Journal of Environmental Management 200 (2017) 6–21

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Landowner preferences for wetlands conservation programs in two Southern Ontario watersheds

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A R T I C L E I N F O

Article history:
Received 5 March 2017
Received in revised form
10 May 2017
Accepted 18 May 2017

Keywords:
Discrete choice experiment
Latent class analysis
Willingness to accept
Participation rate
Agri-environmental programs
Wetlands

A B S T R A C T

Wetlands in the region of Southern Ontario, Canada have declined substantially from their historic area. Existing regulations and programs have not abated this decline. However, reversing this trend by protecting or restoring wetlands will increase the supply of important ecosystem services. In particular, these actions will contribute to moderating the impacts of extreme weather predicted to result from climate change as well as reducing phosphorous loads in Lake Erie and ensuing eutrophication. Since the majority of land in the region is privately owned, landowners can play an important role. Thus, we assessed landowner preferences for voluntary incentive-based wetlands conservation programs using separate choice experiments mailed to farm and non-farm landowners in the Grand River and Upper Thames River watersheds. Latent class models were separately estimated for the two data sets. Marginal willingness to accept, compensating surplus, and participation rates were estimated from the resulting models to gain insight into the financial compensation required by landowners and their potential participation. Many of the participating landowners appear willing to participate in wetlands conservation at reasonable cost, with more willing groups notably marked by past participation in incentive-based conservation programs. They generally favor wetlands conservation programs that divert smaller areas of land to wetlands conservation, target marginal agricultural land, use treed buffers to protect wetlands, offer technical help, and pay financial incentives. However, landowners appear reluctant to receive public recognition of their wetland conservation actions. Our results are of interest to natural resource managers designing or refining wetlands conservation programs.

1. Introduction

Wetlands are critically important ecosystems that produce ecosystem services such as water purification and supply, flood control, recreational opportunities, and carbon sequestration that have significant economic value (Zedler and Kercher, 2005; Barbier, 2011; Brander et al., 2013). Despite their value, the area of wetlands has declined in many parts of the world, including Canada (Mitsch and Hernandez, 2013). The area of wetlands in Southern Ontario, in particular, has decreased significantly and continues to deteriorate. The extent of inland wetlands that are 10 ha or larger has declined 72% from over 2 million ha to near 500,000 ha since European settlement of the region, caused in part by land use change associated with urbanization and agriculture (Ducks Unlimited Canada, 2010). Pressure to convert wetlands is unlikely to abate since the population of Southern Ontario is expected to grow 33% to 17 million by 2041 (Ontario Ministry of Finance, 2014). Furthermore, the functions or distribution of existing wetlands may be altered by a changing climate or invasive species (Mitsch and Hernandez, 2013; Zedler and Kercher, 2004). Though the area of wetlands, and consequently the ecosystem services supplied, has decreased, there is local demand for their conservation (Lantz et al., 2013).

Wetland protection and restoration in Southern Ontario can play a significant role in addressing the local hydrological impacts of climate change and eutrophication of the Great Lakes, particularly Lake Erie. Climate change is expected to result in more intense rainfalls, more frequent high and low streamflows, and increased damages from flooding (Cheng et al., 2012). In certain cases wetlands can alleviate these impacts by storing water, recharging groundwater, and moderating streamflows (Bullock and Acreman,

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http://dx.doi.org/10.1016/j.jenvman.2017.05.055
0301-4797/

2003). Lake Erie's eutrophication condition has recently worsened with harmful cyanobacterial algae blooms and hypoxia in its western and central basins, respectively (Joosse and Baker, 2011; Michalak et al., 2013; Scavia et al., 2014). Nuisance *Cladophora* algae blooms regularly occur in the nearshore of the lake's eastern basin (Depew et al., 2011). Consequently ecosystem health, recreation, drinking water supplies, tourism, and property values have been negatively affected (Joosse and Baker, 2011). Moreover, the harmful algae blooms pose a health risk (Michalak et al., 2013). This eutrophication is thought to be driven mainly by soluble reactive phosphorous loading from non-point sources, much of which originates in Southwestern Ontario (Joosse and Baker, 2011; Scavia et al., 2014). Wetland protection and restoration can play a critical role in reducing such phosphorous loading since wetlands are able to remove phosphorous from the water column and retain it or transform it into biologically unavailable forms (Reddy et al., 1999; Fisher and Acreman, 2004; Scavia et al., 2014).

As a party to the Ramsar Convention on Wetlands, the Canadian government has an international obligation to conserve wetlands though it shares responsibility for their management with provincial governments. Wetland conservation in the Province of Ontario is embedded in legislation and policies governing land use (Ducks Unlimited Canada, 2010; Rubec and Hanson, 2008). Tax incentive and grant programs are also offered at the federal, provincial, and regional levels (Environment Canada, 2015; Clean Water Program, 2013; Ontario Ministry of Natural Resources and Forestry, 2015a). Other initiatives involve non-governmental organizations such as Ducks Unlimited Canada. Despite these efforts, Southern Ontario's wetland area continues to decline.

