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Which Factors Contribute to Environmental Behaviour of Landowners in Southwestern Ontario, Canada?

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Abstract Loss of natural heritage is a problem that is particularly prevalent in areas of high population density. We used a survey to understand the factors that drive environmental behavior of landowners in southwestern Ontario, Canada. The survey, which contained questions about environmental attitude, pro-environmental behavior and demographics, was mailed to 18,090 rural route addresses, and we received 3256 completed surveys (18% response rate). Two types of environmental behavior, namely voluntarily increasing the area of land set aside for conservation, and enrollment in a conservation stewardship program, were significantly correlated with a positive attitude towards conservation. Financial considerations also played a role. We showed that the biggest motivator to enroll in a wetland enhancement program was access to 'more information on how the decline in wetland area affects them personally', while 'public recognition' was the least motivating factor. We suggest that enrollment in voluntary land stewardship programs might be increased by providing information about the effects of ecosystem loss, and by providing financial incentives for participation. In a larger social context, outreach programs by government agencies could focus on improving pro-environmental attitudes, which in turn is likely to result in more pro-environmental behavior of landowners.

Keywords Environmental attitude · Agri-environmental programs · Wetland enhancement · Loss of natural heritage · Agricultural stewardship

Introduction

Agri-environmental programs are designed to help farmers manage their land in an environmentally-friendly way. These are usually payments-for-environmental services programs, such as the Land Stewardship and Habitat Restoration Program (Ontario Ministry of Natural Resources and Forestry), which are particularly prevalent in Europe and North America (Greiner 2015), but non-financially incentivized stewardship programs also exist, such as the Farmland Health Check-Up (Ontario Soil and Crop Improvement Association). Interest in such programs is increasing globally with the need to address the growing problems arising from common agricultural practices (Schmidt et al. 2012; Atari et al. 2009; Karali et al. 2014; Wood et al. 2000; Burton and Schwarz 2013). Of particular concern is the loss of wetlands that is associated with agricultural and urban development. Wetlands provide important ecosystem services, such as supporting biodiversity, flood abatement and carbon sequestration, but globally, about half of all wetlands have already been lost (Zedler and Kercher 2005; Sica et al. 2016; Patino and

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Estupinan-Suarez 2016). In Canada, the Constitution Act (1867) stipulates that the provinces "own" the water resources and are responsible for their day-to-day management (Environment and Climate Change Canada 2016). While most wetlands are owned by some form of municipal or federal government, some wetlands are owned and thus cared for by a private owner. Stewardship programs aimed at privately owned wetlands therefore play an important role in ensuring the well-being of wetlands in Canada and elsewhere.

Compared to many other Organization for Economic Cooperation and Development countries, agri-environmental policy in Canada is characterized by less stringent monitoring mechanisms and enforcement of environmental regulations, and by a larger emphasis on stakeholder negotiation (Atari et al. 2009). This makes voluntary environmental programs particularly important in Canada. A key aspect of the success of these programs is the attitude of farmers towards them, as they determine the level of participation and ultimately, program acceptance and success (Falconer 2000; Colman 1994; Merckx et al. 2009). Yet it is important to note that there is often a disconnect between environmental attitudes and pro-environmental behavior (Méthot et al. 2015; Kennedy et al. 2009). Even when strong concern for the environment exists, a range of demographic, external factors (e.g., institutional, economic, cultural) and internal factors (e.g., awareness, motivation) affect how an environmental attitude is translated into action (Kollmuss and Agyeman 2002).

It remains unclear, however, which factors ultimately determine pro-environmental behavior. It seems likely that financial considerations are taken into account by landowners when making environmental decisions, and costs associated with adoption of new technologies or practices have indeed been shown to influence adoption (Cary and Wilkinson 1997; Van Herzele et al. 2013). Specifically, transaction costs are thought to be crucial, as the time and money tied up in participating in a environmental program can deter farmer or landowner participation in an environmental program (Noga and Adamowicz 2014; Vanclay 1992; Ducos et al. 2009; Palm-Foster et al. 2016). However, a study on Swiss farmers concluded that participation cannot be explained by economics alone (Karali et al. 2014), and an Irish study also suggests that non-pecuniary benefits are generally important to farmers (Howley 2015). Research into agri-environmental scheme participation across Europe found that a conservation-oriented attitude was equally as important as financial motivation (Wilson and Hart 2000).

This paper contributes to the debate by elucidating how two types of conservation-oriented behavior (change in the area of land set aside for conservation, and enrollment in a voluntary environmental stewardship program) vary with ethical attitude and a range of demographic (e.g., age) and external factors (e.g., debt load) of landowners in southwestern Ontario, Canada. We were also interested in the factors behind landowner motivation to participate in wetland enhancement programs. In southwestern Ontario, this loss is particularly severe, as more than 85% of wetlands have been converted to other uses, such as built-up lands, agricultural lands, and urban brown fields (Ducks Unlimited Canada 2010). Understanding the factors that contribute to environmental behavior among landowners can be used in the design of new environmental stewardship programs and facilitate the uptake of existing ones. This study uses data on demographics, attitude and behavior collected in a survey of rural landowners in two watersheds in southwestern Ontario, Canada to understand their motivation for engaging in pro-environmental behavior. It was motivated by the ongoing loss of natural heritage in the study area.

