell me what to do on my farm.	idem	idem

Example of tree in SI-CHAID below (Figure 51): numbers in a column represent the proportion of class members in the group considered, based on our preferred 5-class model. The analysis reads, for example, that class 1 members represent 42% of all respondents, but 60% of the 93 respondents who declared that financial incentives matter the most when selecting their preferred program (Q18_6 level 5); while class 2 members represent 43%

of 69 respondents who stated that they do not consider it, do not consider it much or consider it somewhat (Q18_6 levels 1-3 in a 5-point Likert scale).

Figure 51: Example of analytical tree in SI-CHAID (distribution of respondents by class)

Appendix 18: Open responses in the choice experiment survey

Seven open fields in the survey were used in content analysis (Figure 52

Figure 52), including follow-up questions after specific responses and an open field introduced by the question: “Do you have any other idea or thought on stewardship programs that you want to share?”. 131 respondents provided at least one answer.

Responses from 121 respondents could be included in the content analysis in Figure 52

Figure 52 below.

Figure 52: Content analysis of open responses in the choice experiment survey (n=131)

Appendix 19: Research participants' suggestions for innovative policy instruments (not exhaustive)

- **Should farmers compensate for deforestation, or be paid - through a tax rebate or a grant - to prevent it?**

“A program for farmers where in case there is deforestation involved they would have to be involved in reforestation on idle land or in agreement with a landowner in their area with different levels of participation as for example the bigger the project the higher level of reforestation involved and cover part of the cost of it and in case of sensitive areas no deforestation allowed.”

“To protect forest there should be a program to off set the costs of keeps land in a forested state therefore it might help clear cutting.”

“There should be land tax incentives or grants to encourage farmers to preserve or sustain woodlots and to remove marginal land from production rather then go to extremes with sewage sludge etc., to attempt to make it productive. Payment for carbon sequestration in hardwood forests and permanent grassland would be a boost to environmentally conscious farmers to demonstrate to other farmers that there is a way besides tearing out every tree.”

“I'd like to see more incentives for maintaining forest cover (possibly provincial or federal income tax rebates/credits or bigger municipal tax savings). There are municipal tax savings for farm owners who rent to farmers or who declare over \$8000 in annual farm income. Relax this a bit so land owners get the break even if their farm is not being farmed. It may be good for wildlife. It's sad to see clear cutting in large amounts on rocky or wet land which would be best left to nature.”

- **Other demands for recurring payments**

“A small payment for anyone who has buffers, has cover crops, leaves soil covered with crop residue would encourage people to continue to do these practices the amount would not even have to be significant a small amount that shows society values the effort would mean a lot to farmers who want to help the environment.”

“Have programs that allow only 1 acre to be protected at a competitive rate that compares to local rental prices. This would allow farmers to try the programs with little to no financial loss while not impacting their workable acres. This could introduce many more farms to conservation projects. This may open up the thinking of the farming community that conservation projects can exist along side farming and not be a negative.”

“Financial incentive to have more permanent pastures could be have big environmental benefits.”

- **Various payment schemes**

“Fixed percentage for eligible projects i.e. 50% but with the understanding that funds will be prorated so percentage will be reduced to all if funds are limited. Give 25% when claim is submitted then final payment when all claims have been processed.”

“Each farm should be eligible for "X" amount of dollars each year. They can submit as many applications for the money per year as they need with out set intake dates.”

“Combination of fixed cost-share for specific, identified projects (hedges, riparian buffers), and environmental bonus.”

- **Targeting strategies**

“Target, identify, refine and target again.”

“Projects should be selected by merit, but perhaps a percentage vs fixed cost share. Also there should be a history of the farm applying also to see if he/she shows strong management capabilities vs someone just looking for a free hand out by making the application look professional but they are poor managers when you physically walk on their farm. I believe some merit and also a historic trend of management should be a requirement.”

- **Carbon offset market**

« Aider les agriculteurs à participer à la bourse du carbone en facilitant la création d'agregateurs encadrés par un organisme à but non lucratif ('non-profit'). »

“Carbon sequestration is an important aspect of farming, this should be rewarded if successful practices are put in place. Farmers should be able to participate in a workable cap and trade program and be rewarded for their contributions.”

- **Stewardship rental agreements**

No farmer in the choice experiment suggested to facilitate stewardship on rented land; but this theme was mentioned many times in interviews. Several interviewees (farmers and program managers in Eastern and Southern Ontario) suggested solutions to increase adoption of medium to long-term stewardship leases through incentives, regulation or

cross-compliance. All those interviewees presented their suggestions as tentative options to explore, rather than firm, thought through recommendations. For example, interviewees suggested making farmland tax breaks, that non-farming owners can get on land rented to farmers, conditional to stewardship agreements; bank loans for farming conditional to or cheaper in case long-term stewardship rental; stand alone or bonus agri-environmental incentives.

- **Other**

“Really high value high cost projects must come with guaranties that it will be protected and maintained for long periods of time even if the land is sold or changes hands. Legally transferred responsibility.”

Mentorship: “Start-up farms are in a better position to benefit from funding and mentorship”.

“The only suggestion I would have is to try and convince local municipalities to donate their organic waste to the local farmers so it can be used to help build more stable organic matter in the soil. I would be more than happy to pickup organic waste at a local depot to spread on my farm.”

Appendix 20: Profile of larger farms in the CE

41 of the CE participants farm a thousand acres or more (up to 5100 acres). Table 53 below presents the profile of those large farm respondents in the choice experiment.

Table 53: Comparing large farm respondents with average responses in the choice experiment

Characteristic	All CE participants	Large farms (> 1000 acres) 14% of participants
Socio-economic variables:		
Farm size (acres)	1.4 to 5100 av.: 554	1000 to 5100, av.: 1900**
Farm size owned (acres)	1.2 to 4800, av.: 389	130 to 4800, av.: 1181**
Respondent's age is less than 45 years	31%	65%**
University degree (above college)	36%	33%
Gender = male	82%	87%
Farming is the main household income	63%	98%**
There is a successor on the farm	57%	70%
Interview specificities:		
Computer assisted personal interviewing	12%	20%
Shared idea in final open field	43%	59%*
Attitudinal traits: (indicators)		
Preference for ownership and self direction (PP)	7.39	7.43
Economic motivations (ECO)	7.34	7.32
Preference for environment (ENV)	22.56	21.65
Social connectedness:		
Indicator of peer / contact influence	5.68	5.38
Member in an envtal / hunting association	35%	35%
On the board of a FO	37%	68%**
Past experience: (scale 0-2)		
EFP	1.28	1.54**
Grant approved	0.81	1.2**
Grant unsuccessful	0.54	0.83**
Perception		
On-farm environmental features benefit my farm	85%	83%
Respondents distribution by class		
Class 1 'Business Farmers'	43%	39%
Class 2 'Environmental Champions'	23%	20%
Class 3 'Private Stewards'	13%	10%
Class 4 'Busy Farmers'	12%	12%
Class 5 'Disenchanted Stewards'	10%	20%*

Note: **statistically significant differences at 95% confidence level

* statistically significant differences at 90% confidence level