Reductions in wetland area can partly be attributed to market failure since few wetland ecosystem services are traded in markets (Barbier, 2011). As such many landowners have no incentive to maintain or restore wetlands and instead convert them to produce marketable goods and services. In an agricultural context, draining wetlands expands the area available for crops and increases the efficiency of field operations (e.g., less turning of farm machinery) (Cortus et al., 2011). Compensating landowners to protect or restore wetlands can provide an incentive to engage in conservation (Hansen et al., 2015). In this case payments should be sufficiently large to induce enough landowners to participate so as to achieve conservation objectives, though be within budgetary constraints. To encourage participation, the incentive should at least cover the opportunity costs of private landowners (Cortus et al., 2011). Several techniques have been used to assess the opportunity cost of conserving wetlands or examine landowner willingness to accept (WTA) for maintaining or restoring them, including hedonic analysis, auctions, simulation, market prices, data from existing programs, and contingent valuation (e.g., Brown et al., 2011; Cortus et al., 2011; Gelso et al., 2008; Hansen et al., 2015; Lawley, 2014; van Vuuren and Roy, 1993; Yu and Belcher, 2011).

An alternative technique is the choice experiment (CE). CEs are survey-based techniques that are used to assess preferences for key attributes of a good or service (e.g., conservation programs). If one of the attributes is financial then monetary values can be estimated. CEs are able to incorporate a wider range of values than revealed preference techniques, such as hedonic analysis, or other approaches relying on market prices (Flores, 2003). Similarly, CEs can assess preferences for wetland conservation programs that do not exist. Relative to contingent valuation, CEs are able to evaluate how multiple program characteristics affect landowner support for wetlands protection and restoration (Matta et al., 2009). Finally, CEs reflect economic behaviour better than contingent valuation as respondents are required to consider substitutes (Boxall et al., 1996). CEs directed at assessing landowner WTA for aspects of conservation programs or land management schemes are becoming common and have been applied in a variety of contexts, including forest management and conservation, biodiversity and endangered species conservation, agri-environmental contracts, water quality protection, and carbon sequestration (e.g., Paulrud and Laitila, 2010; Sorice et al., 2011; Beharry-Borg et al., 2013; Greiner et al., 2014; Lienhoop and Brouwer, 2015; Peterson et al., 2015; Vedel, 2015; Villanueva et al., 2015). Similarly, Lizin et al. (2015) used a CE to examine the cost of land use restrictions to farmers by assessing their willingness to pay (WTP) for parcels with varying restrictions.

Our main objective is to examine the preferences of Southern Ontario landowners for voluntary incentive-based wetland conservation programs. To do so we use CEs to investigate landowner preferences for certain program characteristics from which we predict WTA and participation rates for alternative program specifications.[2] The remainder of this paper is structured as follows. The study sites are reviewed in Section 2. Section 3 provides an overview of the method, with details on the choice experiment, data collection, and data analysis. The results are presented in Section 4. Finally, the results and policy implications are discussed in Section 5. The conclusion follows in Section 6.

2. Study sites

The study was conducted in the Grand River and Upper Thames River watersheds (Fig. 1). At 6800 km^2, the Grand River watershed is one of the largest in Southern Ontario and the largest Canadian watershed that empties into Lake Erie. The Upper Thames River watershed, also part of the Lake Erie basin, is 3420 km^2 and drains into Lake St. Clair via the Lower Thames River. Agriculture occurs on 75% and 70% of the Upper Thames and Grand watersheds' land area respectively (Upper Thames River Conservation Authority, 2012; Grand River Conservation Authority, 2014). There are over 6000 farms in the Grand River watershed and more than 3500 farms in the Upper Thames River watershed (Grand River Conservation Authority, 2008; Upper Thames River Conservation Authority, 2015). The Grand River watershed is home to around one million residents concentrated in urban areas that cover 7% of its land area and over 500,000 individuals reside in the Upper Thames River watershed with most living in urban areas that cover 10% of its area. Forests, wetlands, and meadows respectively cover 11.3%, 4.8%, and 2.6% of the Upper Thames River watershed. Forests and wetlands cover 20% of the Grand River watershed (Grand River Conservation Authority, 2014; Upper Thames River Conservation Authority, 2012). While the Grand River watershed as a whole meets Environment Canada's (2013) minimum thresholds for wetland area not all of its sub-basins do (Grand River Conservation Authority, 2008) and the Upper Thames River watershed does not.

Urban and agricultural land uses have lowered surface water quality in both watersheds, notably via runoff of phosphorous, nitrogen, and sediment (Grand River Conservation Authority, 2014; Nürnberg and Lazerte, 2015). Phosphorous concentrations exceed provincial objectives (Ontario Ministry of Environment, 2013). The two watersheds are also the main Ontarian contributors of phosphorous to Lake Erie (Lake Erie LaMP, 2011). Climate change is forecast to increase the frequency of extreme rainfall, and consequent flooding, in the two watersheds. Higher flood damage costs are expected to result, especially in larger cities such as London or Kitchener-Waterloo (Cheng et al., 2012). Conservation authorities

[2] We could have used WTP, which is often lower than WTA thus yielding more conservative estimates of opportunity cost (Horowitz and McConnell, 2002). However, we chose to use WTA since landowners in Ontario hold the rights to their property and WTA better reflects incentive-based conservation programs.