Materials and Methods

Study Area

The study was conducted in the adjacent watersheds of the Grand River and the Upper Thames River in southwestern Ontario. The Upper Thames River watershed (population: 515,640) covers an area of 3421 km^2. It includes the urban municipalities of London, Woodstock, Stratford, and St. Marys. Agriculture is the dominant land use (75% coverage, followed by 14% natural vegetation and 10% urban/built-up land (Upper Thames River Conservation Authority 2013)). The Grand watershed is about twice as large in both area (6800 km^2) and population size (925,000). Agriculture is also the dominant land use, with 70% of the area being farmed (Grand River Conservation Authority 2015). The main municipalities are Kitchener, Guelph, Brantford, Waterloo, and Cambridge.

Survey Design

The data for this study were obtained from a survey of rural landowners in or near the Upper Thames River and Grand River watersheds. We targeted rural landowners as opposed to just farmers to be able to assess whether farmers and non-farmers differ their environmental attitudes and behavior. We slightly modified a survey administered earlier in the Credit Valley watershed area near Toronto, Ontario (Trenholm et al. 2013), which was focused on the views of landowner regarding wetland enhancement. One component was a "Choice Experiment", which was designed to assess the interest of landowners in a range of programs offering compensation for allocating land to wetland or other conservation use. Here, we added additional questions to study

conservation-related behavior of landowners. The surveys were delivered using Canada Post's Unaddressed Admail™ service (Canada Post 2015) to target all households along specified postal routes (Smyth et al. 2011; Yu and Belcher 2011). Surveys were mailed to all rural route addresses along the identified postal routes in the Thames River watershed. Due to budgetary constraints, we used cluster sampling in the Grand River watershed by randomized targeting of postal routes (Lohr 2010).

The surveys were mailed at the end of April 2013. They were administered following the tailored design method by Dillman (2007): households were sent a survey package containing a cover letter and the questionnaire, followed by a card about a week later to remind occupants to complete the survey or to thank them if they had already done so. Two weeks later, the same households were sent a complete second survey package. Respondents could return a ballot to win one of six $100 gift cards in each watershed. Financial incentives for participation have been used in similar surveys (Rahelizatovo and Gillespie 2004; Paudel et al. 2008). The surveys were returned to the Upper Thames and Grand River Conservation Authority offices in pre-addressed, postage paid Canada Post Business Reply envelopes.

Data Collected

We first tested the effect of nine independent variables (see 2.3.2 for detailed description) on two types of conservation-oriented behavior, and then assessed the motivations of landowners to participate in a wetland restoration program.

Dependent variables: conservation-oriented behavior

Change in the area of land set aside for conservation The first indicator of conservation-oriented behavior was the change reported by the landowner (positive or negative) in size of land set aside for conservation (e.g., trees or windbreaks) since 2006. We used a binary variable (0 = negative change, 1 = positive change) to express the change to a property and excluded cases, where no change was left blank, and those that were zero, as we wanted to focus on the factors that drive change, not maintain the status quo.

Participation in environmental stewardship programs The second indicator of conservation-oriented behavior was voluntary participation in environmental stewardship programs. The Upper Thames River and Grand River Conservation Authorities offer a range of stewardship programs, which provide financial assistance with environmental projects, such as developing a nutrient management plan or improving existing septic systems. Participation is voluntary, and depending on the program, eligible projects receive $500–$4000. Participation was expressed using a binary variable (no = 0, yes = 1).

Independent variables

Conservation-oriented attitude Attitudes cannot be directly observed, and we therefore have to use indicators that closely correlate with a given attitude. To express a landowner's attitude towards conservation, we used the answers to two questions in the survey to calculate an 'Ethics Index'. Respondents were asked to assign importance (from 'unimportant' = 1 to 'very important' = 5) to the following questions:

> "People own land for many different reasons. How important are each of the following reasons to you?
> (1) For recreation (hunting, fishing, walking, etc.);
> (2) For the sake of our future generations;
> (3) To preserve ecosystems."

They were also asked to express their level of agreement (from 'strongly disagree' = 1 to 'strongly agree' = 5) with the following scenario:

> "As a landowner, I have the responsibility to:
> (1) Be a good steward of my land and to maintain it in a good condition for future generations;
> (2) Leave the land in a better condition than when I acquired it;
> (3) Take into account the values of society at large when making decisions about my land."

All cases with any blank or 'I don't know' entries were excluded from the analysis. 'To preserve ecosystems' received double weight. The sum of the numeric responses is the Ethics Index for each respondent.

External and demographic variables We used eight other independent variables, which were chosen based on a review of the relevant literature: (1) watershed (categorical: Thames River or Grand River); (2) property size (continuous); (3) reliance on farm income (ordinal: '0%' = 1 to '100%' = 6); (4) education level (ordinal: 'elementary school' = 1 to 'graduate or professional degree' = 4); (5) debt load (ordinal: 'debt free' = 1 to 'high' = 4); (6) year of birth (continuous); (7) landowner type (categorical: farmer or non-farmer; landowners were considered 'farmers' if they declared farming as their main source of land use as opposed to 'forestry', 'residential' or 'other'); and (8) land type (categorical: land left untilled, fence line, wind break, trees, shrub land, meadow, ditch, and wet area/wetland). A respondent could indicate up to seven different types of land. Year of birth and age are interchangeable given that the year of the survey is known. We use the former in our analysis because it was used in another published study

Table 1 Descriptive statistics of property size, year of birth, and age for farmers and non-farmers

Landowner type	Variable	*N*	Range	Mean	SD
Farmer	Property size (acres)	1679	1–3151	171.98	222.56
Non-farmer	Property size (acres)	1415	0–601	14.40	33.98
Farmer	Year of birth	1636	1922–1990	1956	13.87
Non-farmer	Year of birth	1440	1923–1996	1957	13.51
Farmer	Age	1636	23–91	56	13.87
Non-farmer	Age	1440	17–90	56	13.51

based on this survey (Brick et al. 2016). Descriptive statistics for year of birth and age as well as for the other continuous variable, property size, are provided in Table 1.

Motivation to enroll in a wetland enhancement program

The survey provided seven scenarios (see results) as motivators for landowners to enroll in a wetland enhancement program. Respondents expressed their level of agreement with each scenario from 'strongly disagree' = 1 to 'strongly agree' = 5.

Statistical Analyses

We tested whether

(1) change in conservation land area varied with Ethics Index and independent variables 1–8,
(2) in farmers, previous enrollment in a conservation stewardship program varied with Ethics Index and independent variables 1–6 (participation in these programs is generally restricted to farmers),
(3) what motivates landowners to participate in wetland enhancement.

The response variable in tests (1) and (2) above was binary, and binary logistic regression was therefore chosen as the appropriate statistical tool (Agresti and Finlay 2009). Odds ratios are used to compare the relative odds of the occurrence of the outcome of interest. The odds of the response are given by $p/(1-p)$, where p is the probability of the response and the odds ratio is the multiplicative factor by which the odds change with the increase of the independent variable by one unit. A negative parameter estimator indicates that the odds of positive change in the parameter is lower than the reference parameter of the categorical variable (Type: Windbreak, Farm income: 6). We assessed the likelihood that the change in land area and previous enrollment in a stewardship program varied with a set of independent variables. To test for differences among group means, we used paired *t*-tests with a Bonferroni-adjusted *p*-value to correct for multiple comparisons (test 3: 'what motivates landowners to participate in wetland enhancement'). All analyses were performed using the statistical software SYSTAT (2009).

Results

Response Rate and Response Bias

Of the 18,090 surveys that were sent out, we received 3256 surveys that were completed. This equates to an 18% response rate, which is comparable to the response rates for two surveys following a similar design (14% in the Credit River watershed in Ontario (Trenholm et al. 2013) and 15 % in Louisiana (Paudel et al. 2008)). Surveys that target their recipients through mailing lists such as members of farming associations tend to achieve higher (29–53%) response rates (Habron 2004; Rahelizatovo and Gillespie 2004; Rosenberg and Margerum 2008; Atari et al. 2009; Ghazalian et al. 2009). Our sample size compares favorably with other surveys, which tend to be based on much smaller numbers of respondents (e.g., $n = 24$, Karali et al. 2014).

Of the 3256 surveys we received, not all questions were answered by all respondents, we therefore tested for a potential bias in the responses by comparing the means of the continuous independent variables (area size, year of birth, Ethics Index) between those that provided a response to 'change in size of wetland area' (one of the eight land types in the survey) between those that had indicated a positive or negative change and those that had either left it blank or indicated no change.

We used two-sample *t*-test (separate variance) to compare the means of those that had indicated a change in land area and those that had not. There was no significant difference in area size ($t = -1.141$, df = 48.251, $p = 0.259$; no response: $N = 3083$, mean = 98.539, SD = 175.428, response: $N = 49$, mean = 169.204, SD = 432.833), year of birth ($t = -782$, df = 48.859, $p = 0.438$; no response: $N = 3093$, mean = 1957, SD = 13.734, response: $N = 48$, mean = 1958, SD = 12.109) or Ethics Index ($t = -0.608$, df = 46.426, $p = 0.546$; no response: $N = 2666$, mean = 20.383, SD = 4.682, response: $N = 46$, mean = 20.826, SD = 4.905). Note that the sample sizes differ among the tests

differ as not all respondents provided answers to all questions. The lack of significant differences in the three continuous independent variables suggests that the characteristics of those who provided information on change in land area and those who did not do not differ.

Test 1: What Variables Affect Change in Conservation Land Area?

Table 2 shows the odds ratio, which indicates the odds of positive change in any given land type in relation to the reference. For example, for Ditch, the odds of positive change are 0.01 times the odds of positive change in Windbreak, holding the other independent variables fixed. The odds of positive change are 99% (=(0.01–1)*100) lower for Ditch than for Windbreak. Reliance on farm income categories: 1 = 0%, 2 = 1–24%, 3 = 25–49%, 4 = 50–74%, 5 = 75–99%, 6 = 100%. Note that 'Farm income: 6', 'Type: Windbreak', 'Landowner type: Non-farmer', and 'Debt load: 4' are the reference parameters for their category and are not shown in the table as they are set at 0 by default.

The likelihood of positive change in area of land set aside for conservation ($n = 520$) varied significantly with reliance on farm income and land type and it increased with Ethics Index (Table 2). Watershed, property size, landowner type, debt load, and landowner age did not significantly affect change in land area. The lack of difference in change in land area between the two watersheds suggests that conservation behavior does not vary strongly on a local scale, and that it may be possible to extrapolate our findings beyond the two watersheds in south-western Ontario. It also increases confidence in the results given the two different sampling techniques that were used in the two watersheds.

The likelihood of positive change among land types was largest in Windbreak and smallest in Open Ditch, for which the odds of positive change were only 0.01 times the odds of positive change in Windbreak. In other words, the odds of positive change were 99% lower for Open Ditch than for Windbreak. The other land types with low probability of positive change (in comparison with Windbreak) were Fenced (odds ratio = 0.013), Untilled (odds ratio = 0.020), and Shrub (odds ratio = 0.017). The remaining two land types had a comparatively high probability of positive change (Trees: odds ratio = 0.071; and Wetland: odds ratio = 0.047). The odds of positive change were 5.492 greater in landowners who do not rely on farm income (Farm income = 1) than those who rely 100% on it (Farm income = 6).

Table 2 The parameter estimates and odds ratios of the binary logistic regression that models the likelihood of positive change in land area as a function of nine independent variables

Parameter	Estimate	Standard error	*p*-value	Odds ratio	Standard error
Constant	−3.627	22.055	0.869		
Watershed	−0.199	0.266	0.453	0.819	0.218
Type: open ditch*	−4.390	1.172	0.000	0.012	0.015
Type: fenced*	−4.351	1.053	0.000	0.013	0.014
Type: shrub*	−4.104	1.094	0.000	0.017	0.018
Type: tree*	−2.651	1.051	0.012	0.071	0.074
Type: untilled*	−3.905	1.037	0.000	0.020	0.021
Type: wet*	−3.051	1.096	0.005	0.047	0.052
Property size	0.000	0.001	0.513	1.000	0.001
Landowner type	0.561	0.422	0.184	1.752	0.740
Year of birth	0.002	0.011	0.845	1.002	0.011
Debt load: 1	−0.815	0.508	0.109	0.443	0.225
Debt load: 2	−0.238	0.476	0.617	0.788	0.375
Debt load: 3	−0.231	0.441	0.601	0.794	0.350
Farm income: 1*	1.703	0.601	0.005	5.492	3.299
Farm income: 2*	0.895	0.429	0.037	2.447	1.049
Farm income: 3	0.113	0.475	0.811	1.120	0.532
Farm income: 4	0.229	0.481	0.634	1.257	0.605
Farm income: 5	0.065	0.438	0.883	1.067	0.467
Ethics index*	0.131	0.027	0.000	1.140	0.031
Education level	0.193	0.152	0.205	1.213	0.184

Negative change in land area was set as the reference level of the dependent variable. Variables that were significant at alpha = 0.05 are marked with an asterisk

Table 3 The parameter estimates and odds ratios of the binary logistic regression that models the likelihood of positive or negative change in previous enrollment in a conservation stewardship program in farmers as a function of property size, reliance on farm income, ethics index, watershed, debt load and year of birth

Parameter	Estimate	Standard error	*p*-value	Odds ratio	Standard error
Constant	7.776	11.437	0.497	1.073	0.146
Watershed	0.070	0.136	0.605	1.001	0.000
Property size*	0.001	0.000	0.006	0.994	0.006
Year of birth	−0.006	0.006	0.310	1.171	0.097
Education level	0.158	0.083	0.057	0.796	0.210
Debt load: 1	−0.228	0.264	0.386	0.858	0.212
Debt load: 2	−0.153	0.247	0.535	0.958	0.230
Debt load: 3	−0.043	0.240	0.858	0.352	0.092
Farm income: 1*	−1.043	0.260	0.000	0.820	0.200
Farm income: 2	−0.198	0.244	0.418	1.007	0.276
Farm income: 3	0.007	0.275	0.981	1.626	0.441
Farm income: 4	0.486	0.271	0.073	1.615	0.409
Farm income: 5	0.480	0.253	0.058	1.076	0.017
Ethics index*	0.074	0.016	0.000	1.073	0.146

See legend Table 2 for variable details

Test 2: What Variables Affect Enrollment in a Conservation Stewardship Program?

The likelihood of farmers enrolling in a conservation stewardship program (yes = 222, no = 1142) increased with property size and Ethics Index, and the odds of enrollment were 0.820 lower in landowners who do not rely on farm income (Farm income = 1) than those who rely 100% on it (Farm income = 6) (Table 3). Watershed, debt load and age did not significantly affect the likelihood of enrollment in a conservation stewardship program.

Note that the sample size differs between the two analyses. The first analysis excluded all cases without any change in land size. The second analysis was restricted to farmers, as they are more likely to enroll in a conservation stewardship program. In both analyses, cases are removed if one of the independent variables in the model was missing.

Test 3: What Motivates Landowners to Enroll in a Wetland Enhancement Program?

The survey offered seven answer choices as motivators for landowners to enroll in a wetland enhancement program. The most highly rated motivator was (1) 'more information on how the decline in wetland area affects them personally', followed by (2) 'access to technical assistance and information', (3) 'a one-time payment to offset initial cost of enhancement or restoration', (4) 'a small annual payment to offset initial cost of enhancement of restoration', (5) 'concern over loss of wetlands in this region', (6) 'if neighbors undertook this type of practice', and (7) public recognition (e.g., signage on property, stewardship banquets and awards, etc.). All options were significantly different from each other with the exception of options 3, 4, and 5, which did not differ ($P > 0.6$).

Discussion

Two types of environmental behavior, namely voluntarily increasing the area of land set aside for conservation, and enrollment in a conservation stewardship program, were correlated with a positive attitude towards conservation in landowners who responded to a mail survey in southwestern Ontario, and reliance on farm income also played a role. We did not find differences in environmental behavior between the two target watersheds, nor did it vary with property size, debt load, age, or education level. Somewhat surprisingly, we found that the biggest motivator to enroll in a wetland enhancement program was access to 'more information on how the decline in wetland area affects them personally', while 'public recognition' was the least motivating factor.

Environmental Attitude

Despite the plethora of studies on environmentally responsible behavior, there is still disagreement regarding the extent to which behaviors can be predicted from attitudes and concern (Mobley et al. 2009). Attitudes can be influenced by situational factors, which will sometimes result in a gap between a pro-environmental attitude and pro-environmental behavior: an individual may hold positive attitudes toward biodiversity, but may not engage in activities to foster it (Kollmuss and Ageyman 2002). For instance, in a 2000 survey of 1794 Canadian farmers, 79% indicated an interest in learning about environmentally-

friendly farming techniques, and 68 % had actually adopted some (Environics Research Group 2006). This rather small difference shows that it is more likely that an individual who holds a pro-environmental attitude will engage in conservation-oriented behavior than a person who does not hold such an attitude (Goodale et al. 2015). Our study supports this notion, as environmental attitude was shown to be the strongest predictor of our two types of pro-environmental behavior.

Economic Factors

It is often assumed that farmers are profit maximizers and will therefore only participate in an agri-environmental scheme if the conservation payment is sufficiently high to deliver a financial advantage by compensating for lost opportunity and transaction costs (Greiner 2015). This notion was supported by a recent study in Sweden that showed that cost was the main factor preventing farmers in participating in a wetland creation program (Franzén et al. 2016). Strong dependence of household income on farming activities were shown to act as constraints against participation in such programs among farmers in northern Italy (Defrancesco et al. 2009). However, the odds of enrollment in a conservation stewardship program were 0.820 lower in landowners who did not rely on farm income than those who rely 100% on it. An analysis of participation in agri-environmental programs in the USA, Europe, Australia, and South America has shown that the level of stewardship offered to landholders as part of a conservation contract is only one consideration influencing the participation decision (Bremer et al. 2014; Sorice et al. 2013). Some have argued that monetary incentives may even have negative impacts as incentives may have the unintended consequence of changing the driver of long-term adoption. For example, the initial motivation to adopt an activity may come from intrinsic moral values or social pressures, but the introduction of an incentive may shift it: the continued engagement in the conservation practice then hinges on the continued provision of stewardship payments (de Snoo et al. 2013).

Our finding that landowners were most likely to increase the size of their land that was set aside for conservation if they did not rely on farming income supports the notion that economic factors do play a role. It is also consistent with a meta-analysis of studies on adoption of agricultural Best Management Practices (BMP) in the United States that identified financial capacity as one of the key factors for BMP adoption (Baumgart-Getz et al. 2012). On the other hand, debt load did not play a significant role in that decision, nor respondents' decision to enroll in a conservation stewardship program. It is possible that self-declared debt load is not an accurate predictor of the economic situation that a landowner takes into account in these decision processes. Alternatively, reliance on farm income might be the more important factor, which may also explain why previous enrollment in a stewardship program was most likely in farmers who relied on farm income to a certain degree (50–74%).

Land Type

We also found that the likelihood of positive change varied with the type of land owned. Landowners were most likely to add windbreaks to their property, and most likely to remove open ditches. There was a relatively high probability of positive change in trees and wetlands. It is possible that the positive change observed in windbreaks, trees, and wetlands can be attributed to initiatives at the conservation authority level. Both conservation authorities that were part of this study offer native tree planting services and trees at a reduced rate, which could contribute to the increase in windbreaks and trees in general. Likewise, there are incentives available under the Clean Water Program that offer financial assistance for wetlands conservation or enhancement. No comparable financial incentives are available to build fences, or leave agricultural land untilled. Financial assistance to plant shrubs also exists but not to the same extent as the tree planting program (Craig Merkley, Upper Thames River Conservation Authority, pers. comm.).

Education

Education's ability to change attitudes and increase understanding of complex issues provides a clear rationale for its role in promoting environmental behavior. Consequently, it is often assumed that the likelihood to engage with environmental programs increases with the level of formal education (Burton 2014). Yet, as demonstrated here and elsewhere, more education does not necessarily mean increased pro-environmental behavior (Kollmuss and Agyeman 2002) and evidence provided by the extensive body of research on this topic remains inconclusive (Burton 2014). A possible explanation might be that farming education does not necessarily come from formal education (Goodale et al. 2015). Agricultural knowledge is also frequently obtained from sources such as family members, neighbors, books, the internet, or even stewardship or government programs (Mobley et al. 2009).

Farm Size

Some studies have concluded that total farm size in not an important variable in explaining participation in agri-environmental measures (Wynn et al. 2001; Wossink and van Wenum 2003; Comerford 2014), which is consistent

the findings presented here. Others have demonstrated that there is an interaction between farm size and productivity of the land when it comes to participation in agri-environmental measures (see Gailhard and Bojnec 2015), so it is possible that any effect of farm size per se in our study is masked by differences in productivity of different farms.

Age

The extent of farming experience is thought to be important with regards to the adoption of farming-related conservation programs. Typically, farmer age is used as a proxy, but despite extensive research on this topic, it remains to be shown whether, or how, conservation program adoption varies with age. Previous research has suggested that there is no relationship between age and conservation practices (Carlson et al. 1981; Finger and Lehmann 2012; Wilson 1997). Others have shown that younger farmers are more likely than older farmers to take risks and enter agri-environmental measures (Wynn et al. 2001; Murphy et al. 2011) and adopt new technologies (D'Souza et al. 1993) as well as the opposite (Hoover and Wiitala 1980; Abd-Ella et al. 1981; Lasley and Nolan 1981; Barreiro-Hurlé et al. 2010). Our study did not find any evidence for age playing a significant role in shaping environmental behavior, suggesting that at least in this context, environmental attitude and reliance on farm income are more important.

Motivation to Participate in a Wetland Enhancement Program

The most highly rated motivator in our study to take part in a wetland enhancement program was 'more information on how the decline in wetland area affects them personally'. This suggests that lack of information is an important aspect, which is corroborated by a study on beef producers, where the two most commonly cited reasons for non-adoption were unfamiliarity and non-applicability of the practice. These results highlight the importance of educational efforts in encouraging adoption, as well as farm type and financial situation of the farmer (Gillespie et al. 2007).

Conclusions

In our study of landowners in southwestern Ontario, we found that an environmental attitude and economic factors are the strongest predictors of environmental behavior. We suggest that enrollment in voluntary land stewardship programs might be increased by providing information about the effects of ecosystem loss, and by providing financial incentives for participation. In a larger social context, outreach programs by government agencies can play a role in changing attitudes and behavior. Governmental outreach programs could thus focus on improving pro-environmental attitudes, which in turn is likely to result in more pro-environmental behavior of landowners. Policy makers could use the results of this study to first target landowners who are most likely to adopt pro-environmental behavior. Successful implementation of a new stewardship program among selected landowners will facilitate uptake on a larger scale.

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Conflict of Interest The authors declare that they have no conflict of interest.

References

Abd-Ella MM, Hoiberg EO, Warren RD (1981) Adoption behaviour in family farm system: an Iowa study. J Rural Sociol 46:42–61

Agresti A, Finlay B (2009) Statistical methods for the social sciences, 4th edn. Pearson Prentice Hall, Upper Saddle River

Atari DO, Yiridoe EK, Smale S, Duinker PN (2009) What motivates farmers to participate in the Nova Scotia environmental farm plan program? Evidence and environmental policy implications. J Environ Manage 90(2):1269–1279

Barreiro-Hurlé J, Espinosa-Goded M, Dupraz P (2010) Does intensity of change matter? Factors affecting adoption of agri-environmental schemes in Spain. J Environ Plan Manage 53 (7):891–905

Baumgart-Getz A, Prokopy LS, Floress K (2012) Why farmers adopt best management practice in the United States: a meta-analysis of the adoption literature. J Environ Manage 96:17–25

Bremer LL, Farley KA, Lopez-Carr D (2014) What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador's SocioPáramo program. Land Use Policy 36:122–133

Brick J, Nebel S, Lantz V, Trenholm R (2016) Declining education levels in young male farmers in southwestern Ontario. Agric Environ Lett 1:160005. doi:10.2134/ael2016.02.0005

Burton RJF (2014) The influence of farmer demographic characteristics on environmental behaviour: a review. J Environ Manage 135:19–26

Burton RJF, Schwarz G (2013) Result-oriented agri-environmental schemes in Europe and their potential for promoting behavioural change. Land Use Policy 30(1):628–641

Canada Post (2015) Unaddressed Admail™—Customer Guide. https://www.canadapost.ca/tools/pg/customerguides/CGunaadm-e.asp. Accessed 1 June 2015

Carlson JE, Dillman DA, Lassey WR (1981) The farmer and erosion: factors influencing the use of control practices. Agricultural Experiment Station, University of Idaho, Moscow, Idaho

Cary JW, Wilkinson RL (1997) Perceived profitability and farmers' conservation behaviour. J Agric Econ 48:13–21

Colman D (1994) Ethics and externalities: agricultural stewardship and other behaviour. J Agric Econ 45(3):299–311
Comerford E (2014) Understanding why landholders choose to participate or withdraw from conservation programs: a case study from a Queensland conservation auction. J Environ Manage 141:169–176
D'Souza G, Cyphers D, Phipps T (1993) Factors affecting the adoption of sustainable agricultural practices. Agric Resour Econ Rev 22:159–165
de Snoo GR, Herzon I, Staats H, Burton RJF, Schindler S, van Dijk J, Lokhorst AM et al. (2013) Toward effective nature conservation on farmland: making farmers matter. Conserv Lett 6(1):66–72
Defrancesco E, Gatto P, Runge F, Trestini S (2009) Factors affecting farmers' pParticipation in agri-environmental measures: a Northern Italian perspective. J Agric Econ 59(1):114–131
Dillman DA (2007) Mail and internet surveys: the tailored design method, 2nd Edn. Wiley, Hoboken, NJ
Ducks Unlimited Canada (2010) Southern Ontario wetland conversion analysis
Ducos G, Dupraz P, Bonnieux F (2009) Agri-environment contract adoption under fixed and variable compliance costs. J Environ Plan Manage 52(5):669–687
Environics Research Group (2006) National survey of farmers and ranchers. In: Ecological goods and services. Toronto
Environment and Climate Change Canada (2016) https://www.ec.gc.ca/eau-water/default.asp?lang=En&n=E05A7F81-1.
Falconer K (2000) Farm-level constraints on agri-environmental scheme participation: a transactional perspective. J Rural Stud 16:379–394
Finger R, Lehmann B (2012) Adoption of agri-environmental programmes in Swiss crop production. Euro Choices 11(1):28–33
Franzén F, Dinnétz P, Hammer M (2016) Factors affecting farmers' willingness to participate in eutrophication mitigation—a case stud of preferencres for wetland creation in Sweden. Ecol Econ 130:8–15. doi:10.1016/j.ecolecon.2016.05.019
Gailhard İU, Bojnec Š (2015) Farm size and participation in agri-environmental measures:Farm-level evidence from Slovenia. Land Use Policy 46:273–282
Ghazalian PL, Larue B, West GE (2009) Best management practices to enhance water quality: who is adopting them? J Agric Appl Econ 41(3):663–682
Gillespie J, Kim S-A, Paudel K (2007) Why don't producers adopt best management practices? An analysis of the beef cattle industry. Agric Econ 36:89–102
Goodale K, Yoshida Y, Beazley K, Sherren K (2015) Does stewardship program participation influence Canadian farmer engagement in biodiversity-friendly farming practices? Biodivers Conserv 24:1487–1506
Grand River Conservation Authority (2015) http://www.grandriver.ca/index.cfm. Accessed 1 June 2015
Greiner R (2015) Motivations and attitudes influence farmers' willingness to participate in biodiversity conservation contracts. Agric Syst 137:154–165
Habron GB (2004) Adoption of conservation practices by agricultural landowners in three Oregon watersheds. J Soil Water Conserv 59 (3):109–115
Hoover H, Wiitala M (1980) Operator and landlord participation in soil erosion control in the maple creek watershed in Northeast Nebraska. USDA, Washington, DC
Howley P (2015) The happy farmer: the effect of nonpecuniary benefits on behavior. Am J Agric Econ 97(4):1072–1086. doi:10.1093/ajae/aav020
Karali E, Brunner B, Doherty R, Hersperger A, Rounsevell M (2014) Identifying the factors that influence farmer participation in environmental management practices in Switzerland. Hum Ecol 42:951–963
Kennedy EH, Beckley TM, McFarlane B, Nadeau S (2009) Why we don't "Walk the Talk": understanding the environmental values/behaviour gap in Canada. Hum Ecolo Rev 16(2):151–160
Kollmuss A, Ageyman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ Educ Res 8(3):239–260. doi:10.1080/1350462022014540
Kollmuss A, Agyeman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ Educ Res 8(3):239–260
Lasley P, Nolan M (1981) Land owner attitudes towards soil and water conservation in the grindstone-lost-muddy creek project. Department of Rural Sociology, University of Missouri, Columbia, MO
Lohr SL (2010) Sampling: design and analysis, 2nd Edn. Brooks/Cole, Boston, MA
Merckx T, Feber RE, Riordan P, Townsend MC, Bourn NAD, Parsons MS, Macdonald DW (2009) Optimizing the biodiversity gain from agri-environment schemes. Agric Ecosyst Environ 130(3-4):177–182
Méthot J, Huang X, Grover H (2015) Demographics and societal values as drivers of change in the Great Lakes—St. Lawrence River basin. J Great Lakes Res 41(Suppl. 1):30–44
Mobley C, Vagias WM, DeWard SL (2009) Exploring additional determinants of environmentally responsible behavior: the influence of environmental literature and environmental attitudes. Environ Behav 42(4):420–447
Murphy G, Hynes S, Murphy E, O'Donoghue C, Green S (2011) Assessing the compatibility of farmland biodiversity and habitats to the specifications of agri-environmental schemes using a multinomial logit approach. Ecol Econ 71:111–121
Noga W, and Adamowicz WL (2014) A study of Canadian conservation offset programs: lessons learned from a review of programs, analysis of stakeholder perceptions, and investigation of transactions costs. Sustainable Prosperity Research Paper
Ontario Ministry of Natural Resources and Forestry https://www.ontario.ca/page/land-stewardship-and-habitat-restoration-program. Accessed 19/12/2016
Ontario Soil and Crop Improvement Association http://www.ontariosoilcrop.org/oscia-programs/glasi/farmland-health-check-up/. Accessed 19/12/2016
Palm-Foster LH, Swinton SM, Lupi F, Shupp RS (2016) Too burdensome to bid: transaction costs andpay-for-performance conservation. Am J Agric Econ 98(5):1314–1333. doi:10.1093/ajae/aaw071
Patino JE, Estupinan-Suarez LM (2016) Hotspots of wetland area loss in Colombia. Wetlands 36(5):935–943. doi:10.1007/s13157-016-0806-z
Paudel KP, Gauthier WM, Westra JV, Hall LM (2008) Factors influencing and steps leading to the adoption of best management practices by Louisiana dairy farmers. J Agric Appl Econ 40 (1):203–222
Rahelizatovo NC, Gillespie JM (2004) Factors influencing the implementation of best management practices in the dairy industry. J Soil Water Conserv 59(4):155–175
Rosenberg S, Margerum RD (2008) Landowner motivations for watershed restoration: lessons from five watersheds. J Environ Plan Manage 51(4):477–496
Schmidt, C., Mussell A, Sweetland J, and Seguin B (2012) The greening of Canadian agriculture: policies to assist farmers as stewards of the environment. In: Hungry for change: Macdonald-Laurier Institute
Sica YV, Quintana RD, Radeloff VC, Gavier-Pizarro GI (2016) Wetland loss due to land use change in the Lower Paraná River Delta, Argentina. Sci Total Environ 586: 967–978

Smyth SJ, Gusta M, Belcher K, Phillips PWB, Castle D (2011) Environmental impacts from herbicide tolerant canola production in Western Canada. Agric Syst 104:403–410

Sorice MG, Oh C-O, Gartner T, Snieckus M, Johnson R, Donlan CJ (2013) Increasing participation in incentive programs for biodiversity conservation. Ecol Appl 23(5):1146–1155

SYSTAT (2009) SYSTAT® 13.1 Statistics_I_II_III_IV. SYSTAT Software Inc, San Jose, CA

Trenholm R, Anderson T, Lantz V, and Haider W (2013) Landowner views on wetland enhancement and restoration in and adjacent to the credit river watershed: credit valley conservation

Upper Thames River Conservation Authority (2013) Watershed Report Cards 2012. http://thamesriver.on.ca/watershed-health/watershed-report-cards/. Accessed 1 June 2015

Van Herzele A, Gobin A, Van Gossum P, Acosta L, Waas T, Dendocker N, de Frahan BH (2013) Effort for money? Farmers' rationale for participation in agri-environment measures with different implementation complexity. J Environ Manage 131:110–120

Vanclay F (1992) Barriers to adoption: a general overview of the issues. Rural Sociol 2(2):10–12

Wilson GA (1997) Factors influencing farmer participation in the environmentally sensitive areas scheme. J Environ Manage 50 (1):67–93

Wilson GA, Hart K (2000) Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. Environ Plan A 32(12):2161–2185

Wood A, Stedman-Edwards P, Mang J (2000) The root causes of biodiversity loss. Earthscan, New Yord, NY

Wossink GAA, van Wenum JH (2003) Biodiversity conservation by farmers: Analysis of actual and contingent participation. Eur Rev Agric Econ 30:461–485

Wynn G, Crabtree B, Potts J (2001) Modelling farmer entry into the environmentally sensitive area schemes in Scotland. J Agric Econ 52:65–82

Yu J, Belcher K (2011) An economic analysis of landowners' willingness to adopt wetland and riparian conservation management. Can J Agric Econ 59(2):207–222

Zedler JB, Kercher S (2005) Wetland resources: status, trends, ecosystem services, and restorability. Annu Rev Environ Resour 30:39–74